TECHNICAL SPECIFICATIONS

CITY of CUPERTINO
McCLELLAN RANCH PRESERVE
ENVIRONMENTAL EDUCATION CENTER
and BLACKSMITH SHOP RELOCATION
RE-BID

22221 McClellan Road
Cupertino, California 95014

for

CITY OF CUPERTINO
Public Works Department
10300 Torre Avenue
Cupertino, California 95014

Construction Documents Set
January 10, 2014

Project No. 2010-9135

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DOCUMENT 00011

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STRUCTURE RELOCATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Relocation of the existing Blacksmith Shop building, complete, including, but not necessarily limited to the following:
   1. Architectural: Remove, clean, renovate as required, and re-install all non-structural building items both inside and outside the building, including:
      a. Steel bar grating over windows, and mounting hardware.
      b. Wood doors and door hardware.
      c. Interior wood workbench.
      d. Remove sheet metal floor cladding under forge.
      e. Blacksmith equipment including the timber framing in back corner of building and equipment that it is supporting including steel drive wheel, drive belts, and other attached blacksmith equipment.
      f. Retain and reuse all existing removed items and hardware, including hardware for steel bar grating, door hardware, floor plates, mounting bolts and hardware for blacksmith equipment, horseshoes, and square nails.
      g. Remove Blacksmith Shop sign from front of building, clean, refinish, and reinstall with new painted letters. Existing wood letters to be carefully removed and turned over to City
      h. Remove wood battens and trim from exterior walls to provide smooth surface for application of new structural shear plywood.
   2. Structural:
      a. Move building to new location intact in one piece, or otherwise.
      b. Building may be disassembled into major segments consisting of roof, four walls, and wood floor, then moved to new location and re-assembled.
      c. Refer to Structural section for building seismic upgrades.
   3. Protection: Cover holes in roof and openings in walls temporarily with plywood and plastic sheet to prevent water and air intrusion. Protect windows, doors, wood siding and other items attached to building during moving operations.
   4. Verify items to be salvaged for reuse and to be turned over to the City.

B. Related Sections: Exclusions from Work of this Section:
   1. Section 01 50 00 - Temporary Facilities and Controls.
   2. Section 03 30 00 - Cast-in-Place Concrete: New concrete foundation and slab on grade.
   3. Section 05 50 00 - Metal Fabrications: New steel floor plates under forge.
   4. Section 06 10 00 - Rough Carpentry: Seismic upgrades to building; new roof shear plywood; new wall shear plywood.
   5. Section 06 20 00 - Finish Carpentry: Replacement of exterior board and batten wood siding and trim.
   6. Section 07 41 13 - Metal Roof Panels: New corrugated metal roof.
   7. Section 07 60 00 - Flashing and Sheet Metal: New window flashings, flue, roof vent, and spark arrestor for forge.
   8. Section 08 52 00 - Wood Windows: New wood windows.

9. Section 09 91 00 - Painting: Painting/staining.
10. Section 10 14 00 - Signage: New painted lettering.

1.02 SUBMITTALS

A. Submit report of inspections conducted with the Engineer both before and after performing the Work.

B. Work Schedule: Submit a proposed schedule of work items to be performed, and a description of how the work is to be accomplished, for the Engineer's review. Describe the sequence, methods, and equipment proposed for relocating the structure and related items. Relocation plan shall meet with the approval of the Engineer.

C Shop Drawings: If the Contractor chooses to disassemble the building and reassemble it in the new location, provide a complete sets of instructions for field procedures for protection, disassembly, moving, and re-erection, including anchorages, adjustments, and interconnections between elements.

1.03 QUALITY ASSURANCE

A. Mover/Installer Qualifications:
1. Subcontractor shall be experienced in building moving of the type required for this Project, with a minimum five (5) years documented experience in the relocation of historic structures.

B. Standards:
1. Historic Building: The building is listed by the City of Cupertino as a historic site and is of special historic significance. Contractor shall take special care to protect and preserve the building and all of its elements and features in accordance with the Secretary of the Interior's "Standards for the Treatment of Historic Properties".
2. Comply with applicable requirements of American National Standards Institute (ANSI/ASSE) A10.6-2006 - "Safety Requirements for Demolition Operations".

C. Regulatory Requirements: Perform deconstruction and relocation work in accordance with the applicable requirements of the following:
1. California Building Code, Chapter 33 - "Safeguards During Construction".
2. California Code of Regulations (CCR), Title 8 - Industrial Relations, Chapter 4, Subchapter 4 - "Construction Safety Orders."
3. California Fire Code, (CFC), California Code of Regulations (CCR), Title 24, Part 9, Article 87 - Fire Safety During Construction, Alteration, or Demolition of a Building, Section 8706 - Fire Safety During Demolition.

D. Pre-Installation Meetings: Schedule a pre-installation meeting to review the work two weeks prior to beginning work. The meeting shall be attended by the Engineer, City's Representative, Contractor, building moving/installer subcontractor, and others whose work may be affected by moving operations. Review the following items:
1. Review in detail the Drawings, Specifications, and other work related to the building moving. Discuss all conflicts, incompatibilities, and inadequacies.
2. Review in detail the job conditions, schedule, construction sequence, moving and erection requirements, and connections.

3. Review in detail the quality of the completed installation, field work required to complete the work, renovation work, and finishes.
4. Review in detail the means of protecting the work during moving and the remainder of the construction period.

1.04 EXISTING CONDITIONS

A. Conduct deconstruction and relocation work to minimize impact to the structure and elements.

B. Provide, erect, and maintain temporary barriers and security devices. Cover and protect windows and walls.

C. Conduct operations with minimum interference to existing buildings, outdoor classroom presentation areas, and public thoroughfares. Maintain egress and access to other buildings and areas at all times.

PART 2 - PRODUCTS

2.01 SALVAGE MATERIALS

A. Items to be Reused: Carefully remove, store, protect and re-install all of the building's materials and items, both inside and outside the building. Do not dispose of any building materials or items without first verifying status with the Engineer.
   1. Note that the building and its entire contents are of historic significance. Nothing may be removed from the building without the City's or the Engineer's prior specific written permission.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examination: Examine new foundation, slab-on-grade, and surfaces to receive relocated building, and conditions under which it is to be installed. Correct unsatisfactory conditions prior to commencement of installation.

B. Field Verification:
   1. Verify that the site-built foundation dimensions are accurate per plans.
   2. Verify that placement of connectors, anchor bolts, inserts, etc. will allow erection of building within required tolerances.

3.02 PREPARATION

A. Temporary Bracing: Design, construct, and remove when no longer required, temporary bracing as required to prevent movement and excessive stresses during moving operations and to position and brace walls until they are permanently anchored.

B. Apply temporary protection to surfaces to avoid damaging them during moving operations. Protect threads on embedded anchor bolts to avoid damage that would impair installation of nuts or other hardware.

3.03 EXECUTION

A. General: Perform work in accordance with the requirements of U.S. Secretary of the Interior's "Standards for the Treatment of Historic Properties", ANSI A10.6, and applicable regulatory requirements, unless otherwise indicated.

B. Move building in accordance with approved schedule and shop drawings. Install plumb, true, securely anchored, with all required fastenings, clips, anchors, interconnections, hardware, etc. Perform moving and erection using qualified tradesmen experienced in this type of work.

C. Perform relocation work in an orderly and careful manner, allowing the City's continued use of the facilities. Disassemble only as much material as is required for the structure relocation work to be conveniently performed.

D. Cease operations and notify Engineer and City's Representative immediately if structure or items appear to be endangered. Do not resume operations until corrective measures have been taken.

E. Remove materials to be re-installed in manner to prevent damage. Store and protect under provisions of Section 01 60 00.
   1. After building has been relocated, remove lifting devices; seal exposed edges against weather

F. Hazardous Materials: Notify City or Engineer immediately should any materials be encountered which are suspected of being potentially hazardous or dangerous. Do not handle any suspected hazardous materials without first consulting with the City. Do not proceed until determination has been made of the material.
   1. Contaminated Material: Remove and properly dispose of contaminated, mold, termite, or vermin infested materials encountered.
   2. Asbestos: City will remove any asbestos-containing materials under a change order, except as shown on the Drawings.
   3. Paint: Assume that any paint on the building may contain lead.
      a. Remove and properly dispose of painted items which are to be disposed of.
      b. Remove and strip any painted surfaces of materials which are to be refurbished and reinstalled in the building.
      c. Comply with governing Federal and State safety and health standards and manufacturer's written instructions for use of paint remover. Dispose of removed paint in accordance with requirements of Regulatory Agencies.

3.04 FIELD QUALITY CONTROL

A. The Engineer will accompany the Contractor before and after performance of work to confirm physical condition of structure and improvements involved.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 GENERAL

A. Work included: Furnish, install, and remove forms for structural cast-in-place concrete including shoring and form supports. Work included in this section includes formwork required for concrete including walls, elevated slabs, structural slabs, slabs on grade and foundation concrete.

1.2 SCOPE

A. The work under this section includes all materials, labor, accessories, equipment and related services to furnish and place all reinforcement in cast-in-place concrete construction, as shown on Drawings, as specified herein, and all required accompanying accessories.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Concrete Formwork: Section 03 10 00

B. Cast-in Place Concrete: Section 03 30 00

1.4 CODES AND STANDARDS

A. The latest editions of the following references, codes, and standards are hereby made a part of this Section and formwork shall conform to the applicable requirements therein except as otherwise specified herein or shown on the drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

1. "Recommended Practice for Concrete Formwork," ACI 347.

2. California Building Code (CBC), Chapter 19, latest edition.

1.5 ALLOWABLE TOLERANCES

A. Design, construct, set, and maintain formwork so as to ensure completed work within the suggested tolerance limits specified in ACI 347, Section 3.1.1.

1.6 MATERIALS

A. Earth Forms: Unless otherwise indicated or required by the Drawings or these specifications, concrete for footings may be placed directly against vertical excavated surfaces provided the material will stand without caving and provided that minimum reinforcing steel clearances indicated on the Drawings are maintained and suitable provisions are taken to prevent raveling of top edges or sloughing of loose material from walls of excavation. Sides of excavation shall be made with a neat cut and the width made as detailed on the Drawings.

B. Fabricated Forms:

1. Exposed Architectural Concrete Not Otherwise Noted or Specified: Plywood, metal, metal framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practical sizes to minimize number of joints and to conform to joint system shown on drawings.

   If plywood is used, plywood shall comply with U.S. Product Standard PS 1-95 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark. Thickness shall be of sufficient design and strength to hold concrete properly in place and alignment.

2. Chamfer Strips, Reveals, and Score Marks: Extruded polyvinylchloride specifically produced for concrete work; Greenstreak, Vinylex Corp., Preco Industries, Vulcan Metal Products, or approved equivalent.

3. Unexposed Concrete Not Otherwise Specified: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit. Of sufficient design and strength to hold concrete properly in place and alignment.

4. Framing: At Contractor option subject to meeting necessary strengths and surface tolerances.

C. Form Release Agents:

1. Exposed Concrete Including Surfaces to Receive Paint and Other Coatings: Chemically active type producing water insoluble soaps. Form release agents shall be delivered in manufacturer's sealed and trademarked containers and shall be guaranteed to provide clean, stain-free concrete release and not to interfere with future applied coatings and finishes. Release agents shall contain no petroleum solvents such as creosote, paraffin, waxes, or diesel oil.

2. Concealed Concrete: Contractor option except that release agents shall not interfere with bond of any applied finish.

D. Form Sealer (Wood Forms):

1. Burke “Form Sealer,” or approved equivalent, and of a type which will not interfere with bond of applied finishes.

E. Form Ties:

1. Metal, spreader type, removable to 1" from concrete face. Ties for exposed concrete shall leave smooth 1” diameter conical holes with no spalling upon form removal. Ties for exposed concrete shall be of same type throughout Project. Wire ties and wood spreaders will not be allowed.

F. Cold Joints (Exterior Paving Slab on Grade):

1. Standard 24 ga. galvanized steel, keyed profile, sized to suit slab thickness, punched on permit passage of continuous or doweled reinforcing bars of size and spacing shown on the drawings.

PART 2 - EXECUTION

2.1 PREPARATION

A. Vertical and Horizontal Controls: Establish and maintain necessary benchmarks, lines, or controls throughout construction.

B. Secure information and provide for underfloor electric raceways, openings, sleeves, chases, reglets, pipes, recesses, nailers, anchors, ties, inserts, and similar embedded items. Coordinate with concrete work for requirements governing embedment and sleeving of pipes, raceways, and conduits.

2.2 CONSTRUCTION

A. Formwork - General: Construct wood forms of sound material, straight and rigid, thoroughly braced, mortar tight, and of such strength that the pressure of concrete and the movement of men and equipment will not displace them. Visible waves in exposed concrete surfaces after stripping of forms may result in rejection of that portion of the concrete. The design and engineering of formwork shall be the complete responsibility of the Contractor.

B. Plywood Forms for Exposed Concrete: Plywood panels shall be clean, smooth, uniform in size, and free from damaged edges or faces (including holes other than those required for form ties). Use full panels wherever possible. Make plywood panel pattern regular and symmetrical, joints plumb or level, horizontal joints continuous. Block plywood edges, which do not occur at bearing points in order to eliminate, joint offsets.

C. Framing and Bracing: Framing, bracing, and supporting members shall be of ample size and strength to carry safely, without excessive deflection (exceeding allowable tolerances), all dead and live loads to which formwork may be subjected, and shall be spaced sufficiently close to prevent any apparent bulging or sagging of forms.

D. Form Ties: Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading of the forms. Ties for exposed concrete surfaces shall be arranged symmetrically and shall be aligned both vertically and horizontally (do not stagger), with

layout pattern acceptable to Engineer based on Drawing layouts and, where not shown, in accordance with reviewed formwork layout shop drawing submittals.

E. Forms for concrete shall be constructed full height and width between indicated construction joints or emphasized joints in concrete surface and shall not be broken for pour or construction joints within these areas.

F. Construct forms no higher than 12" above top of pour or construction joint.

G. Construction Joints: Construction joints shall be in accord with requirements of Section 77: "Structural Cast-in-Place Concrete." Confine construction or pour joints to rustication strip locations where they occur; where rusticated joints do not occur in a surface, provide a surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints. Prior to subsequent pour, remove strip and tighten forms. Construction joints shall show no "overlapping" or offsetting of concrete surfaces and shall, as closely as possible, present the same appearance as butted plywood joints. Joints in a continuous line shall be straight and true.

H. Score Lines: Where "score," emphasized or rustication lines are indicated on vertical surfaces, obtain such lines by accurate placement of moldings in forms. Pieces shall be in longest lengths practical with joints mitered.

I. Arrange forms to allow proper erection sequence and to permit form removal without damage to concrete.

J. Form Sealer: Uncoated plywood forms for smooth Architectural Concrete shall be sealed on contact faces and edges using two (2) coats of specified form sealer in strict accord with manufacturer's directions.

K. Form Release Agent: Thoroughly clean forms and coat with release agent prior to initial use and before each reuse. Apply release agent in strict accord with manufacturer's directions and coverage recommendations avoiding starved areas or excessive applications. Apply release agents reinforcing steel is placed.

L. Reuse of Forms: Control reuse of forms for exposed surfaces to provide surface of uniform color and texture without sharp demarcation between adjacent surfaces.

M. Prior to placement of concrete, remove dirt, debris, and foreign material from forms. Leave no wood in concrete except nailers.

2.3 FALSEWORK

A. Contractor shall be fully responsible for proper strength, safety, and adequacy of formwork supports, and bearing surfaces thereof, used on and in connection with the work. Falsework shall be designed to support imposed loads without deformation, deflection, or settlement.

B. Vertical and lateral loads shall be carried to ground by falsework system, or by the completed structure after it has attained the requisite strength.

C. Erect shoring and vertical supports so that they cannot tilt or settle. Securely brace inclined shores against slipping or sliding. Cut bearing ends of shores square and with a tight fit at splices. Splices, where used, shall be secure against bending and buckling.

2.4 REMOVAL OF FORMS AND FALSEWORK

A. The removal of forms and falsework shall be carried out in such manner as to ensure the complete safety of the structure. Supports shall not be removed until members have sufficient strength to support safely their own weight and any superimposed loading with proper factor of safety.

B. Forms for exposed concrete surfaces shall be removed in such a manner as to preclude damage to finishes. Pinch bars and similar tools shall not be used for prying against exposed surfaces. Stripping shall commence at top edge or vertical corner where the use of wooden wedge is possible. Wedging shall be done gradually and shall be accompanied by light tapping on panels to loosen them. When free at one end, gradually loosen remaining area without jerking.

C. After concrete is placed, the following minimum times shall elapse before the removal of forms or shoring:

2. Vertical Forms (Walls, Columns, and Beam Sides): 3 days

3. Side Forms (Footings, Slabs on Grade): 48 hours

D. Upon removal of forms, remove bolts, wires, clamps, rod, etc., not necessary to the work to a minimum of 1" from the surface. Conduct operations so as to eliminate the danger of rust stains from form tie materials or other unprotected ferrous materials embedded in or adjacent to exposed concrete surfaces.

*** END OF SECTION ***

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SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 GENERAL

A. Work of this Section shall conform to the requirements of the General Conditions, Supplementary General Conditions and Special Requirements.

1.2 SCOPE

A. The work under this section includes all materials, labor, accessories, equipment and related services to furnish and place all reinforcement in cast-in-place concrete construction, as shown on Drawings, as specified herein, and all required accompanying accessories.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Concrete Formwork: Section 03 10 00

B. Cast-in Place Concrete: Section 03 30 00

1.4 CODES AND STANDARDS

A. Code:

Reinforcement shall conform to the requirements of the 2010 California Building Code.

B. Standards:

Perform all work in accordance with the latest editions and revisions of the following standards which hereby become part of this section.

1. American Concrete Institute (ACI):

   a. ACI 318 "Building Code Requirements for Reinforced Concrete".
   b. ACI 301 "Specifications for Structural Concrete for Buildings".
   c. ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete".

2. Concrete Reinforcing Steel Institute (CRSI):

   a. "Recommended Practice for Placing Reinforcing Bars."
   b. “Suggested Specifications, Reinforcement, including Provisions for Coated Reinforcing Bars.”

3. American Society of Testing and Materials (ASTM):

   a. "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement" (ASTM A615)
   b. "Specification for Steel Wire, Plain, for Concrete Reinforcement" (ASTM A82)
   c. "Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement" (ASTM A706)

1.5 SUBMITTALS

A. Shop Drawings:

1. The Contractor shall prepare shop drawings showing detailed layout of reinforcement, including dimensions, openings, bar spacing, bending details, bar schedules, and similar items required for the proper construction of the work. Drawings shall show grades of reinforcing steel and shall be prepared in compliance with the S tructural and Architectural Drawings.
2. The shop drawings for the top bars and the bottom bars for the slabs shall be prepared on different sheets. Reinforcement of concrete walls and beams shall be shown on elevations with sections as required. Elevations of walls and beams shall be at least 1/4" = 1'-0" scale.
3. Shop drawings shall be prepared in accordance with ACI 315 "Details and Detailing of Concrete Reinforcement".
4. Shop drawings relating to the parts comprising a proposed unit shall be submitted simultaneously so that parts may be checked individually and as an assembly for said unit. Shop drawings shall list the Contract Drawings used as reference in the development of said shop drawings. Shop drawings shall be submitted per the format called for in the General Requirements.
5. Numbering: All shop drawings shall be numbered in a logical and sequential manner.

B. Recycled Content Submittals:

1. Contractor shall provide documentation for reinforcing steel recycled content. Include statement indicating costs.

C. Submissions:
1. Submit under provisions of Section 01 33 00.

D. Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel. Certificates shall reference heat numbers, and corresponding heat numbers shall be indicated on the tags of unbroken bundles of bars. If mill certificates are not available for the heats supplied, or if heat identification is missing from bundles supplied, verification testing of the supplied bars shall be required, paid for by the Contractor. Submit Certificates to Special Inspector in accordance with Source Quality Control requirements of this section.

E. Product Data:

1. Bar Supports.
2. Coated bar tie wire.
3. Mechanical couplers.
4. Headed reinforcing.

F. Samples:

1. One sample of each type of bar support.
2. One 12 inch length of each type of tie wire.
3. One sample of each size of headed reinforcement.

1.6 PRODUCT HANDLING

A. Delivery: Deliver reinforcement to the job site bundled, tagged and marked. Use metal tags indicating bar size, lengths and other information corresponding to markings shown on shop drawings. Note heat identification requirements for correspondence to mill certificates.

B. Storage: Store reinforcement at the job-site in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All reinforcing shall conform to the requirements of ASTM A615, Grade 60 or ASTM A706 Grade 60, unless otherwise noted on the structural drawings.

B. Mechanical couplers:

1. Mechanical couplers shall only be used where specifically indicated on the structural drawings.
2. Mechanical couplers shall satisfy the requirements of 2010 CBC and ACI 318 Section 12.14.3 for both Type 1 and Type 2 splices as noted on the structural drawings.
3. Mechanical couplers shall have a current ICBO Evaluation Report which evidences compliance with requirements of these specifications.
4. Mechanical couplers: “Bar-Lock” as manufactured by Bar-Lock Coupler Systems or ICBO approved equivalent.

C. Headed reinforcing:

1. Headed reinforcing may only be used where specifically indicated on the structural drawings. The connection of the head to the bar shall develop the lesser of 95% of the ultimate tensile strength of 160% of the specified minimum yield strength of the bar.
2. Headed reinforcing shall have a current ICBO Evaluation Report which evidences compliance with requirements of these specifications.

3. Headed reinforcing "HRC 100 series T-headed bars" as manufactured by "Headed Reinforcement Corp", or approved equivalent.

D. Smooth dowels: ASTM A615 Grade 40, smooth; shop painted with iron oxide zinc chromate primer.

E. Tie Wire:

1. Black annealed wire, 16 gauge or heavier.

F. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for supporting, spacing and fastening reinforcement in place:

1. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, and other unacceptable materials.
2. For slabs on grade use supports of precast concrete blocks of size sufficient to resist settlement into soil, but not less than 3 inches square, with embedded plastic coated wires.
3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dip galvanized or plastic protected legs. For this project, soffits and faces of slabs and beams shall be considered as exposed-to-view unless specifically noted otherwise.

PART 3 - EXECUTION

3.1 FABRICATION

A. Fabrication of reinforcing bars shall conform to required shape and dimensions, with fabrication tolerances complying with the CRSI Manual and ACI 315. Fabrication shall not commence until shop drawings have been reviewed and returned by the Engineer as appropriate. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.

B. Unacceptable materials: Reinforcement with any of the following defects will not be permitted in the work:

1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
2. Bends or kinks not indicated on Drawings or final Shop Drawings.
3. Bars with reduced cross-section due to excessive rusting or other causes.

C. Welded splices shall be used only where specifically indicated on the structural drawings. When used, the splice shall have bars butted and welded to develop in tension at least 100 percent of the specified tensile strength of the bar.

D. Welding of stirrups, ties, inserts or other similar elements to longitudinal reinforcing bars shall not be permitted.

3.2 INSPECTION AND SOURCE QUALITY CONTROL

A. Contractor to examine the substrate, formwork, and the conditions at which concrete reinforcement is to be placed, and correct conditions which would prevent proper and timely completion of the work. Do not proceed with the work until satisfactory conditions have been obtained.

B. Contractor shall submit the following to the Special Inspector for all supplied reinforcing steel:

1. Certificates of compliance with specified standards for reinforcing bars.
2. Welding electrodes.
3. Reinforcing bar coating.
4. Certified mill test reports including physical and chemical analysis.

C. Special Inspector will:

1. Collect test reports and certificates of compliance.
2. Review test reports and certificates of compliance for conformance with Contract Documents.
3. Select random samples of reinforcing steel for testing by Testing Laboratory, at the discretion of the Special Inspector.

D. Testing Laboratory will test random samples of reinforcing steel selected by the Special Inspector for compliance with strength, ductility and chemical requirements of ASTM A615 or A706.

3.3 INSTALLATION

A. Comply with the specified standards for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.

C. 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.

D. Place reinforcement to obtain the required minimum coverages for concrete protection. Arrange, space, and securely tie bar supports together with 16 gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

E. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2" beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

F. Splices shall only be made at locations and by the method indicated on the structural drawings. Any proposed alternate location or method must be submitted in writing to the Engineer for approval.

G. Welding:

1. Welding is not permitted unless specifically detailed on the structural drawings.
2. Employ shielded metal arc, gas metal arc or flux cored arc method and conform to requirements of AWS D1.4 using qualified procedures.
3. Welding shall not be done within two bar diameters of any bent portion of a bar which has been bent cold.
4. Welding of crossing bars is not permitted.

3.4 FIELD QUALITY CONTROL

A. Special Inspector will:

1. Inspect placement of reinforcement for conformance with the Contract Documents as required by CBC Section 1704 and Table 1704.4.
2. Inspect mechanical coupling of reinforcing steel in accordance with applicable ICBO Evaluation Report.

B. Testing Laboratory will inspect the following and report results to the Special Inspector:

1. Inspect welding as required by CBC Section 1704.3.1 and Table 1704.3 in accordance with AWS D1.4, including checking materials, equipment, procedure and welder qualifications as well as the welds.
2. Inspector will use nondestructive testing or any other aid to visual inspections that the inspector deems necessary to be assured of the adequacy of the weld.
3. For welding of ASTM A 706 reinforcing steel not larger than No. 5 bars used for embedments, continuous presence during welding is not necessary provided the materials, qualifications of welding procedures and welders are verified prior to the start of work, periodic inspections are made of the work in progress, and a visual inspection of all welds is made prior to completion or prior to shipment of shop welding.

*** END OF SECTION ***

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install cast-in-place concrete required for the Project as shown on the Drawings and specified herein. This Section also includes:

1. Building concrete including walls, elevated slabs, structural slabs, slabs on grade and foundation concrete.
2. Curing of formed concrete surfaces.
3. Installation of anchor bolts, hangers, anchors, reglets, plates, inserts, and miscellaneous metal or other materials embedded in concrete.

B. Related Work Specified Elsewhere:

1. Concrete Formwork: Section 03 10 00

2. Concrete Reinforcement: Section 03 20 00

3. Finish for concrete surfaces including patching and curing of concrete (except curing of formed concrete): See Concrete Finishes: Section 03 35 00.

1.2 REFERENCES, CODES, AND STANDARDS

The following references, codes, and standards are hereby made a part of this Section and concrete work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

A. "Building Code Requirements for Reinforced Concrete", ACI 318-11.

B. California Building Code, 2010 Edition, Chapter 19.

1.3. DEFINITIONS

A. Architectural Concrete: The term "Architectural Concrete" where used herein shall mean concrete normally exposed to view.

1.4 SUBMITTALS:

A. Submit under provisions of Section 01 33 00.

B. Product data for proprietary materials and items, including admixtures, pigments, joint fillers, manufactured grouts, curing materials and vapor retarder.

C. Delivery tickets for each batch of concrete delivered, bearing the following information.

1. Mix identification.
2. Weight of cement, aggregate, water and admixtures, and aggregate size.

D. Samples: Panel using proposed mix design for Architectural Concrete or integrally colored concrete. Panels shall be cast, reviewed by City's Representative and Architect.

E. Quality Control:

1. Mix design for each concrete mix.
2. Laboratory test reports for concrete mixes.
3. Material certificates for concrete materials, including cements, aggregates and admixtures.
4. Statement of installer/finisher qualifications for Architectural Concrete.

1.5 RECYCLED CONTENT SUBMITTALS

A. Provide documentation for fly ash recycled content. Include statement indicating costs.

1.6 ENVIRONMENTAL CONDITIONS

A. Cold Weather Requirements: Comply with ACI 306(R)-10, "Cold Weather Concreting," and CBC 1905.12.

B. Hot Weather Requirements: Comply with ACI 305(R)-10, "Hot Weather Concreting," and CBC 1905.13.

1.7 FINISH

A. Refer to Section 03 35 00 for finishing cast concrete after formwork is stripped.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C 150-12, Type II. Cement shall be of same brand, type, and source throughout Project. Where aggregates are potentially reactive, use low alkali cement.

B. Fly Ash: ASTM C 618 CLASS C OR F, with the following requirements:
1. Fly ash shall be added to all concrete at a 20% minimum up to a 35% maximum rate of replacement by weight of the scheduled amount of cement.
2. Modified ASTM requirements:

a. Loss on Ignition (L.O.I.): Maximum 1%
b. Sulfur Trioxide (SO_3) shall not exceed 3% by weight.
c. Water requirement – maximum: 100% of control
d. $R = \frac{\text{Ca O minus 5\%}}{Fe_2 0_3}$

R = Sulfate Resistance = 0.75 maximum

$\frac{\text{Ca O}}{Fe_2O_3}$ Percentage fly ash oxide analysis

C. Normal Weight Concrete Aggregate: Conform to ASTM C-33 uniformly graded, 3/4-inch (19-mm) maximum aggregate size. Source shall be constant unless 10 days' prior notice is given for approval after recheck of mix design.

C. Water: Clean and potable, free from impurities detrimental to concrete.

D. Admixtures: The use of admixtures shall be subject to prior approval of the Engineer per ACI 318-11 Section 3.6 Admixtures. Calcium Chloride, Thiocyanates, and admixtures containing more than 0.05% chloride ions by mass of cementitious material are not permitted. Batch admixtures in strict accordance with manufacturer's recommendations.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494, Type D
3. High-Range, Water-Reducing Admixture: ASTM C 494, Type G.
4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
5. Color Admixtures: see Section 03 35 00 Concrete Finishing
6. Certification: Prior to preparation of mix designs, submit written conformance to above requirements and the chloride ion content of the admixture(s).

E. Expansion Joint Fillers:

1. Exposed Fillers (On-Grade Slabs and similar flatwork where joints are not otherwise noted or specified): ASTM D 1751-2008, preformed, non-extruding strips, 3/8" thick unless otherwise noted, precut to proper size.

F. Granular Fill: Open graded gravel with maximum ¾-inch (19 mm) aggregate size conforming to Class 2 Aggregate Base as defined in Caltrans Standard Specifications Section 26.

G. Sand: ASTM C33, uniformly graded, clean sand, free from excessive fines, organic materials, and other deleterious substances.

H. Non-Shrink Grout (Metallic): Euclid Chemical Co. "Firmix," Master Builders "Embeco 636," Sonnenborn-Contech "Ferrolith G," or approved equivalent, premixed, metallic grout, conforming to Corps of Engineers Spec. CRD-C-621.

I. Non-Shrink Grout (Non-Metallic): Euclid Chemical Co. "Euco N-S,", LM "Crystex," UPCO "Upcon," U.S. Grout Corp. "Five Star," Master Builders "Masterflow 713," or approved equivalent, non-metallic, non-staining, premixed grout having a compressive strength at 28 days of not less than 6,800 psi, non-shrink at all flow levels.

J. Curing Compounds: Conform to requirements of Concrete Finishes Section

K. Waterstop: Products listed are by Southern Metal & Plastic Products and are specified to establish the required level of performance, quality, and appearance.

1. Provide dumbbell/center bulb waterstops Concrete Tie Catalog Number 28DBCB, or approved equivalent.

2.2 MIXES

A. Mix Designs:

1. Mix designs for concrete shall be Contractor-designed at his expense. Designs shall be prepared by a qualified agency approved by the Engineer. Submit mix designs for review by the Engineer at least 2 weeks prior to placing any concrete. Submissions shall completely indicate brands, types, and quantities of admixtures included. If concrete is to be placed by pumping, recommendations of ACI Committee 304 shall be followed.

2 Mix designs shall be proportioned in accord with Section 4.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318-11. Submit mix designs for each class of concrete for review. If trial batches are used, the mix design shall be prepared by an independent testing laboratory and shall achieve a compressive strength 1,200 psi higher than the specified strength.

2.3 SLABS ON GRADE

A. Place slabs over vapor barrier over 4" clean, free-draining crushed rock over 12 inches (6 inches for exterior concrete flatwork) non-expansive structural fill (95% relative compaction) placed on the prepared subgrade soil. Slope subgrade to drain. The water vapor barrier must provide the performance defined in Section 07 26 00 Vapor Retarders, paragraph 1.1-B.

PART 3 - EXECUTION

3.1 MIXING: Concrete shall be ready mixed per ASTM C 94-11(b). Equipment shall be adequate for the purpose and kept in good mechanical condition at all times.

A. The rate of delivery, haul time, mixing time, and hopper capacity shall be such that mixed concrete delivered shall be placed in the forms within 90 minutes or 300 revolutions of the drum from the time of introduction of cement and water to the mixer. Any interruption in placing in excess of 90 minutes or 300 revolutions will cause shutdown of the work for the day and the wasting of any mixed concrete remaining in hoppers or mixers. In case such interruption occurs, the Contractor shall provide construction joints where and as directed and cut concrete back to such line, cleaning forms and reinforcing as herein specified. Delivery tickets shall show departure time from plants. Revolution counters shall be set at "0" and shall commence to operate when drum revolution begins after introduction of all ingredients into the mixer.

B. No water shall be added to the mix after the initial introduction of mixing water for the batch except when, on arrival at the job site, the slump of the concrete is less than that specified. In this case, additional water may be added from the truck system to bring the slump within required limits. The drum or blades shall then be turned an additional 30 revolutions until the mix is uniform.

C. Mixers shall be equipped with an automatic device for recording number of revolutions of drum or blades prior to completion of mixing operation.

D. Concrete shall be kept continuously agitated until discharged into the hopper at the job site.

E. Contractor shall note that the appearance of concrete surfaces depends upon uniform color and texture within any one area and between adjacent areas and shall exercise strict batching and mixing controls to achieve this end.

3.2 PLACING

A. Notify Engineer 72 hours (3 working days) minimum prior to placing of any concrete.

B. Thoroughly wet absorbent forms before concrete is placed. Aggregate base/sand beds for slabs on grade shall be moist but not saturated when concrete is placed.

C. Placing of concrete shall be done immediately after mixing. No concrete shall be placed or used after it has begun to set and no retempering will be allowed. The method used in placing shall be such that concrete is conveyed to place and deposited without separation of the ingredients. Place no concrete with a free unconfined fall in excess of five (5) feet. Concrete shall not be allowed to cascade through reinforcing steel in such a manner as to promote segregation. Do not support runways on reinforcing steel.

D. Where concrete slab surfaces have obtained 75% of their 28 day compressive strength and such surfaces are to be used for construction traffic, including concrete buggies and other conveyances, such surfaces shall be protected over traffic lanes by not less than 1 layer of waterproof kraft paper and 1 layer of 5/8" (min.) plywood.

E. Remove splash or accumulations of hardened or partially hardened concrete. Protect contact faces of forms for exposed concrete from splash during placement of adjacent concrete. Place concrete containing piping and electric raceways in a manner that will prevent damage to them.

F. Distribution of concrete shall be even and continuous and no placement joints shall show. Before a placement is started, make certain that adequate equipment, workers, and concrete will be available to place in cycles, which will permit proper and thorough integration of each layer of concrete. Upon stopping of a placement, the top surface shall be level.

G. Place no concrete for any element until reinforcing for same is fastened in place nor until forms are complete. Place no concrete before work that is to be embedded has been set. Notify other crafts so that they may deliver anchors, inserts, etc., or other work to be embedded in ample time and also notify them when their assistance in setting is required. Do not disturb reinforcing or other materials that have been set in place.

H. Comply with CBC 1906.3 for requirements governing embedded conduits and pipe. Sleeves and inserts will be provided and set under other Sections of the work

I. Remove debris, mud and water from places to receive concrete. Verify depths of any depressed slab conditions for suitability with type and method of surfacing to be applied over concrete.

J. Remove concrete splash and/or grout from exposed surfaces and from surfaces that will receive painter's finish.

K. Place no concrete in water unless written permission has been obtained from Engineer as to proposed procedures.

3.3 VIBRATION AND CONSOLIDATION

A. Thoroughly consolidate concrete by means of internal mechanical vibrators. Such consolidation shall be produced as will be obtained by placing the vibrator- directly in concrete at 18" - 30" intervals for a period of 5 to 15 seconds and withdrawing slowly or as directed, depending on the consistency of the concrete. One vibrator will be required for each location where simultaneous placing takes place, to ensure thorough vibrating of all sections. Provide sufficient spare vibrators on the job so as to have them readily available in case any vibrator in use should suddenly cease to function properly. When spare vibrators are employed, provide additional spares. Under no condition shall vibrator be placed against reinforcing steel or attached to forms. Do not use vibrators to transport material.

B. Vibrators shall be of the flexible immersion type having a frequency of not less than 8,000 RPM. Use and type of vibrator shall conform to ACI 309, "Recommended Practice for Consolidation of Concrete."

C. Spading will not be permitted on exposed concrete surfaces.

D. Voids and rock pockets shall be eliminated. Voids and rock pockets occurring in exposed concrete may subject that portion to rejection.

3.4 CONSTRUCTION JOINTS

A. Placement of construction joints and the manner in which they are provided for shall be only as approved by the Engineer or as shown on the Drawings. Construction joints shall be as few as possible and will not be permitted simply to save forms.

B. Under no condition will construction joints be permitted in Architectural Concrete surfaces other than where specifically shown and specified. See Concrete Formwork Section.

C. Clean and roughen construction joints by removing entire surface and exposing clean solidly embedded aggregate by means of sandblasting or other approved methods. Clean forms and reinforcing of drippings, debris, etc. Thoroughly consolidate initial pour with grout so that no variation in texture will occur in Architectural Concrete surfaces.

3.5 CURING CONCRETE

A. Curing Concrete shall conform to Section 90-7 “Curing Concrete” of the Caltrans State Standard Specifications.

B. If forms are permitted to be removed prior to expiration of curing period, exposed concrete surfaces shall be kept continuously wet by means of fog sprays or non-staining cotton or burlap mats kept moist or by approved curing compound. Application of curing compounds shall conform to requirements of Concrete Finishes Section.

3.6 EXPANSION JOINT FILLERS

A. Preformed Filler Joints: Place filler material so that top of surface is level and aligned uniformly 1/4" below adjacent concrete surface. Provide where walks abut vertical surfaces, at not over 24 ft. centers horizontally in paving and at other locations so noted on the Drawings. Follow Drawings for pattern where indicated; where not indicated, coordinate locations with Engineer before proceeding.

3.7 GROUTING

A. Where grouting is required and such grout is exposed in the finished work, use non-metallic, non-shrink grout only.

3.8 QUALITY CONTROL

A. Tests and inspections shall comply with CBC Section 1903.1 and shall be performed by qualified individuals, engineering companies, or testing laboratories who shall perform those special inspections required by Table 1704A.4 of the latest California Building Code, those tests and inspections specified below, and other such tests and inspections as the Engineer and City may require to establish the acceptability of the work.

B. Testing and inspection services shall be retained by the City at its expense, except that when tests or inspections reveal failure of materials to meet contract requirements, costs for subsequent tests and inspections will be deducted from the moneys due the Contractor. Excessive inspection time required by Contractor's failure to provide sufficient workers or to pursue properly the progress of the work shall likewise be deducted from the Contract Price.

C. Furnish material and handling for test cylinders and any other samples which testing agency requires for analysis of concrete work.

D. Batch Plant Inspection: Concrete is subject to batch plant inspection as per CBC 1704A.4.2.

E. Compression Tests to determine Strength and Durability of Concrete shall be provided per CBC Sec. 1905.1. Concrete shown to be defective shall be removed and replaced. Cost of core tests, repairs and removal, and replacement of defective concrete shall be paid by Contractor.

F. Slump Tests: Slump tests will be performed as per ASTM C143/C143M-10(a) (slump cone) at time of taking test cylinders.

G. City's testing agency will supervise preparation and selection of samples taken at job site.

*** END OF SECTION ***

SECTION 03 35 00

CONCRETE FINISHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Concrete surfacing and special finishes or treatment, including, but not necessarily limited to:
   1. Architectural exposed wall finish.
   2. Float finish.
   3. Steel trowel finish.
   4. Broom finish.
   5. Integrally colored concrete.
   6. Curing/sealing of integrally colored concrete.
   7. Chemical stained concrete finish.

B. Related Sections:
   1. Section 03 30 00 - Cast-in-Place Concrete.

1.02 SUBMITTALS

A. Product Data: Submit for any specified color treatments, including range of colors.

B. Samples: For colored or stained concrete, submit preliminary color samples from manufacturer's full range of colors for selection by Engineer.

1.03 QUALITY ASSURANCE

A. Finisher Qualifications: Workmen experienced in concrete finishing operations and capable of showing evidence of having successfully completed finishing projects of similar scope and complexity.

B. Standards: Comply with the following:
   1. ASTM International (ASTM):
      a. C1028-07 - Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
      b. E1155 - Determining Floor Flatness and Levelness Using the F-Number System.
   2. Comply with Reference Standards of Section 03 30 00 - Cast-in-Place Concrete.

C. Regulatory Requirements: Completed exposed concrete flatwork shall have a minimum surface coefficient of friction as follows for slip resistance after application of sealer. Field test in accordance with ASTM C1028-07, "Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method".
   1. Level Surfaces: Not less than 0.6
   2. Ramped Surfaces: Not less than 0.8

D. Field Samples: Prepare a sample area approximately 4 x 4 feet, at location directed by Engineer, with representative texture, tooled joint, and pattern, of each finish for Engineer's review and approval.
   1. Approved samples will be used as a standard for subsequent finish work.
   2. Notify Engineer at least 24 hours before surfacing is to be applied to samples.
   3. After approval, protect samples and maintain in good condition at jobsite for comparison with work on actual surfaces.

E. Field Sample for Stained Concrete Slabs: After selection of desired color by Engineer, prepare a 4 x 4 foot sample area for field verification of finished appearance.
   1. Use same materials and curing and finishing methods as proposed for final work. Include divider strips and stains in field sample. Finish sample same as for final work.
   2. Intent of sample is to verify the final color, texture, slip resistance, finishing techniques, and appearance of the work.
   3. Notify Engineer at least one week in advance of the date when mockup will be completed. Obtain Engineer's approval of mockup before start of work.
   4. Retain and maintain approved mockup during construction in an undisturbed condition as a standard for judging the completed work. Remove mockup from Project site upon completion of work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Nothing in this section shall be construed in any way as a modification to the requirements for concrete composition, placement, curing, testing, etc., as specified under Section 03 30 00 - Cast-in-Place Concrete.

B. Penetrating Liquid Floor Treatment that Hardens, Densifies, and Dustproofs Concrete Surfaces: Clear, chemically reactive waterborne solution of inorganic silicate or siliconate materials; odorless; meeting VOC requirements of SCAQMD: Dayton Superior Corporation; Day-Chem Sure Hard (J-17), L&M Construction Chemicals "Seal Hard", W.R. Meadows "LIQUI-HARD", or equal. Use at interior concrete slabs in spaces to remain concrete finish.

C. Integral Colored Concrete Color Additive: Lamp black (black oxide), maximum of 2 pounds per cubic yard of concrete; color to match approved sample.

D. Concrete Non-acidic Waterborne Stain:
   1. Stain: L.M. Scofield Company "Lithochrome Tintura Stain", QC Construction Products, or equal.
      a. Color: To be selected by Engineer from manufacturer's full range of colors.
   2. Clear Sealer over Interior Stained Concrete: L.M. Scofield Company "Selectseal-W" clear semi-gloss acrylic/polyurethane sealer, or equal.

E. Exterior Concrete Clear Waterborne Sealer:
   1. Manufacturer: L. M. Scofield Company "Cureseal-W, QC Construction Products, or equal.
   2. Material: Water-based curing and sealing compound, medium-duty sealer, for use on exterior plaza concrete, VOC compliant, less than 100 g/L, low-gloss finish.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. Lines and Levels: Ensure that surfaces have been brought to proper lines and levels to produce finish surfaces within specified tolerances and at required elevations.

B. Tolerances: Finish concrete to smooth, even surfaces with no abrupt variations, within the following tolerances:
   1. Formed Vertical Surfaces: Comply with requirements of Section 031000 - Concrete Formwork.
   2. Slabs: Verify flatness and levelness of slabs in accordance with ASTM E1155.
      a. Flatness (F_F): Minimum 20.
      b. Levelness (F_L): Minimum 17.

C. Slabs: Finish monolithically unless otherwise shown or specified, ensure that an even joint is maintained between successive concrete pours.
   1. Levels: As shown on Drawings or as directed by Engineer.
   2. Drainage: Slope slabs uniformly to provide positive drainage into floor drains, gutters, etc. where indicated on Drawings.
   3. Finishes: As shown on Drawings and as specified below.

3.02 PATCHING

A. Unexposed Concrete: Eliminate rock pockets and honeycomb, but do not sack.

B. Architectural (Exposed) Concrete Walls:
   1. Areas patched shall not exceed 2 sq.ft. in each 1,000 sq.ft. of surface area. Architectural concrete requiring repair in excess of above standard is subject to rejection by the Engineer and subsequent removal and replacement with new work at no additional cost to the City.
   2. Remove honeycombed and other defective areas down to sound concrete. Brush a mixture of 1 part bonding agent and 1 part water onto the area to be patched.
   3. Mix the patching mixture from the same material and of approximately the same proportions as used for the concrete, except the mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp, loose volume.
   4. Use no more mixing water than necessary for handling and placing. Mix the patching mortar in advance and allow to stand, with frequent manipulation with a trowel, and without addition of water, until it has reached the stiffest consistency that will permit placing. Use a mixture of 1 part bonding agent and 4 parts water as mixing water.
   5. Consolidate the patch mix into place and strike off so as to leave the patch slightly higher than the surrounding surface to permit initial shrinkage. Texture patches to match the surrounding areas. Keep the patched area damp for seven days. Use sponge or wood floats in finishing patches to be left exposed.

3.03 FINISHES

A. General: Locations specified are for general reference only. Specific locations and extent are noted on the Drawings.

B. Architectural (Exposed) Concrete Walls: Smooth surface without texturing.
   1. Tie Holes: Fill with recessed precast concrete plugs set in epoxy adhesive to cover the exposed metal and prevent rusting.
   2. Cut off protruding formwork nails, staples, etc. flush with concrete surface, and grind smooth.
   3. Remove fins and other projections by grinding.
   4. Finish: Sack walls immediately after removal of formwork.
   5. Location: Architecturally exposed smooth-formed walls.

C. Floated Finish:
   1. Description: Screed slabs to proper levels, removing all surface water and laitance. Float slabs by hand using a wood float. Submerge coarse aggregates, eliminating irregularities, dips, and valleys. Make smooth transitions to previous work. Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Sprinkling dry cement on surface to absorb water is prohibited.
   2. Finish: Smooth evenly textured surface, free from sharp ridges.
   3. Locations: Basic preparation for other finishing, where slabs will be covered by grouted finish, and at topping slabs.

D. Steel-Troweled Finish:
   1. Description: Horizontal planes floated and troweled to a hard, smooth surface without tool marks. Finish slab to a tolerance within 1/8-inch in 10 feet. Finish slab monolithically. Strike-off and screed slab to a true surface at required elevations and, as soon as surface water has disappeared, thoroughly compact concrete with floats or tampers to force coarse aggregate below surface. Finish slab on same day that concrete is placed. Whether shown or not, in areas where floor drains occur, slope finished slab to floor drains from the extreme corners of the area being drained.
   2. Finish: Smooth uniform finish, free from blemishes, trowel marks, and other defects. Note special care required of ceramic and quarry tile floors installed with "thin set" method.
   3. Location: Typical interior floor slabs and where noted on Drawings.

E. Broom Finish:
   1. Description: After first troweling, use push-type broom, brushing in direction perpendicular to direction of traffic flow, with smooth troweled edges, unless otherwise indicated on Drawings.
   2. Finish Texture:
      a. Level Surfaces: Light broom finish.
      b. Slopes up to 6%: Medium broom finish.
      c. Slopes 6% and Greater: Non-slip heavy broom finish.
      d. Stairs: Light broom finish, with steel troweled nosings, and 3 equally spaced grooved notches in the front 4 inches of each stair tread.
   3. Locations: Exterior porch, walkways, ramps, stairs, and as noted.

F. Integral Color Concrete:
   1. Application: Add color additive to concrete at batch plant in accordance with manufacturer's written recommendations, to match approved sample. Adjust percentages to provide consistent color to account for fly ash, slag, and other cementitious materials in each mix design.
   2. Locations: Interior floor slabs; exterior porch, walkways, stairs, and pathways.

G. Curing/Sealing Compound at Exterior Colored Concrete:
   1. Application: Apply curing/sealing compound according to manufacturer's written instructions.
   2. Location: Exterior integrally colored concrete slabs.

3.04 STAINED CONCRETE

A. Curing:
   1. Cure concrete in accordance with chemical stain manufacturer's written recommendations. Cure concrete using new, unwrinkled, non-staining high-quality curing paper. Do not overlap curing paper.
   2. Allow concrete to cure a minimum of 14 days before application of chemical stain.
   3. Do not permit traffic on surface until concrete is fully cured and staining operations are complete.

B. Cleaning: Immediately prior to chemical staining, clean concrete surfaces.
   1. Sweep then pressure wash or scrub floors with rotary floor machine. Use commercial detergent if required to facilitate cleaning.
   2. Thoroughly rinse surface after cleaning, until rinse water is completely clean.

C. Stain Application:
   1. Mask and protect adjacent areas which are not to be stained.
   2. Apply concrete chemical stain in accordance with stain manufacturer's written recommendations.
   3. Apply at recommended coverage rate and using application procedures to match the effect achieved by approved field sample.
   4. After stain has remained on the surface for amount of time required by approved sample, remove excess material by wet scrubbing and rinsing. Do not allow excess stain to runoff onto adjacent materials. Dispose of excess material in accordance with requirements of regulatory agencies.
   5. Allow concrete to dry thoroughly after cleaning.

D. Sealing: Seal stained concrete with clear sealer in accordance with manufacturer's written recommendations. Allow sealer to dry thoroughly before allowing foot traffic on floor.

3.05 CONTROL JOINTS

A. Layout: Locate score lines where shown on drawings or as directed by Engineer.
B. Workmanship: Unless otherwise shown, control joints shall be sawcut. Lines shall be straight, parallel and/or square, with square intersections unless otherwise shown

END OF SECTION

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SECTION 03 54 16

HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Cement-based polymer-modified self-leveling underlayment, complete.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data and mixing instructions. Submit manufacturer's installation instructions.

B. Qualification Data: Submit applicator qualifications.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in cementitious self-leveling underlayment with minimum three (3) years experience, and approved by manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in their original unopened packages. Protect from freezing, direct sun exposure, and exposure to moisture.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Perform work at ambient temperatures at or above 50 degrees F (10 degrees C).

B. During cure process, ventilate room spaces to remove moisture.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide cementitious underlayment as manufactured by Ardex, Inc., Mapei, or equal.

2.02 MATERIALS

A. Self-leveling Underlayment: Ardex "Type K-15", Mapei "Ultraplan 1", or equal, cementitious-based high strength, fast setting, non-shrink self-leveling underlayment mix.

B. Trowelable Underlayment For Floor Ramping and Patching: Ardex "Type SD-P", Mapei "Mapecem Premix", or equal, cementitious based high strength, fast setting, non-shrink trowelable grade underlayment mix.

C. Pourable Fast-Setting Horizontal Concrete Repair Mortar: Ardex "Type TRM - Transportation Repair Mortar", Mapei, or equal, microsilica-modified, fast setting, structural repair mortar.

D. Water: Drinkable and not detrimental to underlayment.

E. Primer: Solvent free, as recommended by manufacturer.

2.03 MIXING

A. Site mix materials in accordance with manufacturer's instructions to achieve the following characteristics:
   1. Flexural Strength: 1000 psi after 28 days.
   2. Compressive Strength: 4100 psi minimum after 28 days.
   3. Fire Hazard Classification: 0/0/0 (Flame/Fuel/Smoke) rating in accordance with ASTM E84.

B. Mix self-leveling underlayment to consistency to achieve self-leveling flowability.

C. Mix trowel-grade underlayment to achieve smooth trowelability for the required slopes and patching.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify substrate surfaces are ready to receive work of this Section.

B. Verify that concrete subfloors are of adequate strength, clean, and free of all oil, grease, dirt, curing compounds and all foreign matter before priming.

3.02 PREPARATION

A. Remove nubs, projections, irregularities. Fill voids, cracks, deck joints and irregularities with filler. Finish smooth.

B. Clean subfloors in accordance with manufacturer's recommendations. Vacuum clean substrate surfaces.

3.03 INSTALLATION

A. Mix primer in accordance with manufacturer's written instructions. Apply evenly using a soft bristle pushbroom. Remove all puddles and thick areas. Allow to dry to a thin film.

B. Mix underlayment in strict accordance with manufacturer's written instructions using a mixing drum. Pour or pump liquid and spread in place with manufacturer's recommended spreader, smoother, and touchup methods.

C. Install underlayment in accordance with manufacturer's written instructions to indicated minimum and maximum thicknesses.

1. Provide aggregate in mix where required to achieve proper thickness, in accordance with manufacturer's recommendations.
2. Tolerances: Maintain top surface level to within 1/8-inch in 10 feet.
3. Air cure in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide all materials, labor, equipment and services necessary for the fabrication, erection and completion of all structural steel, including all bracing and shoring required for erection and related work. The work shall include and not necessarily be limited to the following:

1. Structural steel for retaining wall wide flanges, steel connectors in trusses and rod braces, steel columns, anchor bolts, base plates, connection bolts, welded studs connected to structural steel.
2. Verification of anchor bolt setting and of levels to assure adequate fit of the steel work.

1.2 RELATED SECTIONS

A. Structural Cast-in-Place Concrete: Section 03 30 00.

1.3 QUALITY ASSURANCE

A. Standards: Comply with the following applicable standards unless otherwise specified herein:

1. CBC—"California Building Code," 2010 Edition and all applicable local Building Codes.
2. AISC-- American Institute of Steel Construction's "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," latest edition.
3. AISC—American Institute of Steel Construction's "Code of Standard Practice for Steel Buildings and Bridges," latest edition.
4. AWS—American Welding Society's "Structural Welding Code" AWS D1.1, latest Edition.
5. "AISC—American Institute of Steel Construction's "Specification for Structural Joints Using ASTM A325 or A490 Bolts," latest edition.
6. ASTM—American Society for Testing and Materials.
7. SSPC—Steel Structures Painting Council.
8. ICBO—"Evaluation Report" of ICBO Evaluation Service, Inc.

B. Tests and Inspections:

1. Contractor shall certify, test and inspect all materials, welding, fabrication and erection in accordance with the requirements of AISC and AWS D1.1 and as noted herein. The

Owner will employ a Testing Agency to provide for additional testing and inspections only as noted in the sections below.

2. Mill analysis and test reports for the steel, certified and properly executed by the manufacturer, will constitute sufficient evidence of conformity with the specifications. Contractor shall identify steel in accordance with CBC Section 2203A as to heat number and furnish the Testing Agency. If the material cannot be identified or its source is questionable, one set of tension and bend tests shall be made by the Testing Agency in accordance with the CBC Section 2203A.

    a. The cost of all tests including sampling and machining of test coupons shall be paid by the Contractor.

    b. The Contractor shall cooperate with Testing Agency and provide all material required to take coupons for testing, as required by the Engineer.

3. Certificates of compliance for welding electrodes and shear studs properly executed by the manufacturer(s) shall constitute sufficient evidence of compliance with the specification.

4. High strength bolts, nuts, washers and thread rods shall be sampled and tested in accordance with the requirements of the specification for High Strength Bolts for Structural Steel Joints, ASTM A325 or ASTM A490 Bolts.

5. Additional testing required as a result of corrective measures to correct defects shall be paid for by the Contractor.

C. Welding Inspection by the Contractor: All shop and field welding shall be inspected by the contractor's "Welding Inspector" as defined by AWS D1.1, Section 6.1. Governing Building Code regulations shall not be construed as to alleviate either the Contractor's welding inspector of the Testing Agency from the welding inspection requirements of AWS D1.1. The Contractor's Quality Control Inspector shall be present during all shop and field welding operations, shall inspect the work as required by AWS D1.1, Section 6, shall possess and be familiar with all approved WPSs and shall cooperate with the Testing Agency.

D. Welding Inspection by the Testing Agency: All shop and field welding shall be inspected by a qualified and certified "Verification Inspector" as defined by AWS D1.1 Section 6.1, employed by the Testing Agency in accordance with AWS D1.1 Section 6 and in accordance with the Special Inspection Requirements of the governing Building Code. This inspector shall confirm the qualification of welders, the use of AWS qualified procedures, the manufacturer's recommended use of automatic equipment and the proper use of preheat. Inspection personnel shall be qualified for non-destructive testing at Level II as specified in Section 6, Paragraph 6.7 of AWS D1.1. The Testing Agency shall submit welding inspector qualifications to the engineer for approval. The Testing Agency shall submit a welding inspection checklist to the engineer for approval.

1. Welder Qualifications: All welders shall be qualified for the work in accordance with AWS D1.1, Section 5, Part C. Except as noted herein, the welders' qualification shall be considered as remaining in effect indefinitely unless there is a specific reason for questioning the welder's ability, in which case welder re-certification may be required. If in the opinion of the Architect, the welder is not suitable for the project, said welder may be disqualified from the project. Field Welders shall be qualified in all processes to be used on-site, in all positions, and on all thickness.

2. Equipment Electrical Meter Calibration Verification: The Contractor shall verify, to the satisfaction of the Testing Agency, that electrical meters are being used, and those in use accurately reflect voltage and amperage at the welding site for the length of cable in use.
3. Visual Inspection: Visually inspect all shop and field welding, including the superstructure, stairs, guardrails, and supports and/or bracing of finishes and non-structural components. Visual inspection shall be in accordance with AWS D1.1., Sections 5 and 6, and shall include verification of fit up, preheat, calibration of equipment, equipment settings, materials, adherence to approved WPS, interpass temperatures, deposition rates, technique, proper fusion of each pass, ensure the weld is crack free at each pass, confirm porosity and undercut do not exceed AWS requirements and confirm the final weld profile, and confirm that all special requirements specified herein are adhered to. Visual inspectors shall examine each step of the welding process.
4. NDT Ultrasonic Inspection: 100% of all complete joint penetration (CJP) groove welds and partial penetration groove welds shall be subject to ultrasonic testing. Ultrasonic testing shall be performed by a specially trained, qualified technician, who shall operate the equipment, examine the welds and maintain a record of all welds examined, defects found and disposition of each defect. All defective welds shall be repaired by the Contractor and re-tested with ultrasonic equipment, at the expense of the Contractor.
    a. The ultrasonic instrumentation shall be calibrated by the technician to evaluate the quality of the welds in accordance with AWS D1.1., section 6.18.
5. Welded Studs: Testing and inspection of steel studs welded to structural steel shall be in accordance with Section 7, Stud Welding, AWS D1.1.

E. Fabrication Inspection: All fabrication of structural steel shall be inspected by the Testing Agency. This inspection, in addition to the welding inspection requirements specified herein, shall consist of, but shall not necessarily be limited to, the following:
1. Visually inspect steel shapes and plates for existence of defects such as laminations and non-metallic inclusions. Use ultrasonic equipment and other NDT methods to determine extent of defects.
2. Verify steel materials with mill certificates, particularly where yield strength limits, grain size and/or toughness properties are specified in Section 2.01. Verify weld filler metal materials with certificates and manufacturers recommended limitations.
3. Review sections used for conformity to dimensional standards specified.

F. Erection Inspection: All erection of structural steel shall be inspected by the Contractor and the Testing Agency. Provisions under “Fabrication Inspection” and “Welding Inspection" shall apply.
1. All welding shall be inspected by the Testing Agency. Complete and partial penetration welds shall be ultrasonically tested per the provisions under “Welding Inspection.”
2. High strength bolting shall be inspected by the Testing Agency in conformance with the “Specification for Structural Joints using ASTM A325 Bolts” as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineered Foundation.

1.4 SUBMITTALS

A. Mill Test Reports: Contractor shall furnish certified copies of all mill analysis and test reports covering the chemical and physical properties of the steel for review by the Testing Agency and the engineer.

B. Certificates of compliance: Contractor shall submit certificates of compliance for bolts, welding electrodes, and shear studs.

C. Shop Drawings:

1. Contractor shall submit shop drawings showing anchor bolt layout, details of members, their connections, details of weld grove profiles, indication of size and spacing of bolts, and erection plans for the execution of the work showing the marking, and position of each member. Detail drawings shall indicate the position of each member on the framing plans. Shop drawings of details incorporating SR welds shall include explicit references to corresponding approved weld procedure specifications.
2. Submit under provisions of Section 01 33 00.

D. Bolts: Submit manufacturer's data for high strength bolts and direct tension indicator washers.

E. Review of submittals and shop drawings will cover only the general scheme and character of the details, but not the checking of dimensions, nor will such review relieve the Contractor from responsibility for executing the work in accordance with the contract drawings.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL MATERIALS

A. Structural Steel shapes and Plates: ASTM A572 Grade 50, typical unless noted.

B. Rolled steel W and WT sections: ASTM A992, Grade 50.

C. Channel and angle sections may be ASTM A36.

D. Rectangular HSS Sections: ASTM A500, Grade B—Cold Formed Structural Tubing.

E. Steel Pipe: ASTM A53, Grade B.

F. Round HSS Sections: ASTM A500, Grade B, Fy = 42 ksi, Fu = 58 ksi.

2.2 FASTENER PRODUCTS AND MATERIALS

A. A.Anchor Bolts for Columns: ASTM A307.

B. Machine Bolts: ASTM A307.

C. High-Strength Bolts: ASTM A325, Connection Type X, N or SC, as indicated on the Drawings.

D. Direct Tension Indicators: ASTM F959-94A for use with SC bolts.

E. Welded Steel Studs: ASTM A108, shear studs headed per Section 7, Stud Welding, AWS D1.1.

2.3 WELDING PRODUCTS AND MATERIALS

A. Arc-welding Electrodes: Filler metals shall conform to Table 4.1 of AWS D1.1. Electrodes and equipment settings shall be as recommended by the filler metal manufacturer for the position, thickness or other conditions of actual use. All electrodes and filler metals shall be low hydrogen types.

1. 1. Electrode wire diameter: FCAW wire diameter shall not exceed the values specified in AWS D1.1., Section 4.14.1.

B. Arc-welding equipment: Equipment for electric welding shall have calibrated meters for voltage and amperage that accurately indicate voltage and amperage quantities at the welding site for the length of the cable to be used. Contractor shall demonstrate to the satisfaction of the Testing Agency the accuracy of the meters, using external meters attached to extension cables of a length that reflects actual project conditions. If equipment meters do not accurately reflect electrical properties at the welding site, external meters shall be used at the welding site and shall be provided but the Contractor at the Contractor's expense.

2.4 COATING PRODUCTS AND MATERIALS

A. All interior steel items noted on the drawings as painted shall be according to the following specifications:

1. Steel Primer Paint: All interior steel shall be primed with "10-99 Tnemec primer," or "Rustoleum No. 5769 primer," or approved equal.
2. Final Paint, see architectural drawings and paint specifications.

B. Exterior Steel Retaining Wall Wide Flange Posts:

1. Steel Primer Paint: Tnemec Series 90-97 Tnemec-Zinc at 2.5 to 3.5 mils DFT, or equal meeting VOC requirements for BAAQMD of State Air Resources Board.
2. Steel Intermediate coating: Tnemec Series V69 Epoxoline at 4.0-6.0 mils DFT.
3. Steel Final coating: Tnemec Series 1075 Urethane finish at 3.0-5.0 mils DFT.
4. Color: Final color to be selected by Engineer, for pricing purposes use "Briquet" 49GR.

C. Shop Galvanizing: All items noted on the drawings or specifications as galvanized (all exterior steel U.O.N.) shall be hot dipped galvanized in accordance with ASTM A123. Thickness of galvanized coating shall be in conformance with ASTM A123.

D. Galvanizing repair compound shall be All State Galvanizing Powder, Drygalvo, by American Solder and Flux, or approved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship and details of structural steel work, unless otherwise specified, shall conform to Uniform Building Code and the AISCC Specification for Design, Fabrications and Erection of Structural Steel for Buildings. The quality of materials and the fabrication of all welded connections shall conform to the American Welding Society's Structural Welding Code, AWS D1.1.

B. The Contractor shall secure all field measurements necessary for the completion of this work. The contractor shall be responsible for all errors of detailing and fabrication and for the correct fitting of the structural members to each other and to their supports. Provide column anchor bolts and templates for setting under Section 77; this Section to verify location.

C. All materials both before and after fabrication shall be protected from rust corrosion and shall be kept free from dirt, grease and other foreign matter.

D. Each framing member shall be free from twists and bends. Holes and all cut and sheared edges shall be neatly made without kinks, butts, and warped edges. All steel left exposed shall be straight, smooth and free of nicks, scars and dents. Exposed welds shall be uniform and neat.

E. Installation of steel studs, headed for shear connectors and threaded for parts connectors, welded to structural steel, shall be in accordance with Section 7, Stud Welding, of AWS D1.1.

F. Holes for Bolts: Holes for bolts shall be 1/16 inch larger than the nominal diameter of the bolt. If the thickness of the material is not greater than the nominal diameter for the bolt plus 1/8 inch, the holes may be punched. Holes in thicker material shall be drilled from the solid or sub-punched and reamed. Holes for high-strength bolts shall have all burrs removed by grinding.

G. Column Bearing Surfaces: Column bases, as required by the AISC specification, and all column bearing surfaces shall be milled to a true plane perpendicular to the axis of the member to assure a complete bearing at the contact face.

H. Camber: All beams and girders shall be cambered if and as indicated on the Drawings.

I. Dimensional Tolerances: Fabrication and erection tolerances shall conform to AISC requirements except where closer tolerances are shown on the Drawings.

3.2 WELDING

A. Welded Connections: Where structural joints are made by welding, the details of all joints, the techniques of welding employed, the appearance and quality of welds made, and the methods used in correcting defective work shall conform to requirements of "Structural Steel for Buildings" of American Institute of Steel Construction and "Structural Welding Code" of the American Welding Society.

B. Qualification of Welders: Welding operators shall qualified by tests, as prescribed in the "Standard Qualification Procedure of the American Welding Society (AWS D1.1) to perform the type of work required, including process, position and thickness. All welders shall be capable of reading and following the approved written WPS.

C. General Requirements: All welding shall conform to the following:

1. Equipment: Use equipment which will supply proper current, voltage, etc., as recommended by the manufacturer of electrodes to be used, adjusted to suit arrangement and thickness of base metal. Suitable meters and means of adjustment shall be provided for current and voltage

2. Preparation for Welding: All surfaces shall be clean, free of rust, paint and foreign matter of any kind. Scale shall be removed by wire brush, chipping or hammering as required. Thermal cut edges to be welded shall be chipped clean, and ground at least 1/32 inch to bright metal before welding. Clamp members as required, space and alternate welds all as may be necessary to prevent warping or misalignment.

3. Fitup: Weld joint profiles shall meet dimensional requirements and maximum tolerances specified by AWS D1.1 or as specified in approved Qualification Procedures. Joint fitup that does not comply shall be corrected using approved procedures and approved by the inspector before welding proceeds.

4. Preheat/Interpass/Postheat: Provide minimum preheat and interpass temperatures and Post-heat/Cool Down procedures as required by AWS D1.1, unless otherwise specified herein. Deposition rates shall be controlled to be within minimum and maximum interpass temperatures.

5. Weld Quality: Welds shall present a uniform surface, free of imperfections as defined by AWS, and without undercutting or over-lapping and free of excessive oxides, gas pockets and non-metallic inclusions. Welds shall be made with the proper number of beads or passes to secure sound, thoroughly fused joints. Each deposit shall not exceed 5/16 inch of weld for each pass, nor shall each deposit exceed maximum layer height and bead width specified in AWS D1.1. Each pass shall be cleaned by chipping and wire brushing to remove scale and slag, before placing any additional weld metal.

6. Sequence of Welding: For highly restrained connection and/or weldments, the sequence of welding shall be designed to minimize distortion of the members and to minimize the buildup of internal stresses.

7. Filler Metal: Filler metal shall conform to Table 4.1 of AWS D1.1. Weld metal shall be thoroughly fused with the base metal along all surfaces and edges of the union. Penetration shall be 1/16 inch minimum and shall be into the root of the joint.

D. Faculty and Defective Welding: Any welding performed without inspection or contrary to the approved WPS, or showing cracks, slag inclusion, lack of fusion, undercut or other defects as defined by AWS, ascertained by visual or other means for inspection, shall be chipped out and properly replaced by the contractor, and re-inspected by the Testing Agency, all at the Contractor's expense.

3.3 ERECTION

A. Field Connections: Workmanship of field bolted and welded connections shall conform in all respects to methods and tolerances specified for fabrication. Holes shall be cut, drilled or punched to a diameter 1/16" larger than the bolt holes, UON. Holes shall not be burned or enlarged by flame cutting.

B. All bolted connections shall conform to the AISC and shall use high strength threaded fasteners, UON. High Strength bolted connections shall be made in conformance with the "Specification for Structural Joints using ASTM A325 , heavy hexagonal structural diameter, approved by Research Council of Riveted and Bolted Joints of the Engineering Foundation."

C. Tighten nuts using wither "Calibrated Wrench" method, "Twist off Element" method, "Turn-of-Nut" method, or by the use of a "Direct Tension Indicator". Minimum bolt tension as per applicable standard ISC "Specification for Structural Joints using ASTM A325 or A490 Bolts" for each bolt type and size used. Washers may be omitted for ASTM A325 bolts when "Turn-of-Nut" method is used.

D. Column anchor bolts shall be furnished under this Section and set under Section 77, Structural Cast-in-Place Concrete. Anchor bolts shall be Heavy Hex Head ASTM F1554-55 ksi yield strength. Provide washers under nuts and heads.

E. Metal templates shall be furnished with bolts for setting of all column anchor bolts. The Contractor shall furnish instructions for the setting of anchor bolts and shall ascertain that the items are properly set during the progress of the work.

F. Column base plates shall be set level to correct elevation, and temporarily supported until the supported members has been plumbed and the column base plate grouted. The entire bearing area under plates shall be grouted solid under Section 03 30 00 Cast-in-Place Concrete with non-shrink grout placed in strict accordance with the manufacturer's recommended procedures for 28-day minimum ultimate compressive strength of 5,000 psi.

3.4 FRAMING AND BRACING

A. All structural steel shall be erected true and plumb. Temporary shoring and bracing shall be used wherever necessary and shall be adequate for all loads to which the structure may be subjected, including wind and erection equipment and operation of same. Leave temporary bracing and shoring in place as long as may be required for safety, and until final framing construction is completed.

B. No final connections shall be made until the structure has been properly aligned. All temporary flooring, planking and scaffolding necessary in connection with the erection of the structural steel, or support of erection machinery shall be provided as part of the erection work. The temporary floors and scaffolding shall conform to the requirements of all laws governing safety regulations.

C. Drifting done during assembly shall not distort the metal or enlarge the holes. Mismatching of holes greater than 3/32 inch shall require reaming for the next larger bolt. Mismatching of holes greater than 1/8 inch shall be cause for rejection.

3.5 SHOP PAINTING

A. General: Shop prime all structural steel work except members or portions of members to be fireproofed or embedded in concrete. Prime embedded steel that is partially exposed on the exposed portions and the initial 2" of embedded areas only. Do not prime contact surfaces that are to be welded or high-strength bolted with friction-type connections or top flanges of beams to which metal decking will be welded.

   1. Apply two coats of primer to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

B. Surface Preparation: After inspection, clean all steel work to be primed and prime before shipping from the shop. Remove loose rust, mill scale and spatter, slag or flux deposits. Clean all steel, including steel to be fireproofed or embedded in concrete as follows:

   1. Clean steel in accordance with Steel Structures Painting Council's "Painting Manual" for Solvent Cleaning (SSPC-SP 1) and either Hand Tool Cleaning (SSPC-SP2) or Power Tool Cleaning SSPC-SP3).

C. Also refer to Part 2.4 – Coating Products and Materials

3.6 FIELD TOUCH-UP PAINTING

A. After installation, all field welds and areas in which shop painting has been disturbed shall receive surface preparation as specified for shop painting.

3.7 DEFECTIVE WORK

A. Work found to be defective, missing or damaged shall immediately be replaced with proper work. Such replaced work and the inspection for it shall be at the expense of the Contractor.

B. Straightening of any material, if necessary, shall be done by a process and in a manner that will not injure the materials, and which is approved by the Architect. Sharp kinks or bends shall be cause for rejection. Heating will not be allowed.

C. De-lamination and other rolling defects in structural shapes and plates shall be cause for rejection when, in the judgment of the Architect, repairs are not feasible or acceptable.

D. If defects or damaged work cannot be corrected in the field, the material shall be returned to the shop, new parts furnished, as the Architect directs; the Contractor shall replace all work at his own expense.

E. Beams supporting metal deck that are not in alignment or at the right elevation shall be changed to suit proper support conditions of the metal deck.

F. Welds completed, or in process, that do not conform to the approved Welding Procedure Specification may be considered defective and shall be repaired at the Contractor's expense.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metal fabrications, miscellaneous metal, and related accessory items, galvanized and prime painted, complete, as indicated and specified. The work includes, but is not limited to, the following:
   1. Steel railings, guardrails, handrails, brackets and sockets.
   2. Steel framing for ceiling-hung equipment items.
   3. Chain downspouts.
   4. Channel framing system.
   5. Steel floor plates at Blacksmith Shop.
   6. Miscellaneous steel framing, supporting angles, plates, brackets, clips, anchors and bolts for equipment, and other work which is not specifically included in other Sections, but required to complete the Project.

B. Related Sections:
   1. Document 00800 - Special Conditions.
   2. Section 03 30 00 - Cast-in-Place Concrete.
   3. Section 09 91 00 - Painting.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings of all fabricated items for review before fabrication and installation. 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.

B. Product Data:
   1. Submit manufacturer's product data for all standard pre-manufactured items.
   2. Paints and Coatings: Submit manufacturers product data for field-applied paints and coatings, including printed statement of VOC content and chemical components. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.

C. Samples: Submit samples of finishes, if requested by Engineer.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. General: Conform to California Building Code (CBC), 2010 Edition.
   2. Handrails and Guardrails: Fabricate and install to meet ASTM E985 and CBC requirements to withstand a minimum concentrated live load of at least 200 pounds or a minimum uniformly distributed live load of 50 pound/feet per foot of rail applied to the top

of the railing system, in both horizontal and vertical downward directions, whichever is greater.

3. Accessibility: Conform to California Building Code, and Americans with Disabilities Act (ADA) "Accessibility Guidelines for Buildings and Facilities" (ADAAG).
4. Welders' Qualifications: Qualified in accordance with AWS D1.1.
5. Paints and Coatings: Conform to CCR Title 24, Part 11 (CALGreen), Section 5.504 "Pollutant Control".

B. Standards: Comply with the following applicable standards:
1. American Institute of Steel Construction (AISC): "Specifications for the Design of Cold-Formed Steel Structural Members."
2. American Welding Society (AWS) D1.1-00 "Structural Welding Code - Steel".
3. National Association of Architectural Metal Manufacturers (NAAMM):
   a. "Pipe Railing Manual".
4. SSPC: The Society for Protective Coatings (SSPC): "Steel Structures Painting Manual, Systems and Specifications".

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store steel materials, either plain or fabricated, above ground on platforms, pallets, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

1.05 PROJECT CONDITIONS

A. Existing Conditions: Make all field measurements as required prior to fabrication and installation.

B. Scheduling and Sequencing: Coordinate with other trades to ensure proper sequencing and fitting of construction. Furnish information and assistance required for locating embedded items.

C. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordination of installation.

PART 2 - PRODUCTS

2.01 BASIC MATERIALS

A. Ferrous Metals:
1. Recycled Content of Steel: Provide products with an average recycled content so post-consumer recycled content plus one-half of preconsumer recycled content is not less than the following.
2. Steel Plates, Shapes, and Bars: ASTM A36; hot-dip galvanized for exterior use in accordance with ASTM A123. Provide channels, angles and shapes with 60 percent recycled content. Provide plates and bars with 25 percent recycled content.
3. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304.
4. Stainless Steel Bars and Shapes: ASTM A276, Type 304.

5. Steel Tubing: ASTM A500, Grade B cold-formed steel tubing. Provide with 25 percent recycled content.
5. Steel Pipe: ASTM A53, Type S, Grade A, standard weight, hot-dip galvanized after fabrication for exterior use. Provide with 25 percent recycled content.
    a. Thickness: Schedule 40, unless otherwise indicated; schedule 80 for railing posts.
    b. Diameter: 1-1/4-inch UPS (1.66-inch O.D.) for railings and handrails, unless otherwise noted.
6. Stainless Steel: ASTM A167, Type 301, 302, 304, or 316, cold-rolled, square edges.
7. Cast Iron: ASTM A48, Class 30, unless otherwise indicated or required by load.

B. Fastenings:
1. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and for fastening aluminum; and zinc-plated fasteners with coating complying with ASTM B663, Class Fe/Zn 5 at exterior walls. Select for type, grade, and class required.
2. Steel Bolts, Nuts, and Washers: ASTM A307, Grade A, regular hexagon-head bolts; with ASTM A563 hex nuts; and flat washers where indicated.
3. Stainless Steel Bolts and Nuts: ASTM F593 regular hexagon-head annealed bolts; ASTM F594, Alloy Group 1 for nuts; and flat washers where indicated.
4. High-Strength Bolts, Nuts, and Washers: ASTM A325, friction or bearing type, with threads in shear plane.
5. Anchor Bolts: ASTM F1554, Grade 36. Provide hot-dip zinc-coated anchor bolts where item being fastened is indicated as galvanized.
6. Eye Bolts: ASTM A489.
7. Expansion Anchors for Use in Concrete: Type 316 stainless steel. Conform to ACI 318, Appendix D.
8. Welding Materials: AWS D1.1; type required for materials being welded.

C. Nonshrink Metallic Grout at Interior Dry Locations: ASTM C1107, factory-packaged, ferrous-aggregate grout; Master Builders "Embeco No. 885 Grout", Conrad Sovig's "Metal-Mxs Grout", Sonneborn's "Ferrolith G Redi-Mixed Grout", Upco's "Upcon", or equal.

D. Nonshrink Nonmetallic Grout: ASTM C1107, factory-packaged, nonstaining, noncorrosive, nongaseous grout specifically recommended by manufacturer for interior and exterior applications.

E. Epoxy Anchoring Grout: ASTM C881; VOC compliant, 100 percent solids, high modulus, high strength, epoxy grout; Dayton-Superior "Sure-Anchor Epoxy", E-Poxy Industries "Eva-Pox Mortar Mix", or equal.

F. Universal Shop Primer at Interior Non-Exposed Steel: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79; Tnemec "Series 10", Rust-Oleum, or equal.
1. Use primer with a VOC content of 350 g/L or less when calculated according to 40 CFR 59, Subpart D.

G. Zinc-Rich Primer at Exposed Steel: SSPC-Paint 20 or SSPC-Paint 29, and compatible with topcoat; Tnemec "Tneme-Zinc 90-97, Carboline "Carbozinc 621", or equal.
1. Use primer with a VOC content of 340 g/L or less when calculated according to 40 CFR 59, Subpart D.

H. Bituminous Paint: ASTM D1187, cold-applied asphalt emulsion.

2.02 MANUFACTURED PRODUCTS

A. Metal Channel Framing System:
   1. Manufacturers: Unistrut Corp. "Unistrut P-1000 Series", Grinnell Supply Sales Co. "Power-Strut", Thomas & Betts Co. "Super Strut", or equal.
   2. Description: 1-5/8-inch wide x 12-gage steel channel framing system. Provide system complete with bolts, spring-loaded nuts, washers, end caps, angles, suspension rods, seismic sway bracing, attachment clamps, and other accessories as required.
   3. Finish: Pre-galvanized to G-90 finish in accordance with ASTM A924.

2.03 FABRICATION - GENERAL

A. Verify dimensions on site prior to shop fabrication. Coordinate all metalwork with adjoining work for details of attachment, fitting, etc. Be responsible for all fabrication detailing and correct fitting of steel members to each other and to their supports.

B. Fit and shop assemble in largest practical sections, for delivery to site and handling through building openings. Fabricate items with joints tightly fitted and secured. Make exposed joints butt tight, flush, and hairline.

C. Welds: Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design, except where specifically noted otherwise.

E. Provide components required for anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.

2.04 FABRICATED ASSEMBLIES

A. Steel Handrails: Comply with NAAMM "Pipe Railing Manual", unless otherwise indicated.
   1. Form from 1-1/2 inch diameter steel tubing, with welded jointing, unless otherwise noted. Fabricate right-angle and 45 degree bends with 3-inch radius to center line of tubing without flattening the tubing noticeably.
   2. Ends: Provide bend returns at free ends of handrails to 1/2 inch from face of wall with end caps at free ends of handrails and railings. Weld all joints, end caps, returns, and transitions. Grind smooth and make flush.
   3. Fittings, Elbows, Tee-shapes, and Escutcheons: Machined steel. Provide splice connectors of steel welding collars.
   4. Handrail Extensions: Provide at edges of stairs to comply with CBC and ADAAG requirements for accessibility.
   5. Mounting Brackets and Flanges: Provide for secure anchorage of handrails and railings.
   6. Finish: Hot dip galvanized at exterior locations.

B. Sunshade Frame and Supports:
   1. Steel Shapes: ASTM A36 steel.

2. Steel Tubes: ASTM A500 Grade B steel tubing.
3. Steel Tension Rod and Fittings: Galvanized steel rod, 67 ksi yield strength, size as indicated on Drawings. Provide galvanized steel threaded-end jaw fittings, with bolt holes, stainless steel bolts, locknuts, and accessories, complete; TriPyramid, or equal.
4. Sunshade Wood Screen: Refer to Section 06 20 00.
5. Frame Finish: Hot-dip galvanized and factory prime painted after fabrication, for field finish painting.
6. Mock-up required.

C. Steel Chain and Brackets at Roof Downspouts:
1. Brackets: ASTM A36 steel, ungalvanized.
2. Chain: ASTM A413 - Carbon Steel Chain, Grade 30 - Proof coil chain.
3. Chain Size: Nominal 3/8-inch diameter x 1.38 inch link inside length, unless otherwise indicated.

D. Steel Floor Plates at Blacksmith Shop:
1. Plate Material: ASTM A36 steel, ungalvanized, 1/4 inch thick unless otherwise noted.
2. Attachment Screws: Flat head steel wood screws, countersunk flush.

2.05 FINISH

A. Cleaning: Thoroughly clean all mill scale, rust, dirt, grease, and other foreign matter from ferrous metal prior to any galvanizing, hot-phosphate treatment, or painting.
1. Remove oil, grease, and similar contaminants in accordance with SSPC SP-1, "Solvent Cleaning" using biodegradable detergent or steam cleaning method prior to any other surface preparation and priming.
2. Remove scale, rust, and other deleterious materials before applying shop coat in accordance with SSPC SP-2, "Hand Tool Cleaning"; SSPC SP-3, "Power Tool Cleaning"; or SSPC SP-7, "Brush-Off Blast Cleaning."

B. Galvanizing: Provide a zinc coating for all exposed exterior items and items embedded in concrete, complying with the following:
1. ASTM A153 for galvanizing iron and steel hardware.
2. ASTM A123 for hot-dip galvanizing of rolled, pressed, and forged steel shapes, plates, bars, strips, and steel assemblies 1/8-inch thick and heavier.

C. Shop Priming: Shop-paint miscellaneous metalwork, except members or portions of members to be embedded in concrete, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise specified.
1. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's instructions and at a rate to provide uniform dry-film thickness of 2.0-mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.
2. Apply one shop coat to fabricated metal items, except apply two coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the conditions in which the Work is to be installed. Verify alignment of items with adjacent construction. Coordinate with related work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchor, which are to be embedded in concrete construction. Coordinate delivery of such items to project site.

B. Coordinate metalwork with adjoining work. Do all cutting, shearing, drilling, punching, threading, tapping, etc., required for miscellaneous metal or for attachment of adjacent work. Drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces.

C. Obtain Engineer's review prior to site cutting or making adjustments to structural members not scheduled.

D. Clean and strip steel to bare metal where site welding is required.

E. Make provision for erection loads with temporary bracing. Keep work in alignment.

3.03 INSTALLATION

A. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction, including threaded fasteners for concrete inserts, through bolts, lag bolts, screws, and other connectors as required.

B. Fit exposed connections accurately together to form tight hairline joints. Conceal all fastenings where practical. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Form joints exposed to weather to exclude water.

C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Provide temporary bracing anchors in formwork for items which are to be built into concrete or similar construction.

D. Field Welding:
   1. Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
   2. Field weld connections which cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop-paint coat.
   3. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

E. Handrails: Secure steel handrails with bracket specified. Unless otherwise noted, locate brackets 6 inches from ends of handrail, 6 feet on center maximum, and space brackets

equidistant at each handrail. Where bracket is fastened to stud wall, provide fire-retardant-treated wood blocking or steel plate backing securely fastened to studs; toggle bolt secured to gypsum wallboard is not acceptable.

F. Protect dissimilar metals from galvanic corrosion by pressure tapes, coating, or isolators as acceptable to Architect.

G. Grout frames, plates, sills, bolts, and similar items with nonshrink grout.

3.04 CLEAN AND TOUCH-UP

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas and paint exposed areas with same material as used for shop painting to comply with SSPC-PA1 for touching up shop-painted surfaces. Apply by brush or spray to provide a minimum 2.0-mil dry-film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

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SECTION 05 58 30

CUSTOM STAINLESS STEEL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Custom stainless steel fabrications, miscellaneous metal, and related accessory items, complete. The work includes:
   1. Free-standing stainless steel tables, sinks and counter tops.
   2. Miscellaneous supporting angles, plates, brackets, anchors, bolts, and components required to complete the work.

B. Products Supplied But Not Installed Under This Section: Sink drain fittings.

C. Related Sections:
   1. Section 05 50 00 - Metal Fabrications.
   2. Section 07 92 00 - Joint Sealants.
   3. Division 22 - Plumbing: Connection of plumbing work.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and catalog cuts of each product to be furnished.

B. Shop Drawings: Submit shop drawings for each item of custom stainless steel work. Include plans, elevations, sections, and details as required to illustrate shop fabrication, field assembly, and installation. Show size and locations of all cutouts. Identify all manufacturer's standard components with catalog numbers, and identify all materials of custom-fabricated items.

C. Samples: Submit samples of the following:
   1. Stainless Steel Top: 8 x 10 inch size with specified finish and edge treatment.

1.03 QUALITY ASSURANCE

A. Manufacturer/Fabricator Qualifications: Custom stainless steel fabrications specified other than by name and catalog number shall be manufactured by a fabricator with at least five (5) years' experience in this type of work, who has the plant, personnel, and engineering facilities to properly design, detail, and manufacture custom stainless steel fabrications.

B. Standards: Comply with the following applicable standards.
   1. American Welding Society (AWS), "Structural Welding Code D1.1."
   2. ASTM International (ASTM).
   3. National Sanitation Foundation (NSF).

B. Coordination: Make all field measurements, and verify all dimensions prior to fabrication. Coordinate with other trades to ensure proper sequencing and fitting of construction. Fabricate all equipment so that it may be handled through finished door openings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The fabricator shall be fully responsible for shipping and shall bear shipping expense, retain title during transit, and file damage claims as necessary.

B. Store materials in a secure and protected area until installation is complete. Damaged or defective materials or assemblies will not be accepted and shall be replaced at no cost to the City.

C. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

1.05 SITE CONDITIONS

A. Coordinate with plumbing work for proper sizing, location, and sequence of construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:
   1. Concealed Metal: Steel or wrought-iron sections, galvanized by the hot-dip process after fabrication.
   2. Gages: U.S. standard gage.
   3. Extrusions: Free of tool or construction marks, dents, or other imperfections.
   4. Finish: At the completion of the work, all metal shall be gone over with a portable machine and buffed and dressed to a uniform finish.

B. Stainless Steel Sheet: ASTM A167, corrosion resistant, nonmagnetic, Type 304 or 316 Series; gage as indicated, with a tolerance of +/- 0.05 percent in gage thickness; #4 finish of 180 grit on exposed work.

C. Stainless Steel Pipe: ASTM A167 and A269, Type 304, cold-rolled, seamless, No. 4 finish.

D. Bolts, Screws, Rivets, and Fasteners:
   1. To Galvanized Work: Galvanized steel or brass.
   2. Exposed Fasteners: Finished to match adjacent surfaces, flush and buffed smooth.

E. Sound-Deadening Mastic: H.W. Mortell Co., Kankakee, Illinois, or equal. Spray on by use of mechanical device to minimum thickness of 1/8-inch.

F. Sealant: Silicone type, clear color, as specified in Section 07 92 00.

G. Drain Fittings: Stainless steel crumb cups, tailpieces, and sliding gate valves, along with sinks provided. Units shall fit standard 3-1/2-inch drain openings. Forged brass fittings are not acceptable.

2.02 FABRICATION

A. Welding: Electric-arc type process, then ground smooth and polished to match #4 finish. Grind free of fractures and air sport. All raw edges shall be ground smooth. Soldering of required field joints not permitted.

B. Welded Parts: Nonporous and free of imperfections. Welds of galvanized metal on tables and sinks shall be ground smooth, sandblasted, and sprayed with molten zinc at 1,200 degrees F. to a thickness of 0.004-inch. Tinning is not acceptable. Welds of stainless steel shall be ground and polished to the original finish.

C. Pipe Stands and Frames: Unless otherwise noted, construct pipe stands for open base tables and sinks of seamless stainless steel tubing. Joints shall be welded and ground smooth. Flattened ends on tube stretchers are not permitted. Provide stretchers front to back and across the back between all legs, except where a shelf occurs. Unless otherwise noted on Drawings, tubing for legs, stretchers, and braces shall be 1-1/2-inch diameter x 16-gage.

D. Counter, Sink, and Table Tops:
   1. Thickness: 14-gage stainless steel, unless otherwise noted, with all seams and corners welded, ground smooth, and polished.
   2. Reinforce working tops of closed-base fixtures on the underside with a framework of 1-1/2 inch angles or 16-gage hat sections on open pipe stand frames with 4 inch channels at each pair of legs. Reinforce tops so that there will be no noticeable deflection. Stud weld reinforcements to the underside of the top.
   3. The leg sockets shall be welded to this channel, and the channel in turn shall be secured with nuts and lock washers to stud bolts which have been welded to the top.
   4. Provide one channel runner, running lengthwise at midpoint, on all tops up to 30 inches wide. Provide two runners at third point on all tops over 30 inches wide.
   5. Edges: Unless otherwise shown on the detail drawings, metal tops shall be turned down 3 inches, back 1 inch, and up 1/2 inch, except where adjacent to walls or other pieces of equipment. The wall side shall be turned up 12 inches, unless otherwise noted. Ends of splashes shall be closed, and the space between wall and splashed at junctions shall be sealed with sealant. Free corners of tops shall be rounded.
   6. Apply sound-deadening mastic to the underside of all tops.

E. Undershelves on Open-Base Tables:
   1. Thickness: 16-gage stainless steel, unless otherwise indicated.
   2. Edges: Flanged 2 inches down and 1/2-inch to return. Weld the corners to the legs. Turn up back of shelves 4 inches where indicated.

F. Sinks and Drainboards:
   1. Thickness: 14-gage stainless steel, unless otherwise indicated. Working edges of sinks shall be provided with 1/2 inch radius sanitary rolled edges in one piece with rounded corners. Drainboards shall be made as an integral part of the sinks.
   2. Vertical and horizontal corners shall be rounded with 1/2 inch radius, and the working front edges shall be maintained at one level, taking up the pitch the drainboards by dropping the sink bowl to allow for same. Depth of sink bowl shall be determined from the top of the bowl.
   3. Sinks and drainboards shall be provided with a backsplash and end splash with top edge flanged back 1 inch and attached to the wall with a 14-gage, galvanized iron, continuous

clip secured to wall at 24 inches on center. Backsplash of sinks and adjacent drainboards within same fixtures shall all be grained in the same direction.

4. Cut suitable openings for hot- and cold-water supplies and waste outlets. Provide surface plumbing trim as called for on the Drawings and herein.
5. Sink bowls shall be made individually, having four sides and bottom, welded together and capped on the front, bottom, and completely up the back, making verminproof by welding a 14-gage x 2 inch wide flush stainless steel trim band across the joint. All corners, including the bottom, shall be rounded. Sink bowls shall be provided with an overflow connection placed at the back of and 2 inches below the top line of the bowl. Bottom of sink bowl shall have a center drain connection fitted with a 2-inch lever-type action waste valve with a satin finish, stainless steel lever, unless otherwise specified. This waste valve shall be constructed of cast brass and furnished with a chrome-plated, removable, perforated, and reversible "Beehive" strainer. Waste valve shall be mounted into sink in an approved manner, absolutely watertight, and the bottom left with 2-inch male thread.
6. Grind smooth all welding, and score bottom of sink to the center of drain.
7. Spray apply 1/8 inch thick sound-deadening mastic to underside of sink bowls and drainboards; apply in one, even, smooth application for ease in cleaning.

2.03 SHOP OBSERVATION

A. Fifteen (15) days prior to completion of the shop fabrication of stainless steel fabrications, notify the Engineer so that review of items may be arranged prior to delivery to the jobsite. Failure to comply with this requirement will be cause for rejection of the fabricated items on delivery at the jobsite.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrates and conditions under which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Provide a competent and experienced superintendent to supervise, coordinate, and expedite work continuously.

B. Uncrate items and anchor or fasten to floors or walls, as required, complete, ready to receive final utility connections.

C. Perform all necessary cutting, drilling, and fitting required to accommodate electrical outlets and fixtures, plumbing, and other work required for connection to utilities.

D. Where abutting, curved, or irregularly shaped angles or projecting corners of wall occur, assemble items in a group. Provide all necessary fillers or connecting pieces as may be required to make a complete, sanitary, and vermin-proof group. Where assembled items may be too large to be brought into the space, assemble items in the space.

E. Set all items in place, level and true.

F. Buff and dress all finished stainless steel with portable machines to remove any scratches.

3.03 CLEANING

A. Prior to final acceptance, clean all items thoroughly of all stains, spots, protective wrappings, coating, tape, dust, and polishing compounds. Remove all shipping materials from the Project site.

END OF SECTION

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SECTION 06 10 00

ROUGH CARPENTRY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included: Rough carpentry, light hardware, and miscellaneous items of work not included in another Section. This Section also includes:

1. Structural wood supports, grounds, backing, and blocking required for millwork and casework items and which are an integral part of wall, floor and/or ceiling construction.
2. Wood cants, stops, and nailers for roof as may be required.
3. Wood blocking, backing, and nailers for flashings and sheet metal work.
4. Plywood backboards for electrical equipment.
5. FSC 2x wall framing lumber (Note: Shear walls shall be 3x framing).
6. Reclaimed 2x wall framing lumber (Note: Shear walls shall be 3x framing).

B. Related Work Specified Elsewhere:

1. Cast-in-Place Concrete Section 03 30 00.
2. Finish Carpentry Section 06 20 00.
3. Architectural Woodwork Section 06 40 00.
4. Thermal Insulation Section 07 21 00.
5. Joint Sealants Section 07 92 00.
6. Access Doors and Panels Section 08 31 00.
7. Door Hardware Section 08 71 00.
8. Non-Structural Metal Framing Section 09 22 16.

1.2 REFERENCES, CODES AND STANDARDS

The following references, codes and standards are hereby made a part of this Section and carpentry work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained herein shall be construed as permitting work that is contrary to code

requirements.

A. "Standard Grading and Dressing Rules #17," of the West Coast Lumber Inspection Bureau, Current Edition, with current supplements.

B. "Western Lumber Grading Rules," of the Western Wood Products Association, current edition, with current supplements.

C. "Plywood Design Specification" PS1, American Plywood Association, Current edition.

D. American Wood Protection Assn. (AWPA) UCS Standard, "User Specification for Treated Wood U1-11".

E. American Wood Protection Assn. (AWPA) UCS Standard "Processing and Treatment Standard T1-11".

F. American Wood Preservers Bureau (AWPB) Quality Control Standards.

G. Factory Manual "Loss Prevention Data No. 1-49-Perimeter Flashing", latest edition.

H. California Building Code, Current Edition, Chapter 23.

1.3 QUALITY ASSURANCE:

A. Lumber and plywood shall be grade or quality marked by WWPA, WCLIB, APA, AWPA, or by other grading and inspection agencies acceptable to the Engineer. Grade marks shall include the designation "S-DRY" (or "MC-15" as applies) where applicable. Grade and quality marks shall not be apparent on surfaces exposed in the finish work.

B. The stamped end of all graded reclaimed framing lumber shall be left intact and cuts shall be made from the opposite end.

1.4 PRODUCT STORAGE

Store kiln dried materials, in enclosed areas, protected from moisture and separated from contact with concrete or soil.

1.5 SUBMITTALS

A. Provide documentation certifying that wood products were obtained from forests verified by an FSC accredited certification body. Include statement indicating costs.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Temporary Construction: Clean lumber at Contractor's option, rough or smooth as usage requires, strength as required for purpose.

B. Forest Stewardship Council (FSC) Certified: All wood shall be FSC Certified and shall be obtained from forests verified by an FSC accredited certification body.

C. Reclaimed Lumber: At Contractor's option Reclaimed Lumber Graded No. 2 or better, supplied by the City, can be used.

D. Framing Lumber Not Otherwise Specified or Noted: Douglas Fir or Larch graded and grademarked according to Reference Standard 1.02 A or B. Maximum bow, crook, and cup shall be as established by WWPA Para. 752.00 for "Light" or better.

Item	Grade	Reference (WCLIB)
Studs	See drawings	
Beams 4x and Larger	No. 1	123 (c) and 130 (b)
Joists and Rafters	No. 2	123 (c)
Posts and Columns	No. 1	131 (b)
Other members	No. 2	123 (d)
Reclaimed 2x Wall Framing	Graded, Use No. 2 or better. (Not for Shear Walls (3x required))	

1. Boards: Construction Grade.

2. Sill Plates (on Concrete or Concrete Masonry): Construction Grade Light Framing, pressure treated as hereinafter specified.

E. Plywood: Each panel shall be identified with the appropriate grade-trademark of the American Plywood Association (APA) and shall meet the requirements of Reference Standard 1.02C.

1. Miscellaneous Not Otherwise Specified (Concealed): CD or better and free of defects, which would adversely affect finish materials.

2. Miscellaneous (Exposed): "A" face or better.

3. Exterior plywood, interior plywood exposed to continuing moisture, and pressure treated plywood shall be fabricated with exterior glue. Plywood with interior glue shall be fully protected from soaking or continuing moisture at all times and shall not be used for any structural purposes.

4. Roof and Wall Sheathing not noted as "Structural I": APA Rated Sheathing CD, Exposure 1 with proper span rating. Wall sheathing under cement plaster shall have a 24/0 or Wall-24 span rating for framing at 16" O.C. and a minimum 24/0, 7/16" or thicker for framing 24" O.C.

7. Roof and Wall Sheathing noted as "Structural I": Structural I-CD, all veneers Group 1 species.

F. Rough Hardware:

1. Bolts and Nuts: ASTM A 307 (a) and A 563 (a), Grade A.

2. Lag Bolts: Fed. Spec. FF-B-561.

3. Nails: Fed. Spec. FF-N-101, common unless otherwise noted or specified.

4. Powder Actuated Fasteners: Hilti, Simpson Strong Tie, or approved equivalent, unless otherwise noted, galvanized.

5. Joist Hangers and Framing Connectors: Simpson, USP Connectors, or approved equivalent, unless otherwise noted, galvanized.

6. Round Plate Washers: ASTM F844, Current Edition.

7. Expansion Bolts: Simpson Strong Tie, Hilti, or approved equivalent. See also Section 03255 – Expansion Anchors

8. Self Tapping Screws: Chromed finish screws or stainless steel screws.

9. Self Drilling Screws: Simpson Strong Tie SDS wood screws, or approved equivalent.

G. Pressure Treatment (Decay and Termite Prevention):

1. Pressure treat for decay and termite prevention, wood materials, which are embedded in or set against concrete, masonry, plaster, or roofing, or where otherwise exposed to continuing dampness or moisture required by California Building Code. Where materials are also required to be treated for fire retardance, fire retardant shall be in lieu of decay and termite treatment.

2. Treat in accord with Reference Standard 1.02 D and E quality marked as per Reference Standard 1.02 F.

3. Treat with either of the following processes at Contractor option except do not use waterborne salts where wood is in contact with built-up roofing and other bituminous products. Creosote type preservatives are not permitted.

   a. Alkaline Copper Quatenary (ACQ) 0.6 retention or ACZA.

   b. Members treated with waterborne salts shall be dried to a moisture content not exceeding 19% after treatment.

4. Where possible, pre-cut material before treatment.

5. Holes and cut-offs and handling and storage shall be in accord with AWPA M-4.

6. Ensure that ferrous metal fastenings and items in contact with wood treated with waterborne salts are hot dip galvanized (1.25 oz. coating).

2.2 MOISTURE CONTENT:

At time of closing in: 15% maximum for 2x thickness or less; 19% maximum for thickness greater than 2x, and 22% maximum thickness greater than 4x.

2.3 SIZES:

Surfaced to "Dry" sizes. Sizes noted are nominal unless shown as net.

2.4 SURFACING:

S4S unless noted or specified elsewhere.

PART 3 - EXECUTION

3.1 ERECTION AND INSTALLATION:

A. Bridging and Blocking: Conform to CBC Sections 2308.8.5, 2308.9.3, 2308.9.3.1, 2308.9.3.2, 2308.9.4.1, 2308.9.4.2 and 2308.10.6. Provide 2x blocking at intersections of finished surfaces for adequate bearing and at points where required for internal support of fixtures, cabinets, hardware, and other equipment suspended from ceiling or mounted on walls. Provide fireblocking and draftstopping as per CBC Section 717. Provide vent holes in blocking at concealed areas per the Drawings as required.

B. Connections and Fastenings: Conform to Section 2304.9, California Building Code, unless otherwise specified or shown on the Drawings, conform to minimum nailing requirements of Table 2304.9.1. For bolted connections, provide washers under heads and nuts bearing on wood, and draw nuts tight. Retighten before closing in framing.

C. Coordinate with Roofing Section and provide treated cants, stops, blocking and nailers for rigid insulation, roof drains and flashings in accord with roofing manufacturer's requirements. Fit cant strips flush at ends and to wall surfaces corner mitered.

D. Wood cants, blocking, backing, and nailers for perimeter sheet metal flashings shall be anchored in accord with recommendations contained in Reference Standard 1.02 G.

E. Sill Plates: Sill plates on concrete shall be pressure treated (decay and termite) Douglas fir or Larch. Unless otherwise noted, plates shall be attached with a minimum of 5/8" diameter steel anchor bolts at a maximum spacing of 4'-0" O.C. with a minimum of two bolts per piece of sill plate and a bolt located not more than 12" or less than 4" of each end of each piece.

F. Framing: Conform to CBC Sec. 2308 where same covers points not indicated in the Drawings. Properly lay out framing with pieces closely fitted, accurately plumbed, leveled and aligned, and rigidly secured in place. Select corner studs and trimmers free of crook or

wind; plates free from perceptible variations from straight line. Locate studding for proper installation of finish, trim, cabinets, fixtures, piping, and other work. Set joists and beams with crown up. Vent roof framing as required to provide circulation of outside air in encased spaces above ceiling or soffit. Set headers on edge, doubled and supported at each end by cripples unless otherwise shown. Frame walls with piping and conduits to provide clearances for same. Fur walls or reinforcing plates and sills with metal as required for rigidity and bearing of finishes.

G. Except as specifically shown on Structural Drawings, cutting of all wood joists, beams, wall framing, etc., is limited to those cuts permitted by CBC Sections 2306.2.2, 2326.11.9, and 2326.12.4.

H. Plywood (General): Unless more stringent requirements are indicated on the Drawings or required by Code, application and nailing of plywood shall be in accord with recommendations of the American Plywood Association. Use full 4' x 8" sheets wherever possible to minimize joints, with minimum sheet size at any vent in either direction to be 24".

i. Roof Sheathing: Unless otherwise indicated, install with long dimension of panel across supports with panel continuous over two or more spans. Stagger end joints and locate over framing. Allow 1/8" spacing at panel ends and ¼" at panel edges unless otherwise recommended by panel manufacturer.

ii. Wall Sheathing: Allow 1/8" spacing at panel ends and ¼" at panel edges unless otherwise recommended by panel manufacturer. Where used under cement plaster, install with long dimension or strength axis across studs with panel continuous over two or more stud spaces. Install blocking or plywood cleats at all horizontal joints.

I. Flashing (Paper): Install flashing strips of duplex building paper (9" minimum width) at periphery of cased openings in exterior walls. Weather lap, fold and turn in under sills.

J. Plywood Soffits and Paneling: Allow 1/8" spacing at panel ends and edges unless otherwise recommended by panel manufacturer. Nail with hot dip galvanized siding nails. Use 6d for ½" and less material and 8d for greater thickness. Where plywood is applied over backing, make nail length sufficient for penetration of ½" length in bearing. Space nails 6" o/c. at panel edges and 12" o/c. at intermediate bearings. Align in both directions. Locate joints only when indicated on Drawings. Transverse joints will not be permitted unless specifically shown. Install soffit vents to fit neatly, plywood edges fully concealed, and joints of vent units butted.

K. All Foundation Plates or Sills and Sleepers on concrete or masonry foundations which is in direct contact with earth shall be treated wood or foundation grade redwood, all marked by an approved agency.

L. Any wood located nearer than 6 inches to the earth shall be treated wood or wood of natural resistance to decay.

M. Columns and posts located on concrete or masonry floors or decks exposed to the weather or to the water splash or in basements supporting permanent structures shall be supported by concrete piers or metal pedestals projecting at least 6 inches above exposed earth or 1 inch

above the floor unless wood of natural resistance to decay or treated wood is used.

N. Provide minimum 18-inch clearance under floor joists and 12 inches under girders.

O. Positive connection shall be provided between post and beam or girder construction.

P. Fire stops shall be provided in the following locations per CBC Section 717.

1. Concealed spaces of stud walls and partitions, included furred spaces, at the ceiling and floor levels and at 10 foot intervals both vertical and horizontal.

2. At all interconnections between vertical and horizontal spaces such as soffits, drop and cave ceilings.

3. In concealed spaces between stair stringers at the top and bottom of the run and between studs along and in line with the run of stairs if the walls under the stairs are unfinished.

4. In openings around vents, pipes, ducts, chimneys, fireplaces and similar openings that afford a passage for fire at the ceiling and floor levels, with noncombustible materials.

5. At openings between attic spaces and chimney chases for factory-built chimneys.

Q. All materials shall be approved grade and identified by a grade mark.

R. Minimum nailing of structural members shall be in accordance with CBC Table 2304.9.1.

S. Allowable Spans for floor joists, ceiling joists, and rafters shall be in accordance with CBC Tables Chapter 23.

T. Floor Joists shall be supported laterally at the ends and at each support by solid blocking.

U. The size, height, and spacing of studs shall be in accordance with CBC Table Chapter 23.

V. Studs shall be placed with their side dimension perpendicular to the wall.

W. Bearing stud walls shall have double top plates and a single bottom plate the full with of the studs.

X. The building shall be adequately braced per CBC Chapter 23.

Y. Rafters shall be framed directly opposite each other at the ridge.

Z. Provide a minimum one-half inch air space around sides and ends of girders entering masonry or concrete.

AA. Provide a minimum of one and one-half inch bearing for joists resting on wood or metal not less than three inches on masonry.

BB. Provide a minimum of 3-inch bearing for ends of beams or girders supported on masonry or concrete.

CC. Joists under and parallel to partitions shall be doubled.

DD. Trimmer and header joists shall be doubled or of lumber of equivalent cross section when the span exceeds four feet.

EE. The ends of header joists more than six feet long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition or wall.

FF. Trimmer and header rafters framing around openings shall be doubled, or of lumber of equivalent cross section when the span of the header exceeds 4 feet. The ends of the header rafters more than 6 feet long shall be supported by framing anchors or rafter hangers unless bearing on a beam, partition or wall.

GG. Lateral support shall be provided for studs in bearing walls over 10 feet in height per Table 2308.9.1.

*** END OF SECTION ***

SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: All finish carpentry and millwork items, including hardware and attachment accessories, complete, including, but not necessarily limited to the following:
   1. Exterior wood porch.
   2. Exterior wood siding boards, battens, and trim.
   3. Exterior wood bench.
   4. Recycled wood from site, milled and planed to match existing, for floor sleepers and repair work at Blacksmith Shop Building.
   5. Interior window stools and aprons.
   6. Interior wood base, running trim, and mouldings.
   7. Alternative Item No. 5: Exterior wood sunshades above windows.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry.
   2. Section 06 40 00 - Architectural Woodwork.
   3. Section 09 91 00 - Painting: Painting and finishing of finish carpentry items.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings indicating materials, component profiles, fastening methods, jointing details, finishes, and accessories to a minimum scale of 1-1/2-inch to one foot.

B. Samples: Submit three samples of each item to receive a transparent finish, 12 inches long minimum, illustrating wood grain and specified finish.

C. Qualification Data: Submit installer qualifications.

D. Certificates:
   1. Woodwork Institute (WI) Certificate: Upon completion, submit WI compliance certificates.
   2. Certified Wood: Submit certificates of chain-of-custody signed by manufacturers showing that products specified to be made from certified wood were certified by an independent FSC-accredited certification body to comply with FSC 2.1 APrinciples and Criteria@.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Qualified installers that can demonstrate successful experience in installing finish carpentry items similar in type and quality to those required for this Project.

B. Standards: Comply with the following:
   1. Lumber Standard: PS 20 "American Softwood Lumber Standard".
   2. Plywood Standard: PS 1 "Construction and Industrial Plywood".

3. Structural Panel Standard: PS 2 - "Wood-Based Structural-Use Panels".
4. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency showing compliance with grading rule requirements, and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
5. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of the standard referenced below:
   a. Particleboard: National Particleboard Association (NPA) 8 "Standard for Formaldehyde Emission from Particleboard".
   b. Medium-Density Fiberboard: National Particleboard Association (NPA) 9 "Standard for Formaldehyde Emission from Medium Density Fiberboard (MDF)".
   c. Hardwood Plywood: HPMA FE.

C. Certified Forestry Source: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2 "Principles and Criteria".
   1. Exterior siding boards, battens, and standing and running trim.
   2. Exterior wood shading screens.
   3. Interior standing and running trim.

1.04 DELIVERY, STORAGE, AND HANDLING

A. 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 under temporary coverings.

1.05 PROJECT CONDITIONS

A. Store interior materials in ventilated, interior locations under constant minimum temperatures of 60 degrees F. (16 degrees C.) and maximum relative humidity of 55 percent.

B. Proceed with exterior finish carpentry only when existing and forecasted weather conditions are in compliance with manufacturer's recommendations and substrates are completely dry.

PART 2 - PRODUCTS

2.01 LUMBER SUPPLIERS

A. Suppliers of FSC-Certified Wood: Provide a minimum 70 percent of wood from FSC-certified sources. Verify and report if location of wood extraction is within 500 miles of the jobsite.
   1. Beronio Lumber, San Francisco, CA; Tel.415-824-4300.
   2. Cascadia Forest Goods, Arcata, CA; Tel. 541-485-4477.
   3. Certified Forest Products, Orinda, CA; Tel.925-258-4372.
   4. Channel Lumber, Richmond, CA; Tel.510-234-0233.
   5. Collins Pine Co., Chester, CA; Tel. 800-329-1219.
   6. Earth Source Forest Products, Oakland, CA; Tel. 866-549-9663.
   7. Economy Lumber, Campbell, CA; Tel. 408-378-5231.
   8. Fairfax Lumber, Fairfax, CA; Tel. 415-453-4410.
   9. Hayward Lumber, Salinas, CA and San Luis Obispo, CA; Tel. 831-755-8800.
   10. J.E. Higgins Lumber, Castroville, CA; Tel.831-632-2980.

11. Pine Cone Lumber, Sunnyvale, CA; Tel.408-736-5491.
12. Or equal.

2.02 LUMBER MATERIALS

A. Exterior Wood Siding Battens, Shading Screens, and Standing & Running Trim with Clear Finish at Environmental Education Center Building:
   1. Species: WRCLA Western Red Cedar.
   2. Grade and Grain: WCLIB "C and Better Clear", maximum 19 percent moisture content.
   3. Label: WCLIB Grade-marked, and FSC labeled to be from a well-managed forestry source.
   4. Texture: S4S (surfaced four sides), with smooth face.
   5. Lumber for Transparent Finish: Solid lumber stock. Finger joints not allowed.
   6. Profiles: Smooth finish trim pieces, sizes as indicated on Drawings, minimum 6 foot length boards.

B. Exterior Wood Board and Batten Siding, and Trim for Blacksmith Shop Building:
   1. Species: WRCLA Western Red Cedar.
   2. Grade and Grain: WCLIB "C and Better Clear", maximum 19 percent moisture content.
   3. Label: WCLIB Grade-marked, and FSC labeled to be from a well-managed forestry source.
   4. Texture: S4S (surfaced four sides), with smooth face.
   5. Lumber for Transparent Finish: Solid lumber stock. Finger joints not allowed.
   6. Profiles: Match existing profiles.
      a. Vertical Boards: Nominal 1 x 12 inch.
      b. Vertical Battens: 3/4 x 2-1/2 inch.
      c. Horizontal Lap Siding at North Elevation: Nominal 1 x 8 inch channel rustic.
      d. Corner Trim: Nominal 1 x 6.

C. Interior Standing and Running Trim and Rails for Transparent Finish:
   1. Species: Douglas fir
   2. Grade: Conforming to WI "Manual of Millwork, Section 3 - Lumber": Custom Grade.
   3. Texture: Surfaced four sided, smooth.
   4. Lumber for Stained or Clear Finish: Solid lumber stock; finger jointed material not acceptable.
   5. Profiles: As indicated on Drawings.

D. Lumber for Shimming, Blocking, and Backing: Softwood lumber, Douglas Fir species, preservative treated if exposed to the outside or in contact with concrete or roofing materials.

E. Exterior Wood Bench.
   1. Manufacturer/Model: Fair Weather Site Furnishings "Cascade Series, Model CA-1 Wood Bench", Columbia Cascade Company "TimberForm Parkway Series, Model 2006-6", or equal.
   2. Seat: Wood slats, 3 inches deep, kiln-dried, lengths as shown, with eased edges, mounted with 1/2 inch space between slats.
      a. Species: Western red cedar or premium grade Douglas fir, clear vertical grain.
      b. Finish: Clear wood preservative.
   3. Frame: ASTM A36 steel shapes, hot-dip galvanized or corrosion-resistant iron phosphate precoating after fabrication.

a. Finish: Polyester powder coating factory finish, minimum 4 mils thick.
b. Color: Black..
4. Fasteners: Stainless steel screws and bolts.
5. Mounting: Embedded in concrete.

2.03 ACCESSORIES

A. Nails: Common nails, steel, size and type to suit application.
1. Interior: Smooth steel, finish nail head type.
2. Exterior: Hot-dip galvanized steel, regular head if concealed, finish head if exposed.

B. Screws, Bolts, Nuts, Washers, Blind Fasteners, and Lags: Size and type to suit application; electro-galvanized finish when used indoors, hot-dip galvanized when used outdoors.

C. Underlayment Paper: Two layers building paper meeting California Building Code and UBC Standard 17-1, Style 2, Grade D, and additionally having 60 minute water resistance; Fortifiber Corporation "Super Jumbo Tex 60 Minute", Leatherback Industries "Super PK", or equal.

2.04 FABRICATION

A. Shop fabricate finish carpentry to WI "Custom Grade" standards, typical unless otherwise noted.

B. Shop fabricate finish carpentry to dimensions, profiles and details indicated. Provide runs in longest lengths possible to minimize joints.

C. For transparent finished items, shop prepare and identify components for grain matching during site erection.

D. Verify measurements at jobsite. Verify details and dimensions of equipment and fixtures integral with finish carpentry for proper fit and accurate alignment. Coordinate details with other work supporting, adjoining, or fastening to finish carpentry items.

E. Thoroughly hand sand wood surfaces. Perform final sanding in direction of grain; ease knife-edge corners by sanding. Provide wood surfaces free from dust, glue, stains, and other foreign matter and in proper condition to receive finish.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and field measurements are as shown on shop drawings.

B. Verify mechanical, electrical, and building items affecting work of this Section are placed and ready to receive this work.

C. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Before installation, prime surfaces to be painted of items or assemblies to be in contact with cementitious materials.

B. Back-prime lumber for painted finish exposed on the exterior and surfaces to be installed against concrete or plaster. Prime backs, edges, and ends of exterior wood, including running and standing trim, lattice, and fascia trim prior to installation.

C. Underlayment Paper: Install under exterior siding. Install in a double layer in accordance with building code requirements.
   1. Install horizontally in shingle fashion, weather lapping a minimum 2 inches for horizontal joints and minimum 6 inches for vertical joints. Stagger vertical joints.
   2. Wrap around corners and tops of walls. Fasten in place to substrate.

3.03 INSTALLATION

A. Install interior transparent finish carpentry in accordance with WI standard for Premium Grade.

B. General: Install finish carpentry plumb, level, true, and aligned with adjacent materials. Use concealed shims where required for alignment.
   1. Scribe and cut finish carpentry accurately to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Secure in place with fastenings, clips, braces, brackets, anchors, shims, and blocks.
   3. Coordinate finish carpentry with materials and systems that may be in or adjacent to standing and running trim and rails. Provide cutouts for mechanical and electrical items that penetrate exposed surfaces of trim and rails.

C. Do not use finish carpentry materials that are unsound, warped, bowed, twisted, improperly treated or finished, not adequately seasoned, or too small to fabricate with proper jointing arrangement.

D. Exterior Siding Battens: Install with fasteners that penetrate through mineral fiber cement siding and into plywood substrate.

E. Standing and Running Trim and Rails:
   1. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available.
   2. Stagger joints in adjacent standing and running trim and rails.
   3. Cope at returns and miter at inside and outside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.
   4. Plane back of casings to provide uniform thickness across joints.
   5. At transparent finish trim, match color and grain pattern across joints.
   6. Install trim after drywall joint finishing operations are completed.
   7. Exterior Finish Carpentry: Fit exterior joints to exclude water. Apply flat grain lumber with bark side exposed to weather.

F. Install components, trim, and exposed wood with nails or screws or bolts with blind fasteners at 8-inch on center. Set nail heads for putty in exposed locations. Sand work smooth.

G. Install hardware supplied by other Sections in accordance with manufacturer's instructions.

H. Remove damaged or otherwise disfigured portions and replace with new prior to City's acceptance.

I. Site Finishing: Refer to Section 09 91 00.

3.04 TOLERANCES

A. Plumb and Level: Install to a tolerance of 1/8-inch in 8 feet.

B. Install finish carpentry with abutting materials to a tolerance of 1/16-inch maximum offset for flush installation and 1/8-inch maximum offset for reveal installation.

3.05 SITE TREATMENT OF WOOD MATERIALS

A. Brush apply one coat of preservative treatment on all exterior located finish carpentry items, other than cedar.

B. Apply preservative treatment in accordance with manufacturer's instructions.

C. Treat site-sawn ends. Allow preservative to cure prior to erecting materials.

D. Verify that materials requiring paint finish do not exceed 12 percent moisture content before applying wood preservative treatment.

END OF SECTION

SECTION 06 40 00

ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: All architectural woodwork, complete. The work includes the following:
   1. Fixed wood veneer casework.
   2. Alternative Item No. 6: Casework cabinets and wood wall shelving in Meeting Room C.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Grounds and support framing.
   2. Section 06 20 00 - Finish Carpentry.
   3. Section 09 91 00 - Painting: Finishing wood trim items.

1.02 SUBMITTALS

A. Product Data: Submit for each type of product indicated, including cabinet hardware, fire-retardant-treatment, and finishing materials and processes.
   1. Manufacturers' product data for installation adhesives, including printed statement of VOC content.
   2. Composite wood manufacturer's product data for each composite wood product used indicating that bonding agent contains no urea formaldehyde.
   3. Adhesive manufacturer's product data for each adhesive used indicating that adhesive contains no urea formaldehyde.

B. Shop Drawings: Submit shop drawings including materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes. Affix a Woodwork Institute (WI) Certified Compliance label to the first page of shop drawings.

C. Samples:
   1. Factory-finished Wood Casework: Submit finish samples 12 x 12 inch size, showing the complete finish color, sheen, and appearance of factory-finished wood casework.

D. Certificates: Before delivery to the jobsite, woodwork supplier to submit the following:
   1. If a Woodwork Institute (WI) Licensee: Submit a WI Certified Compliance Certificate, indicating the millwork products furnished for this Project, and certifying that they fully meet all the requirements of the WI Grade or Grades specified.
   2. If Not a Woodwork Institute Licensee: Submit evidence that the millwork supplier has arranged for inspection by a WI inspector after completion of fabrication and installation. If all conditions are found to be compliant, the WI inspector shall issue a WI Certified Compliance Certificate, indicating the millwork products furnished for this Project, and certifying that they fully meet all the requirements of the WI Grade or Grades specified.

1.04 QUALITY ASSURANCE

A. Standards:

1. Comply with standards of The Woodwork Institute (WI) "Architectural Woodwork Standards, Edition 1, 2009".

B. Fabricator Qualifications: Equipped for and experienced in doing work including fabricating, finishing, and installing equal to standards specified, and able to provide evidence of such experience to the Engineer's satisfaction.

C. Certifications: Furnish the following:
1. First Page of Shop Drawings: WI Certified Compliance Label.
2. Each Elevation of Casework: WI Certified Compliance Label.
3. Each Plastic Laminate Countertop: WI Certified Compliance Label.
4. Upon Completion of Installation: WI Certified Compliance Certificate for installation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework items to jobsite only after proper facilities are available for handling, storing, and protecting items; receiving areas are broom cleaned; exterior openings are closed up; wet work and mechanical and electrical rough-ins are completed.

B. Store materials in ventilated, interior locations under constant minimum temperatures of 60 degrees F. and a relative humidity between 43 and 70 percent.

C. Provide temporary protective covers for items during delivery, installation, and until date of completion of Project.

1.06 PROJECT CONDITIONS

A. Environmental Requirements: Provide proper heat and humidity in area of installation to maintain equilibrium moisture content in wood until installation is completed. Relative humidity shall range from 40 to 65 percent at 70 degrees F.

B. Sequencing: Provide information as required for proper placement of backing.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Exposed Casework and Exposed Woodwork:
1. Manufacturer: Columbia Forest Products "Woodstalk", Klamath Falls, OR, or equal.
2. Panels: Wood fiber based MDF, FSC-certified to be from a well-managed forestry source, no added urea formaldehyde, 3/4-inch thick unless otherwise noted.
3. Face Veneers: Plain sliced maple, sanded faces, FSC-certified to be from a well-managed forestry source. Provide with veneer backing of same species and thickness as face veneer.
4. Matching of Adjacent Veneers: Book matched.
5. Matching of Adjacent Panels: Running matched, with solid hardwood frames and edge banding of same species, eased edges.
6. Finish: Factory-applied transparent clear finish conforming to the requirements of WI Section 5 - Finishing, System #7 - Catalyzed Vinyl Lacquer.

B. Cabinet Bodies, Shelving, and Concealed Surfaces:
   1. Manufacturer: Sierra Pines "Medite II", Roseberg, OR; or equal.
   2. Material: Wood fiber based MDF, 100 percent recycled content, SCS certified, no added urea formaldehyde, unfinished, meeting ANSI A208.1, M3 Industrial-grade.
   3. Size: 3/4-inch thick, unless otherwise noted.

C. Wall Shelving:
   1. Face Veneers: Plain sliced maple, sanded faces, FSC-certified to be from a well-managed forestry source. Provide with veneer backing of same species and thickness as face veneer.
   2. Panels: 3/4-inch thick, ply-core or stave-core plywood, FSC-certified to be from a well-managed forestry source.
   4. Matching of Adjacent Veneers: Book matched.
   5. Matching of Adjacent Panels: Running matched, with solid hardwood frames and solid stock edge banding of same species as face veneers, eased edges.
   6. Finish: Factory-applied transparent clear finish conforming to the requirements of WI Section 5 - Finishing, System #7 - Catalyzed Vinyl Lacquer.

2.02 ACCESSORIES

A. Cabinet Hinges:
   1. Flush Overlay Casework: ANSI/BHMA A156.9, Grade 2, minimum 120-degree opening, concealed type, self-closing, plated finish; Blum, Hafele, or equal.

B. Drawer Slides: ANSI/BHMA A156.9, Grade 1, ball-bearing construction, full-extension, sized for the appropriate drawer size, with hold-in feature, rail-mounted; Accuride, Grant, Knape-Vogt, or equal.

C. Pulls: 4-inch long, wire type, US26D brushed chrome finish; Trimco, Knape-Vogt, Stanley, or equal.

D. Cabinet Adjustable Shelf Standards: ANSI/BHMA A156.9, Grade 1; sized for the appropriate loading; Grant, Knape-Vogt, Stanley, or equal.

E. Countertop Support Brackets: Rangine Corp. (508-376-4545) "Rakks Counter Support and Sill Support Brackets", or equal.

F. Wall-Mounted Adjustable Shelf Standards: ANSI/BHMA A156.9, Grade 2; Knape Vogt #KVE180 brackets, with #KVE80 standards, or equal, factory-painted white finish.

G. Cabinet Locks: US26D brushed chrome finish; Stanley, Best, Corbin, or equal.

H. Grommets: Plastic, 2 inch diameter, with adjustable opening, color to match countertop.

I. Door Bumpers: Felt or plastic, two per door and drawer.

J. Door Glazing: Single glazed, 3/16 or 1/4 inch thick, fully-tempered.

K. Adhesive: FS MMM-A-130. Type recommended by laminate manufacturer to suit application, containing no urea formaldehyde, and complying with South Coast Air Quality Management

District (SCAQMD) Rule #1168, effective July 1, 2005 and rule amendment date of January 7, 2005.

L. Fasteners: Size and type to suit application.

M. Bolts, Nuts, Washers, Lags, Pins, and Screws: Size and type to suit application; plain finish in concealed locations.

2.03 FIRE-RETARDANT TREATMENT

A. Comply with California Building Code. Treat all exposed wood and plywood to achieve ASTM E84 UL Class A flame spread rating.

2.04 FABRICATION - GENERAL

A. Fabricate cabinets in flush-overlay type construction. Fabricate to the following standards, unless otherwise noted:
   1. Wood Veneer Casework: WI Premium Grade.
   2. Wood Veneer Wall Shelving: WI Premium Grade.

B. Fabricate cabinets and shelving with the required finish on all exposed surfaces, including edges of doors and shelves, and backing for doors.

C. Provide hinges, locks, and pulls as specified herein at casework doors. Install in accordance with manufacturer's written recommendations.

D. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

E. Exposed Wood: Set nails; apply wood filler in exposed nail indentations. Sand smooth surfaces and wood filler holes. Remove cutter marks by sanding parallel to grain. Sand edges and corners of exposed wood surfaces to just remove sharp edges and splinters.

F. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut edges.

G. Each elevation of casework shall bear the WI Certified Compliance Label indicating that the cabinets and tops fully meet the requirements of the WI Grade specified.

2.05 PRE-FINISHED CABINETRY

A. Shop finish transparent finished cabinetry prior to delivery to the jobsite. Construction requirements, sanding, and similar work shall be as specified herein. All finishing work shall be done by experienced mechanic using equipment standard in the industry today.

B. Transparent Finish: Cabinetry shall have a "natural" (transparent) finish stain coat to provide a uniform color for all exposed and semi-exposed surfaces. Seal all stained surfaces and finish with not less than 3 coats of finish sanded between coats. Final coat shall be semi-gloss. Finish

all drawer and closed cabinet interiors with sealer coat and minimum 2 coats of lacquer. All concealed surfaces shall be fully sealed.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing. Do not begin installation until unsatisfactory conditions have been resolved.

3.02 INSTALLATION

A. Installation Standards:
   1. Transparent Finish Woodwork: WI Premium Grade.
   2. Plastic Laminate and Opaque Finish Woodwork: WI Custom Grade.

B. General: Install woodwork plumb, level, true, and aligned with adjacent materials. Use concealed shims where required for alignment.
   1. Scribe and cut woodwork accurately to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Secure in place with fastenings, clips, braces, brackets, anchors, shims, and blocks.
   3. Coordinate woodwork with materials and systems that may be in or adjacent to woodwork. Provide cutouts for mechanical and electrical items that penetrate exposed surfaces.
   4. Install components, trim, and exposed wood with nails or screws or bolts with blind fasteners at 8 inches on center. Set nail heads for putty in exposed locations. Sand work smooth.

C. Standing and Running Trim and Rails:
   1. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available.
   2. Stagger joints in adjacent standing and running trim and rails.
   3. Cope at returns and miter at inside and outside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.
   4. Plane back of casings to provide uniform thickness across joints.
   5. At transparent finish trim, match color and grain pattern across joints.
   6. Install trim after drywall joint finishing operations are completed.
   7. Hardwood Trim: Drill pilot holes in hardwood prior to nailing or fastening to prevent splitting. Fasten to prevent movement or warping. Countersink nail heads on exposed carpentry work and fill holes.

D. Install hardware supplied by other Sections in accordance with manufacturer's instructions.

E. Remove damaged or otherwise disfigured portions and replace with new prior to City's acceptance.

3.03 ADJUSTING AND CLEANING

A. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.

B. Clean exposed interior and exterior surfaces of all casework, counters, hardware, fittings and fixtures.

C. Repair or replace all damaged or defective work as directed. Engineer shall be the final judge of the disposition of any damaged or defective work.

END OF SECTION

SECTION 06 82 10

FIBER-REINFORCED PLASTIC (FRP) PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. New fiberglass reinforced plastic (FRP) wall panels and associated trim pieces at Environmental Education Center building, complete.
   2. Patching of holes in existing FRP wall panels at renovations in existing restrooms. Replacement of existing FRP wall panels with new panels to match existing, if repair work consists of more than patching of holes.

B. Related Sections:
   1. Section 09 29 00 - Gypsum Board: Wall substrate.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing layout of panels, sizes, locations of penetrations, and details used in the installation of panels.

B. Product Data: Submit manufacturer's product data identifying materials, accessories and adhesives. Include manufacturer's recommended method of handling and installation.
   1. Low-Emitting Materials, Adhesives and Sealants: Submit manufacturer=s product data for panel adhesive including printed statement of VOC content.

C. Samples: Submit 6 x 6 inch samples of each type of material specified.

D. Quality Control Submittals:
   1. Submit certificate indicating materials supplied are asbestos free.
   2. Submit certificates indicating compliance with UL or NFPA fire-resistance ratings.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of fiberglass reinforced plastic panels with minimum three years experience.

B. Regulatory Requirements:
   1. Flammability: Conform to NFPA 255 "Method of Test of Surface Burning Characteristics of Building Materials."
   2. Adhesive VOC Limits: Comply with 2010 CCR Title 24 Part11 (CALGreen), Section 5.504 - "Pollutant Control" and South Coast Air Quality Management District (SCAQMD) Rule #1168. Provide adhesive with maximum VOC limit of 50 g/L.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with the manufacturer's recommendations for storage of materials to be used in the Work.

B. Keep all materials dry, fully protected from the weather and direct sunlight, and protected from damage due to scratching or impact. Stack units flat, taking care to prevent sagging and damage to ends, edges, and surfaces.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Relative Humidity: Maintain within manufacturer's recommended range for specified materials.

B. Maintain uniform temperature range of 60 to 85 degrees F. for at least 48 hours prior to installation, during, and after installation of panels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide FRP panels by Kemlite Company "Fire-X Glasbord"; Lasco Panel Products "FireFlex"; Marlite "Class A FRP Panels"; Nudo Products Inc. "Fiber-Lite Liner Panels LP-F9FR"; or Sequentia Inc. "Structoglas Pyro Panl #1200 FR-25".

2.02 MATERIALS

A. Panel Characteristics:
   1. Size: 4 feet wide x height as indicated. Provide with fewest possible seams.
   2. Thickness: 0.090-inch minimum.
   3. Weight: 0.7 pounds/sq.ft.
   4. Finish: Textured or embossed.
   5. Color: As selected by Engineer from manufacturer's standard range.
   6. Sanitary: USDA approved.
   7. Fire Rating: UL classified and NFPA 255 classified for Class A, when tested in accordance with ASTM E84.
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 200 or less.

B. Trim: Manufacturer's standard intermediate butt joint Tee shapes, and end panel, floor, and ceiling "J" trim; color and fire-rating to match panels.

C. Panel Adhesive: Type recommended by manufacturer for panel installation that complies with South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and rule amendment date of January 7, 2005.

D. Sealant: Wall panel manufacturer's standard USDA-accepted silicone sealant, color to match panels.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine wall substrates to receive the work of this Section. Do not proceed with the Work of this Section until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install FRP wall panels using panel adhesive in accordance with the manufacturer's installation instructions and the approved shop drawings. Do not use screws through the exposed face of panels.

B. Install panels complete with intermediate and edge trim and sealants.

C. Cover fastener penetrations neatly with silicone sealant specified above.

3.03 CLEANING

A. Clean soiled or discolored units surfaces after installation.

B. Touch up scratches, abrasions, voids, and other defects in surfaces.

C. Remove and replace damaged and stained FRP panels with new units.

3.04 PROTECTION

A. At locations where the installed FRP wall panels will be subject to damage by impact during the remaining construction process, provide temporary protection.

END OF SECTION

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SECTION 07 13 26

SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Self-adhesive applied bituminous sheet waterproofing, with sealed membrane terminations and protection board, complete.

B. Related Sections:
1. Section 06 10 00 - Rough Carpentry.
2. Section 33 46 13 - Foundation Drainage.

1.02 SUBMITTALS

A. Product Data: Submit product data for all products to be used. Include applicator's list of completed installations, and endorsement by materials manufacturer.

B. Qualification Data:
1. Submit membrane manufacturer qualifications.
2. Submit installer qualifications.

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

D. Closeout Submittals: Submit warranties.

1.03 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing waterproofing sheet membranes with ten (10) years experience in the field.

B. Applicator Qualifications: Company specializing in application of specified waterproofing with minimum three years experience, and approved by manufacturer.

C. Sole Source: Supply all waterproofing system components and drainage and protection materials by a single-source manufacturer. Use waterproofing products from the same manufacturer for all blind side and positive side, horizontal and vertical applications

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's instructions. Protect from damage from weather, excessive temperature and construction operations. Remove and dispose of damaged material in accordance with applicable regulations.

1.05 PROJECT CONDITIONS

A. Environmental Requirements: Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

B. Do not apply waterproofing during inclement weather or when air temperature is below 40 degrees F (5 degrees C), or is expected to fall below 40 degrees within 24 hours after application.

1.06 WARRANTY

A. Manufacturer: Provide five (5) year manufacturer warranty. Include coverage of materials and installation from failure of system to resist penetration of moisture.

B. Contractor: Provide two (2) year Contractor installation warranty

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Positive Side Vertical Below Grade Waterproofing: Provide as manufactured by one of the following:
1. Grace Construction Products "Bituthene 4000".
2. Polyguard Pipeline Products "Polyguard No. 650".
3. W.R. Meadows "Mel-rol".
4. Or equal.

2.02 MATERIALS

A. Positive Side Vertical Below Grade Waterproofing: Minimum 0.060-inch thick rubberized asphalt, polyethylene coated sheet, adhesive backed, and self-sealing.

B. Membrane to have the following properties:

Property	Test Method	Typical Value
Color		Black with white protective coating
Thickness	ASTM D3767 Method A	1.07 mm (0.042 in.) nominal
Low Temperature Flexibility	ASTM D1970	Unaffected at -23☜C (-10☜F)
Elongation	ASTM D412 Modified	300% minimum
Crack Cycling at -23☜C	ASTM C836	Unaffected
Tensile Strength, Film	ASTM D412	27.6 Mpa (4,000 lbs/sq. in.) minimum
Peel Adhesion to Concrete	ASTM D903 Modified	880 N/m (5.0 lbs/in.) minimum
Lap Adhesion	ASTM D1876 Modified	440 N/m (2.5 lbs/in.) minimum
Resistance to Hydrostatic Head	ASTM D5385 Modified	70 m (231 feet) maximum
Puncture Resistance:	ASTM E154	
Vertical Membrane		445 N (100 lbs) minimum
Horizontal Membrane		800 N (180 lbs) minimum
Permeance	ASTM E96 Method B	0.6 ng/m^{2}sPa (0.01 perms) max.

Water Absorption	ASTM D570	0.5% maximum

C. Surface Conditioner (Primer): Water Based Acrylic Primer.

D. Fillet: Manufacturer's standard liquid membrane.

E. Mastic: Manufacturer's standard trowel-on elastomeric mastic.

F. Vertical Protection Board: 1/8-inch thick asphalt-impregnated fiberboard.

G. Protection Board Adhesive: Manufacturer's standard adhesive for adhering protection board.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify items which penetrate surfaces to receive waterproofing are rigidly installed.

B. Verify surfaces are free of cracks, depressions, waves, or projections which may be detrimental to successful installation.

C. Do not apply waterproofing to damp, dirty, dusty, or surfaces unacceptable to manufacturer.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Prepare and treat substrate according to manufacturer's written instructions. Clean surfaces of foreign matter detrimental to installation of membrane.

C. Vertical Applications: Substrates shall be smooth and sound.

D. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to waterproofing manufacturer's written instructions.

3.03 INSTALLATION

A. General: Install membranes in accordance with waterproofing manufacturer's written instructions.
   1. Cover inside and outside corners with a strip of membrane 11 inches minimum width.
   2. Provide minimum 6 inch wide strip of liquid membrane around penetrations.

B. Vertical Positive Side Applications:
   1. Apply surface conditioner (primer) to substrate with a lambswool roller at the rate of 700-800 square feet per gallon. Allow to dry until tack free. Cover with membrane same day or re-prime.

2. Using a strip of membrane 8 inches wide minimum, cover cracks over 1/16-inch wide and construction joints after they have been properly prepared and sealed.
3. Cover inside and outside corners with a strip of membrane 11 inches minimum width.
4. Provide a minimum 6 inch wide strip of liquid membrane around all penetrations.
5. Lay membrane sheets shingle fashon with 3 inch side laps and 6 inch end laps. Stagger end and side laps.
6. Press firmly into place and roll with a 150 pound linoleum roller cushioned with carpet or foam to eliminate bubbles.

C. Place cover over membrane within 30 days of membrane application.

D. Follow details and manufacturer's recommendations for top edge termination, flashing at penetrations, and stripping and lapping at cracks, joints, and corners.

E. Seal vertical and horizontal terminations with a troweled bead of mastic.

F. Carefully inspect all membrane surfaces and make corrections before covering.

G. Slit fishmouths and patch with membrane. Patch tears and inadequately lapped seams. Seal edges of patches with mastic.

3.04 FIELD QUALITY CONTROL

A. Field inspection of membrane application shall be performed by the waterproofing manufacturer's representative. Comply with manufacturer's representative's directions

3.05 PROTECTION OF MEMBRANE

A. Apply adhesive to completed membrane surfaces at the rate of 250-300 square feet per gallon.

B. Immediately adhere approved protection board in accordance with manufacturer's instructions.

C. Insure that any membrane still left exposed at top of walls is covered with weather-resistant flashings.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Thermal batt insulation at exterior wall and roof construction.
2. Acoustical insulation at interior acoustical walls.
3. Rigid foam thermal insulation at exterior walls.
4. Flexible foam insulation for filling perimeter gaps at windows, doors, and penetrations.

B. Related Sections:
1. Section 06 10 00 - Rough Carpentry: Supportive construction.
2. Section 09 29 00 - Gypsum Board.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data, specifications, and installation instructions for each type of insulation and accessory material required.

B. Material Certificates: Submit manufacturer's certificates attesting to the following:
1. Insulation materials comply with the California Quality Standards for Insulating Material.
2. Batt insulation contains no urea formaldehyde binder.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Flame Spread and Smoke Development: Comply with 2010 California Building Code (CBC) Section 719 for flame-spread and smoke-developed requirements on insulation materials. Insulating materials, including the facing material (vapor barrier) having a flame-spread rating greater than 25 and smoke-developed rating greater than 450, tested in accordance with ASTM E84, shall not be exposed anywhere in the building, including above-the-ceiling (plenum) spaces.
2. Thermal-Resistive Value: Comply with California Quality Standards for Insulating Material, Title 20, Chapter 4, Article 3. Where insulation is identified by "R" value, provide thickness required to achieve the indicated value, when tested in accordance with ASTM C518.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in manufacturer's, original packaging. Clearly identify manufacturer, contents, brand name, applicable standard, and R-value.

B. Store materials off ground, protected against weather, condensation, and damage.

C. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Thermal Batt Insulation:
   1. Manufacturers:
      a. Knauf Insulation "EcoBatt", Shasta Lake, CA.
      b. CertainTeed Corp. "Sustainable Insulation", Chowchilla, CA.
      c. Johns Manville Corp., Willows, CA.
      d. Owens-Corning Fiberglas "EcoTouch Insulation", Santa Clara, CA.
   2. Type: Unfaced fiberglass blanket conforming to ASTM C665, Type I, Class A.
   3. Content: Glass fibers, 100 percent regionally sourced, minimum of 25 percent total recycled content, and containing no formaldehyde binder. Submit certification verifying compliance.
   4. Thermal R-value when tested in accordance with ASTM C518:
      a. Walls: R-21 minimum.
      b. Ceilings: R-38 minimum.

B. Thermal Rigid Board Insulation:
   1. Manufacturers: Atlas Roofing, Dow Chemical, or R-Max.
   2. Type: Glass fiber faced, polyisocyanurate board insulation meeting ASTM C1289, Type II, Class 1 or Class 2.
   3. Flammability: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
   4. Thickness at Exterior Wall Sheathing: Minimum 1-inch thick, R-6.5.
   5. Thickness at Metal Roof Sheathing: Minimum 2-inch thick, R-13.

C. Acoustical Batt Insulation:
   1. Manufacturers:
      a. Knauf Insulation "EcoBatt", Shasta Lake, CA.
      b. CertainTeed Corp. "Sustainable Insulation", Chowchilla, CA.
      c. Johns Manville Corp., Willows, CA
      d. Owens-Corning "EcoTouch Insulation", Santa Clara, CA.
   2. Type: Unfaced fiberglass blanket conforming to ASTM C665, Type I, Class A.
   3. Content: Glass fibers, 100 percent regionally sourced, minimum of 25 percent total recycled content, and containing no formaldehyde binder. Submit certification verifying compliance.
   4. Thickness: 3-1/2-inch nominal thickness.

D. Foamed-in-Place Insulation at Penetrations, Cracks, and Gaps Around Windows and Exterior Door Frames: Minimal-expanding, single-component, flexible, insulating latex-based foam sealant, in aerosol cans; DAP "DAPtex Latex Multi-Purpose Insulating Foam Sealant", or equal, containing no CFC or HCFC blowing agents.

2.02 INSULATION ACCESSORIES

A. Nails or Staples: Steel wire; electroplated; type and size to suit application.

B. Tape: Bright aluminum, mesh-reinforced, 2-inch wide.

C. Wire Mesh: Galvanized steel, hexagonal wire mesh.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas scheduled to receive insulation to ensure protection against inclement weather, or other hazards and work of preceding trades is completed. Building shall be closed in prior to insulation installation.

B. Examine the substrate and space allocated for insulation for proper depth to receive material. Proceed with installation only when conditions are satisfactory.

C. Verify mechanical and electrical services within walls have been installed and tested.

D. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.02 INSTALLATION - BATT INSULATION

A. Install batt insulation in accordance with manufacturer's written instructions.

B. Fiberglass Insulation: Comply with worker safety recommendations of North American Insulation Manufacturer's Association (NAIMA), Publication #N027-9/99: "Recommended Work Practices for the Installation of Synthetic Vitreous Fibers (SVF)", as endorsed by OSHA.

C. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members. Install in walls and ceiling spaces without gaps or voids. Trim insulation neatly to fit spaces. Use batts free of damage.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.
   1. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for, or protected from, contact with insulation.

E. Wood-Framed Construction: Install blankets according to ASTM C1320. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

F. Tape in place where framing or obstructions do not permit wiring to framing. Retain in place with wires or wire mesh secured to framing members where insulation is not wired or force-fitted to framing members and will sag or droop.

G. Joints, Cracks, and Openings: Pack batt insulation or spray foam insulation in all gaps, joints and openings between structural framing members and door frames, window frames, skylight frames, and penetrations in the thermal and acoustical envelope.

H. Penetrations: Spray foamed-in-place insulation around all penetrations in the thermal and acoustical envelope to create a thermal and acoustical seal.

3.03 INSTALLATION - BOARD INSULATION

A. Install board insulation between furring strips. Nail or tape in place until subsequent finish material can be applied.

3.04 FIELD QUALITY CONTROL

A. Building Envelope Durability Management Verification: Immediately upon completion of insulation installation, notify the Engineer to perform a visual verification of insulation installation and integrity of the thermal envelope.
   1. Allow adequate time for visual verification before beginning installation of gypsum board.
   2. Engineer will provide report of Quality of Insulation Installation and Thermal Bypass Checklist.
   3. Make all corrections to insulation installation as required by report.

END OF SECTION

SECTION 07 26 00

VAPOR RETARDERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Vapor retarder membrane under cast-in-place concrete slabs on grade, with sealed membrane joints and terminations, complete.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete.
2. Division 31 - Earthwork.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data for all materials to be used stating physical properties of the materials. Include manufacturer's installation instructions.

B. Qualification Data: Submit installer qualifications.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of sheet membranes used as vapor retarders, with a minimum of five (5) years of successful history and experience in this field.

B. Installer Qualifications: Experienced in the installation of specified vapor retarders, with documented experience in this type of work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Under-Slab Vapor Retarder Membrane: Reinforced polyolefin plastic water vapor retarder.
1. Manufacturer: Fortifiber Corp. "Moistop Ultra 15", Stego Industries "Stego Wrap 15-mil Class A", W.R. Meadows "Perminator Vapor-Mat 15 Mil", or equal.
2. Standards: Meeting ASTM E1745-96, Class A, and the additional minimum requirements:

Property	Test	Results
Water Vapor Permeance	ASTM E96, Method A or B	Max. 0.03 perms.
Tensile Strength	ASTM E154	Min. 70 lbf/in.
Puncture Resistance	ASTM D1709, Method B	Min. 4200 grams

B. Tape: As recommended by the manufacturer of the vapor retarder.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify items which penetrate surfaces to receive vapor retarder are rigidly installed. Verify surfaces of subgrade are free of large rocks, bumps, depressions, or projections which may be detrimental to successful installation.

B. Coordinate the installation of vapor retarder with related trades and the Project schedule. Beginning of installation means the Contractor's acceptance of existing conditions.

3.02 INSTALLATION

A. Install vapor retarder in accordance with ASTM E1643, unless otherwise instructed by manufacturer's written recommendations.

B. Apply vapor retarder over entire area to receive concrete slabs.

C. Lay membrane with seams perpendicular to, and lapped in the direction of the pour. Lap edges a minimum of 6 inches, unless otherwise instructed by manufacturer, and seal with tape. At perimeters, turn edges up to top of slab or down to bottom of footings.

D. Where expansion joints are indicated at adjacent vertical surfaces, extend vapor retarder beyond expansion joint filler, and turn up to top of slab. Where expansion joints are indicated within the slab, lay vapor barrier continuous under expansion joint filler.

E. Tape vapor retarder tightly to pipes, conduits, and penetrations of vapor retarder. Allow no screed supports or other items to penetrate vapor retarder.

3.03 PROTECTION OF MEMBRANE

A. Protect vapor retarder from damage until permanent covering is in place.

B. Repair punctures and tears using patches of the material which overlaps the puncture or tear a minimum of 6 inches. Seal with tape.

END OF SECTION

SECTION 07 41 13

METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Preformed corrugated metal roof systems, complete. The work includes girts, miscellaneous supports, flashings, exposed sheet metal trim, closures, fasteners, and sealants associated with the work of this Section.

B. Related Sections:
1. Section 07 21 00 - Thermal Insulation.
2. Section 07 54 23 - Thermoplastic-Polyolefin Roofing.
3. Section 07 60 00 - Flashing and Sheet Metal.

1.02 PERFORMANCE REQUIREMENTS

A. Design Load: In accordance with California Building Code.

B. Wind Uplift: Install metal roofing for UL580 Class 90 wind uplift.

C. Air and Water-Infiltration Requirements: Install the metal roofing work so that no air or water infiltrates through the panels, in accordance with ASTM E283 and E331.

D. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-90, complying with ASTM E108, Class A fire performance.

E. Thermal Movements: Install the metal roofing work capable of withstanding thermal expansion and contraction movements for ambient temperature from 20-120 degrees F without failure of any kind.

F. Energy Star Rating: High-emissivity roof coating meeting the following:
1. Initial Reflectance: Minimum 0.25 when tested in accordance with ASTM E903.
2. Three-year Aged Reflectance: Minimum 0.18 when tested in accordance with ASTM E903.
3. Emissivity: Minimum 0.9 when tested in accordance with ASTM E408.
4. Solar Reflectance Index (SRI): Minimum of 29, when calculated according to ASTM E1980

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings indicating dimensions, elevations, panel layout, construction details, method of anchorage, trim, accessories, and method and sequence of installation. Submit shop drawings prior to framing roof.

B. Product Data: Submit manufacturer's product data sheets and installation instructions for all materials. Submit data indicating that metal roof assembly meets requirements for a Class A fire-resistance rating.
   1. Paint Coating: Indicate whether coating is Energy Star Rated and SRI compliant.
   2. Metal Roofing: Indicate percentages by weight of post-consumer and pre-consumer recycled content.

C. Samples: Submit exterior color samples from manufacturer's full line of colors, including Energy Star rated finishes. Submit not less than 8 x 10 inches in size on actual materials illustrating color and finish selected.
   1. Provide color sample of interior (back face) finish for each exterior color finish.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Firm experienced in installing work of this section, approved by the manufacturer.

B. Coordination: Coordinate metal roof layout with roof framing and blocking at eaves. No exposed fasteners allowed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Examine metal roof materials and surfaces for damage before off-loading. Do not accept damaged materials.

B. Protect the finished metal surfaces from damage and abrasion during storage and handling. Surfaces having noticeable and objectionable damage or abrasion, as deemed by Engineer will be rejected.

1.06 WARRANTY

A. Manufacturer Warranty: Provide a manufacturer's 20 year NDL warranty for entire roofing system, warrantying that roofing system will not leak water, deteriorate, or otherwise fail to perform as required.

B. Contractor and Subcontractor: Jointly guarantee for a period of five (5) years from the date of final acceptance that the metal roof panels shall be free of defects in material and installation and that they will not leak water, deteriorate, or otherwise fail to perform as required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pre-formed Corrugated Metal Panels at Environmental Education Center:
   1. Manufacturer: Berridge Manufacturing Co. "S" Deck profile, AEP Span, or equal.
   2. Material: Smooth-textured aluminum-zinc alloy coated steel sheet conforming with ASTM A792, Class AZ-50 coating (Zincalume"), Grade 40; structural quality.
   3. Surface: Smooth finish.

4. Profile: Corrugations 7/8 inch high x 2-2/3 inches wide, nominal 31-1/2 inch wide panel coverage.
5. Thickness: Minimum 24-gage.
6. Finish: Kynar 500 metallic finish coated, Energy Star rated for high emissivity, with coating to meet the following:
   a. Solar Reflectance Index: Greater than 0.29.
   b. Reflectance after 3 Years: Greater than 0.18.
   c. Emissivity: Greater than 0.90.
7. Color: To be selected by Engineer.

B. Formed Metal Trim, Corners, Flashings, and Other Exposed Items in Contact with Roof: 24-gage aluminum-zinc alloy coated sheet steel matching roofing panel in material and finish.

C. Metal Closure Strips: Galvanized steel, 24-gage minimum, in profile matching roofing panel corrugation.

D. Flexible Closure Strips: 1-inch wide (minimum) closed-cell neoprene, rubber, or EPDM in profile matching roofing panel corrugation in continuous lengths. Individual pieces in size of corrugation is not acceptable.

E. Self-Adhering, High-Temperature Underlayment: Cold-applied sheet underlayment, minimum of 30 mils thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 220 deg F, in accordance with ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F, in accordance with ASTM D1970.
3. Manufacturers:
   a. Carlisle Construction Materials, "WIP 300HT".
   b. Grace Construction Products, "Grace Ice and Water Shield HT".
   c. Henry Company, "Blueskin PE200 HT".
   d. McElroy Metals "Titanium Slip Sheet".
   e. Metal-Fab Manufacturing, "MetShield".
   f. Or equal, as approved by metal panel manufacturer.

F. Rigid Insulation: Refer to Section 07 21 00.

G. Fasteners:
1. Exposed to the Weather: Stainless steel with neoprene washer
2. Concealed or Interior Fasteners: Stainless steel or cadmium plated.
3. Exposed Fasteners: Same finish and color as contiguous metal panel.
4. Type: Hex-head screws, #14 size minimum.
5. Size and Length: As required by structural and functional requirements of the work.

H. Sealant: As recommended by roofing manufacturer.

2.02 FINISHES

A. Coil-Coated Organic Finish:
1. Coating Manufacturers: Arkema Inc. "KYNAR 500" or Solvay Solexis "HYLAR 5000".
2. Exterior Finish: High performance organic finish, meeting AAMA 2605, three (3) coat metallic fluoropolymer finish, containing not less than 70 percent PVDF resin by weight in

color coat, formulated to achieve SRI performance requirement, and containing no PFOA. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Exterior Color: As selected by Engineer from manufacturer's full range of metallic colors.
4. Interior Finish, Exposed at Eaves: Hot dip galvanized or "Galvalume" coating.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the conditions and substrates in which the metal roofing work is to be installed. Do not proceed until unsatisfactory conditions have been corrected.

B. Do not install any component which has defects, including damaged finish, dents, warps, and bends. Do not remove the protective coating or wrapping until the component is ready for installation.

3.02 PREPARATION

A. Install underlayment slip sheet over plywood substrate in accordance with manufacturer's recommendations. Lap seams to drain water off roof. Install in continuous sheets with minimum of joints.

3.03 INSTALLATION

A. General: Comply with metal panel manufacturer's written instructions for assembly, installation, and erection of metal roofing, except where more stringent requirements are indicated.

B. Anchor component parts of metal roofing securely in place, providing for necessary thermal and structural movement.

C. Apply sealant as recommended by roofing manufacturer to prevent water infiltration.

D. Provide flashings, trim, caps, and accessories in sizes and shapes as shown or as acceptable to Architect. Install trim and caps with exposed leg tight against the face of standing seam.

E. Install closure strips where shown and where required to prevent air and water infiltration. Provide a continuous bead on the sides of flexible closure strip where it butts against substrate for a complete air and water seal.

F. Install fasteners as required for complete assembly of the roofing and the performance intended. Exposed pop-rivets will not be allowed, unless specifically accepted by Engineer. All exposed fasteners shall be spaced evenly and aligned.
   1. Prior to driving the screw, brush the steel shavings from the hole for the screw; do not drive screw head down onto steel shavings.

3.04 CLEANING AND PROTECTION

A. Clean exposed surfaces of preformed metal roofing work promptly after completion of installation including removal of strippable coating. Comply with recommendations of both the panel and coating manufacturers.

B. Remove strippable coating from face of panels. Remove all shavings from the face of panels.

C. Protection: Protect the preformed metal panels as needed to ensure that the work will be without damage or deterioration at the time of final acceptance.

3.05 REPAIR AND TOUCH-UP

A. Damaged Material: Remove and replace panels and component parts of the work which have been damaged (including finish) beyond successful repair, as determined by the Engineer. Repair minor damage as acceptable to the Engineer.

END OF SECTION

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SECTION 07 46 46

MINERAL FIBER CEMENT SIDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Preformed mineral-fiber cement panels, complete. The work also includes flashings, exposed sheet metal, trim, fasteners, and sealants associated with the work of this Section.

B. Related Sections:
1. Section 06 20 00 - Finish Carpentry.
2. Section 07 60 00 - Flashing and Sheet Metal.
3. Section 07 92 00 - Joint Sealants.

1.02 PERFORMANCE REQUIREMENTS

A. Load: Fabricate and install the siding capable of supporting a design wind load of 20 psf with deflection no greater than L/180.

B. Water-Infiltration Requirements: Install the siding panels so that no water infiltrates through the panels.

1.03 SUBMITTALS

A. Shop Drawings: Submit complete fabrication and erection drawings. Indicate dimensions, elevations, panel layout, construction details, method of anchorage, trim, accessories, and method and sequence of installation.

B. Product Data: Submit manufacturer's specifications, literature, and product data, and installation instructions.

C. Samples: Submit samples not less than 6 x 6 inches size, in texture specified, along with fasteners.

D. Qualification Data: Submit installer qualifications.

E. Product Certification: Submit certification that mineral-fiber cement siding is asbestos-free.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Workers trained in the installation of fiber cement siding.

B. Preinstallation Meeting: Conduct a preinstallation meeting at the jobsite to review installation procedures and coordination with related work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect the finished surfaces from damage and abrasion during delivery, storage, and handling. Any surface having noticeable and objectionable damage of abrasion, as deemed by the Architect will be rejected.

B. Stack panels on edge or laid flat on a smooth, level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing. If sheet should become wet, allow to dry thoroughly before installing.

1.06 SEQUENCING

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.07 WARRANTY

A. Warrant for a period of 2 years from the Date of Completion that the siding shall be free of defects in material and workmanship and that it will not leak water, deteriorate, or otherwise fail to perform as required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fiber-Cement Vertical Siding Panels:
   1. Manufacturer: Located within 500 miles of the jobsite.
      a. James Hardie Building Products "Hardipanel", Reno, NV.
      b. Certainteed Corp., White City, OR
      c. Or equal.
   2. Standard: Conforming to ASTM C1186, Type A - Exterior, Grade II.
   3. Combustibility: Non-combustible, in accordance with ASTM E136.
   4. Fire Resistance: ASTM E84: flame spread = 0; smoke developed = 5.
   5. Size/Profile: 5/16 inch thick x 48 inch wide x full story height.
   6. Texture: Smooth.

B. Battens, Corners and Trim: Red cedar, as specified in Section 06 20 00.

2.02 ACCESSORY MATERIALS

A. Underlayment Paper:
   1. Standard: Two layers building paper meeting FS-UU-B-790a, Type 1, Grade D, Style 2, and UBC Standard 14-1, and having 60 minute water resistance.
   2. Manufacturer: Fortifiber Corporation "Super Jumbo Tex", Leatherback Industries "Super Plasterkraft 60", or equal.

B. Formed Sheet Metal Trim, Corners, Flashings, Joint Backing, and Other Exposed Items: Galvanized sheet metal. Refer to Section 07 60 00.

C. Fasteners for Siding Panels: Type 302 or 304 stainless steel hexagonal head screws or bolts with stainless steel and neoprene self-sealing washers, as recommended by the panel manufacturer and conforming to ASTM F593.

D. Sealant: As specified in Section 07 92 00.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the conditions and substrates in which the siding work is to be installed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION - UNDERLAYMENT

A. Lay single thickness of underlayment with horizontal joints lapped 2 inches minimum and vertical joints 6 inches minimum.

B. Install second layer of underlayment 12 inches wide at corners or extend first layer 6 inches around corner to make double thickness. Fasten felts with only enough nails to hold in place until covered with siding.

3.03 INSTALLATION - SIDING PANELS

A. Do not install any component which has defects, including damaged finish, chips, dents, cracks, and bends.

B. Follow carefully methods and procedure recommended by panel manufacturer.

C. Apply siding panels vertically, with straight joints, unless otherwise indicated.

D. Drill and fasten to panel sheathing, framing and to each other with approved stainless steel screws and toggle bolts.

E. Install closure strips at head, sills and other locations as shown.

E. Fit panels to sheet metal flashing, penetrations and perimeter materials and conditions as shown and as required to attain close joints and weather-tightness.

F. Fit and bolt corners and other trim shapes as required to complete installation.

G. Seal at lap joints and at corner and other trim in accordance with panel manufacturer's recommendations.

H. Seal at penetrations and at perimeter where panels abut metal frames, projections, etc., as shown and in conformance with Section 07 92 00.

3.04 CLEANING AND CORRECTION

A. Upon completion of installation remove debris and excess materials from premises.

B. Damaged Material: Remove and replace panels and component parts of the work which have been damaged (including finish) beyond successful repair, as determined by the Engineer. Repair minor damage as acceptable to the Engineer.

END OF SECTION

SECTION 07 54 23

THERMOPLASTIC-POLYOLEFIN ROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fully-adhered thermoplastic-polyolefin (TPO) membrane roofing over tapered insulation board, with flexible flashings and accessories, complete.

B. Related Sections:
1. Section 06 10 00 - Rough Carpentry
2. Section 07 41 13 - Metal Roof Panels.
3. Section 07 60 00 - Flashing and Sheet Metal: Metal counterflashing.
4. Division 22 - Plumbing: Roof drains.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings detailing special joint and termination conditions and conditions of interface with other materials.

B. Product Data: Submit product data for sheet membrane, elastomeric flashing, joint cover sheet, and joint and crack sealants, with temperature range for application of membrane.

C. Samples: Submit samples of the following:
1. Two samples of each product proposed for use.
2. 24 x 24 inch sample of membrane and typical field seam showing layers of construction.

D. Installer Qualification Certificates: Submit certificates signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

E. Installation Instructions: Submit manufacturer's installation instructions.

F. Sample Warranty: Submit sample copy of system manufacturer's 20-Year Total System Warranty covering all roofing components installed above the roof deck.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installation of sheet roof membranes approved by membrane manufacturer to install the type of system specified.
1. Submit written evidence that Contractor is authorized and trained by the manufacturer to install the specified membrane system.

B. Regulatory Requirements:
1. Comply with requirements of California Building Code.
2. Comply with Underwriters Laboratories, Inc. (UL) for Class A Fire Hazard Classification.

3. Factory Mutual Engineering Corporation (FM): Roof assembly classification, FM Construction Bulletin 1-28, Class 1 Construction.

C. Standards: Comply with the following Factory Mutual Global (FMG) "Loss Prevention Data Sheets":
1. FMG 1-28 "Wind Loads to Roof Systems and Roof Deck Securement".
2. FMG 1-29 "Above-Deck Roof Components".
3. FMG 1-49 "Perimeter Flashing".

D. Mockups: Submit field sample mockup to represent conditions of finished work including internal and external corners, seam jointing, attachment method, sealing and counterflashing cover, control and expansion joints.

E. Pre-Installation Meeting: Schedule a pre-installation meeting to review the roofing work two weeks prior to actual installation. The meeting shall be attended by a representative of the City, Engineer, Contractor, roofing material manufacturer, roofing and roof deck installer, sheet metal installer, and other installers whose work may affect the quality of the roofing. Review in detail the following major items:
1. Specifications, roof plan, roof deck, drainage, flashing details, and other work related to roofing. Discuss conflicts, incompatibility, and inadequacies.
2. Job conditions, schedule, construction sequence, application requirements, and the quality of the completed installation.
3. Means of protecting the completed work during the remainder of the construction period. Present to the City recommendations for future roof maintenance and inspection.

F. Certification: Roofing contractor and manufacturer shall review details, existing conditions, and adjacent construction and state in writing that adjacent materials and construction are compatible with their product and warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the jobsite in their original, tightly-sealed containers or unopened packages.
1. Clearly label all materials with the manufacturer's name and product identification.
2. Each package shall bear the label of an approved agency having a service for the inspection of material and finished products during manufacture, in accordance with CBC, Chapter 15, Section 1507.2 Identification.

B. Store membrane rolls lying down, fully protected from moisture and in sealed storage bags. Store adhesives at temperatures above 40 degrees F. Follow storage instructions and precautions recommended by material manufacturer.

C. Store materials other than roofing membrane in weather protected environment clear of ground and moisture. Protect insulation from direct sunlight exposure.

D. Replace damaged materials with new materials.

1.05 PROJECT CONDITIONS

A. Do not apply membrane during inclement weather or when air temperature is below 40 degrees F.

1.06 WARRANTY

A. Provide manufacturer's Total System Warranty covering labor and materials for a period of twenty (20) years from Date of Completion. Include coverage of materials and installation, and resultant damage resulting from failure to resist penetration of moisture.

B. Warrant system against wind damage for up to 60 mph design wind speed for mechanically attached insulation, and for up to gale force winds for adhered insulation.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Johns Manville "TPO-60 Fully Adhered System", Carlisle SynTec Inc. "Sure-Weld", Firestone Building Products, or equal.

2.02 MEMBRANE MATERIALS

A. Membrane: Scrim-reinforced flexible uncured Thermoplastic-Polyolefin (TPO) Sheet, meeting ASTM D6878.
   1. Thickness: Minimum 60 mils.
   2. Color: White.
   3. Reflectivity and Emissivity: As listed by the Cool Roof Rating Council (CRRC):
      a. Reflectivity: Minimum 0.70
      b. Emissivity: Minimum 0.90.
      c. SRI: Minimum 78.

Property	Test	Results
Breaking Strength, Min.	ASTM D751	225 lbf
Elongation at Reinforcement Break	ASTM D412	Min 15 percent
Tear Strength, Min.	ASTM D751, Procedure B	55 lbf
Shore A Hardness	ASTM D2240	75
Brittleness Point,	ASTM D2136	-45 deg. C
Ozone Resistance, no cracks	ASTM D1204	Pass
Water Absorption	ASTM D1149	3.0 percent
Field Seam Strength, lbf/in	ASTM D3274	No cracks, after aging
Water Vapor Permeance, Perms	ASTM D1876	60 typical
Puncture Resistance, lbf	ASTM FTM 191B	250 lbf
Weather Resistance	ASTM G155	No cracks

B. Flashing: Same membrane as roofing membrane, furnished by membrane manufacturer for the system. Provide unreinforced membrane for field-fabricated vent stacks, pipes, drains, and corners.

C. Adhesives, Sealants, Primers and Caulks:
   1. Bonding Adhesive: Manufacturer's recommended bonding adhesive, for bonding

membrane to substrates, furnished by membrane manufacturer for the system.
2. Sealant: Manufacturer's recommended all-purpose sealant, for use as a water cutoff mastic, sealant to top off pitch boxes, and an exterior grade caulk for metal work.
3. Cut Edge Sealant: Manufacturer's recommended Seam Sealant, solvent based, to seal exposed cut edges of reinforced membrane.
4. Seam Cleaner: Manufacturer's recommended seam cleaner, to clean dirty or contaminated membranes prior to heat welding.

2.03 RELATED MATERIALS

A. Polyisocyanurate Board Insulation:
1. Manufacturers: Johns Manville, Carlisle SynTec, Firestone Building Products, and as approved by the roofing membrane manufacturer.
2. Standard: Meeting ASTM C1289, Type II, felt or glass-fiber mat facer on both major surfaces.
3. Tapered Insulation: Provide tapered insulation to provide smooth transitions at crickets and to slope to drains.

B. Cover Board: Silicone-treated gypsum core with fiberglass mat facings, UL listed Class A fire hazard, 0 flame spread and 0 smoke developed when tested in accordance with ASTM E84, 1/2-inch thick; G-P Gypsum Corp. "Dens Deck", or equal.

C. Mechanical Fasteners: Corrosion resistant type appropriate to deck substrate and purpose intended, length as required for thickness of insulation and material, with washers, furnished or accepted in writing by the membrane manufacturer.

D. Wood Nailers: Douglas Fir #2 or better, pressure treated with salt preservatives, of thickness so that top of nailer is flush with the membrane underlayment.

E. Termination Bar: Manufacturer's standard bar.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify deck is clean and smooth, free of debris, depressions, waves, projections or other irregularities, and properly sloped to drains. The substrate shall be clean, smooth, free of flaws, sharp edges, loose and foreign material, oil and grease.

B. Verify roof openings and penetrating elements through roof are solidly set, wood cant strips, wood nailing strips and reglets are in place.

C. Do not apply roofing materials to damp, frozen, dirty, dusty, or deck surfaces unacceptable to manufacturer.

D. Verify that surface joints and adjacent walls do not vary more than 1/4 inch in plane. Repair wider joints with insulation or other appropriate material.
E. Before beginning installation, state in writing that existing conditions are acceptable, and that existing conditions are in compliance with the roofing product and warranties. Do not begin

installation until unsatisfactory conditions have been resolved.

3.02 PREPARATION

A. Install nailers at the perimeter of the roof and around all roof projections, unless otherwise shown on manufacturer's standard details.

B. Securely anchor nailers to the deck at a maximum 3'-0" on center, to resist a pullout force of 175 pounds per foot in any direction. Provide a 1/2 inch vent space between adjacent lengths of nailers.

C. Height of nailers shall match the surface level of the insulation and roof membrane.

3.03 INSTALLATION - INSULATION

A. Place insulation boards in accordance with insulation manufacturer's written instructions and recommendations for use with a fully-adhered roofing system.

B. Lay boards to moderate contact without forcing joints. Cut boards to fit neatly to perimeter blocking and around penetrations and projections through roof.

C. Lay tapered or feathered boards to provide a sump area around roof drains for positive drainage.

D. Mechanically fasten insulation boards over roof surface in accordance with the manufacturer's recommendations and Factory Mutual "Loss Prevention Data 1-49".

E. Tape joints of boards in accordance with insulation manufacturer's instructions.

F. Install cant strips to internal corners by mechanical fasteners.

G. Install cover board over insulation, fully adhered using manufacturer's recommended adhesive, in accordance with membrane manufacturer's written recommendations.

3.04 INSTALLATION - MEMBRANE

A. Install membrane roofing in accordance with membrane manufacturer's written instructions. Do not expose materials to the elements in quantities greater than can be applied and sealed during same day.

B. Roll out membrane, minimizing wrinkles and bubbles.

C. Apply a 100 percent continuous coat of bonding adhesive to the bottom side of membrane and to the substrate. Spread adhesive by roller full strength. Allow adhesive to become tacky, then unroll the glued portion of the membrane and lower onto the glued substrate surface. Roll with a pressure roller to achieve full contact.

D. Clean membrane prior to seam welding in accordance with manufacturer's written recommendations.

E. Shingle joints on sloped substrate in direction of drainage. Overlap edges and ends of

membrane 2 inches and hot-air weld without any contaminants in the seam. Use automatic hot air welder for field seaming application.

F. Check welded seams for continuity and integrity with an approved probing tool after seam has cooled to verify seam consistency. Do not probe before seam has cooled.

G. Perform destructive tests daily on a 3 inch wide area of seam weld to verify good peel strength. Properly welded seam will have membrane delamination from scrim before weld failure. Perform destructive tests on welds for the first seam of the day, first seam after robot welder has been allowed to cool down, and after any extreme changes in weather conditions.

H. Caulk cut edges by applying Seam Sealant from a squeeze bottle.

I. Protection: Protect membrane immediately after installation and throughout subsequent construction. Retest any areas left exposed and/or damaged during construction.

3.04 INSTALLATION - FLASHING

A. Install flexible sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions and standard details.

B. Apply 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. Securely attach flashings and terminations in the plane of the roof deck as recommended by the manufacturer.

C. Roof Penetrations: Seal items penetrating membrane with manufacturer's recommended edge sealant. Provide flashing metal or membrane pieces around all roof pipe penetrations to seal penetration tight to membrane. Provide draw band and sealant at vent pipes.

3.05 WATER TEST

A. Immediately after installation of the roofing membrane, and when the membrane is fully set, dry and cool, dam the area designated by the Engineer and subject to a flood test of 2 inches minimum of water for not less than 48 hours. After the water has been removed, repair leaks, re-test and protect the accepted segment.

3.06 CLEANING AND PROTECTION

A. Upon completion of work, clean roof of all construction materials, dirt, sealant, smudges, etc.

B. Protect finished installation from damage. Close off area to prevent unauthorized traffic.

END OF SECTION

SECTION 076000

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Flashing and sheet metal work, complete, including, but not necessarily limited to, the following:
   1. Coping, edge, and cap flashings.
   2. Gutters and rain-water-leaders.
   3. Downspouts.
   4. Roof and miscellaneous flashings.
   5. Flue pipe, roof exhaust vent, spark arrestor, and vent cap for forge at Blacksmith Building.
   6. Counterflashings over base flashings at vent stacks, etc.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry.
   2. Section 07 41 13 - Metal Roof Panels.
   3. Section 07 54 23 - Thermoplastic-Polyolefin Roofing.
   4. Section 07 92 00 - Joint Sealants.
   5. Section 09 91 00 - Painting: Prime and finish painting.
   6. Division 22 - Plumbing: Flashing sleeves and collars for plumbing vents protruding through roofing, and downspout boots.
   7. Division 23 - HVAC: Flashing sleeves and collars for HVAC items protruding through roofing membrane.

1.02 SUBMITTALS

A. Shop Drawings: Submit fully detailed, large-scale shop drawings of all fabricated items, including all flashing, and counterflashings. Describe material profile, jointing pattern, jointing details, fastening methods, and installation details.

B. Qualification Data: Submit installer qualifications.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company experienced and specializing in fabricating and installing sheet metal flashing work.

B. Standards: Conform to the applicable provisions of the "Architectural Sheet Metal Manual", latest edition, as issued by the Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA).

1.04 DELIVERY, STORAGE, AND HANDLING

A. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.

B. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Galvanized Steel: ASTM A653, G90; 24-gage core steel; minimum 27 percent post-consumer recycled content; typical at all flashings, counterflashings, gutters, and caps, unless otherwise noted.

B. Elastomeric Flashing: Modified bituminous sheet rubber, self-adhesive-backed rubberized asphalt, in continuous length x widths as required; W.R. Grace "Vycor V40", Johns Manville, or equal. Provide under sheet metal parapet caps, under gutters, under sheet metal valleys, and where shown on the Drawings.

C. Screens for Strainers and Gutters: Stainless steel wire hardware cloth woven of minimum No.20 B&S gauge wire with 1/2-inch square mesh.

D. Downspouts: Schedule 40 galvanized steel pipe, diameter as indicated on Drawings.

E. Screws and Fasteners: Same material as sheet metal or material being fastened; hot-dip galvanized or stainless steel.

F. Solder For Galvanized Steel: ASTM B32; 50 percent tin, 50 percent lead, with rosin flux.

G. Cleats: 2-inch wide x 3-inch long, unless otherwise indicated. Fabricate from same material and gage as sheet metal being installed.

H. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessories as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gage as required for performance.

I. Galvanized Repair Paint: Zinc-rich repair paint, Z.R.C., Cold Galvanizing, Tnemec-zinc 92, or equal.

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15 mil dry film thickness per coat, non-corrosive, free of asbestos fibers, sulfur components and other deleterious impurities.

K. Elastomeric Sealant: ASTM C920, polyurethane or silicone sealant, of type and class required to seal joints in sheet metal flashing and trim, and remain watertight.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects. Form pieces in longest practical lengths. Solder and seal metal joints. After soldering, remove flux. Wipe and wash solder joints clean.

1. Cleats and Starter Strips: Fabricate of same material as sheet, minimum 3 inches long, interlockable with sheet.
2. Exposed Edges: Hem on underside 1/2 inch; miter and seam corners. Form material with flat lock and cover plate seam, as shown.
3. Corners: Fabricate from one piece with minimum 24 inch long legs; mechanically fasten and solder watertight.
4. Vertical Faces: Fabricate with bottom edge formed outward 1/4 inch and hemmed to form drip.
5. Counterflashings: Fabricate to allow toe to extend 4 inch minimum over roofing surface. Return and brake edges.

2.03 FINISHES

A. Exposed Surfaces: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for applying and designating finishes. Protect prepainted finishes on exposed surfaces with a strippable temporary protective covering.
   1. Colors: To be selected by Engineer.

B. Concealed Surfaces: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting with bituminous coating. Apply a minimum of 15 mils dry film thickness.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrate and the conditions under which flashing and sheet-metal Work is to be performed. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.

C. Verify membrane termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Field measure site conditions prior to fabricating work. Install starter and edge strips, and cleats before starting installation.

3.03 INSTALLATION

A. General: Apply all work to even, smooth, sound, thoroughly clean, and dry surfaces free from defects. Install all work plumb and securely fastened for watertight installation. Provide accessories and other items essential to completion of work, though not specifically shown or specified.
B. Install sheet metal according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Conform to drawing details included in SMACNA manual. Install self-adhesive membrane flashings prior to or in conjunction with sheet metal items as shown on the Drawings.

C. Attachments: In general, confine attachments of sheet metal less than 12 inches wide to one edge only. Space screws or nails evenly and approximately 4 inches apart. Where sheet metal is applied to surfaces other than wood, provide shop drawings to establish locations for sleepers and nailing strips required to secure the work properly.

D. Soldering: Solder metal joints watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

E. Expansion and Contraction: Provide expansion and contraction joints at all sheet metal work. Unless otherwise specified or indicated, make up long straight runs of sheet metal work in 12 foot lengths maximum, and connect together with 3 inch loose-lock slip-type joints, and fill with sealant as specified. For straight runs less than 12 feet but more than 8 feet, make a similar slip-type joint at center of run. Lock and solder seams of intermediate joints between expansion joints.

F. Flashings:
   1. Provide flashings, where shown or required, to provide watertight protection; use galvanized sheet metal, unless otherwise indicated on Drawings.
   2. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations approved by Architect.
   3. Fit flashings tightly in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

G. Counterflashings:
   1. Provide counterflashings at intersections of roof with vertical surfaces and similar conditions. Secure to vertical surfaces as detailed.
   2. Turn down counterflashings over base flashings not less than 4 inches; form to provide a spring action against base flashing or roofing.
   3. Insert counterflashings into reglets to form tight fit. Secure in place with plastic wedges at maximum 16 inches on center. Seal into reglets with sealant.
   4. Overlap joints a minimum of 4 inches and bed with elastomeric sealant. Provide prefabicated end closures.

H. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
   1. Anchor interior leg with screw fasteners and washers at maximum 24 inches on center as recommended by SMACNA and FMG for Wind Zone 1.

3.04 CLEANING AND PROTECTION

A. Clean off excess solder and sealants. Remove temporary protective coverings and strippable film as sheet metal flashing and trim are installed.

B. Protect dissimilar metals from contact with each other and from surfaces which cause corrosion of the metal by coating with bituminous coating or other approved isolator. Paint faces of all sheet metal in contact with exposed pressure-treated wood with bituminous paint.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Firestopping materials for fire-rated construction, complete, as specified, including the following:
   1. Through-penetration firestop systems for penetrations through fire-rated assemblies.
   2. Fire-resistant joint systems for joints between walls and floors/ceilings.

B. Related Sections:
   1. Section 07 21 00 - Thermal Insulation: Thermal and acoustical insulation.
   2. Section 09 29 00 - Gypsum Board: Fire-rated gypsum board assemblies.

1.02 PERFORMANCE REQUIREMENTS

A. Fire Resistance of Penetration Systems: Provide firestopping materials which are asbestos-free and are manufactured and installed to resist spread of fire, passage of smoke and other gasses, and maintain fire rating of assembly penetrated, in accordance with ASTM E814 and the following:
   1. Materials: Asbestos-free and lead-free, and that do not deteriorate over time.
   2. Combustibility: Non-combustible, in accordance with ASTM E136.
   3. Fire Resistance and Hose Stream Tests: Rated "F" and "T" in accordance with ASTM E814 or UL 1479.
   4. Ratings: Match the fire-resistive rating of the floor, wall, partition, or roof assembly in which the firestop material is installed.
   5. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479. Provide with air leakage L-Rating not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.
   6. Movement: Provide sealants sufficiently flexible to accommodate motion due to building movement, thermal expansion, pipe vibration, water hammer, etc. without damage to seal.
   7. Compatibility: Provide firestop systems that are compatible with one another, with the substrates forming openings, and with the items penetrating the fire barrier, as demonstrated by the firestop manufacturer based on independent tests.
   8. Systems Exposed to Moisture: Provide moisture-resistant firestopping systems.
   9. Insulated Piping Systems: Provide systems not requiring removal of insulation.
   10. Systems Exposed To View: Flame-spread rating of 25 or less, and smoke-developed rating of 450 or less, when tested in accordance with ASTM E84.

B. Fire Resistance of Joint Systems: Provide systems with fire ratings equal to, or greater than the construction in which the joints are located, as determined by ASTM E1966.
   1. Materials: Asbestos-free, and that do not deteriorate over time.
   2. Movement: Provide joint systems tested to accommodate movement in accordance with cyclic movement test criteria of ASTM E1399, ASTM E1966, or ANSI/UL 2079 without air leakage. Provide joint sealants sufficiently flexible to accommodate movement due to building movement and thermal expansion without damage to seal.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings of each firestopping condition and assembly showing material installation details including reinforcement, anchorage, fastenings, and UL listing indicating "F" and "T" rating. Provide a schedule on shop drawings which identifies each firestopping type, material, and thickness, including applicable UL or FM system number.

B. Product Data: Submit manufacturer's product data for each firestopping material including composition, performance characteristics, and installation procedures, in accordance with UL or rating agency's listing requirements.
   1. Indicate VOC content in g/L calculated according to 40 CFR 59.

C. Qualification Data: Submit installer qualifications.

D. Certificates of Compliance:
   1. Submit manufacturer's certificates of compliance that the materials meet the requirements specified.
   2. Submit a statement from applicator of firestopping systems that each system has been accepted by local governing agencies for each specific condition on Project.
   3. Research/Evaluation Reports: Submit for each type of fire-resistive joint system showing compliance with ICC Evaluation Service AC30.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Firm having documented experience in the installation of firestopping materials on projects of comparable size to this Project, and approved by the firestopping material manufacturer(s).

B. Regulatory Requirements:
   1. Penetrations: Comply with 2010 California Building Code (CBC) Section 713 - Penetrations.
   2. Joint Systems: Comply with 2010 CBC Section 714 - Fire-Resistant Joint Systems.
   3. Listings: Provide materials, accessories, and application procedures which are listed by State Fire Marshal and by an approved testing agency, and which are non-toxic and non-hazardous.
   4. VOC Limits: Comply with 2010 CCR Title 24 Part11 (CALGreen), Section 5.504 - "Pollutant Control" and South Coast Air Quality Management District (SCAQMD) Rule #1168. Provide sealants and primers with the following maximum VOC limits:
      a. Sealants: 250 g/L.
      b. Sealant Primers for Nonporous Substrates: 250 g/L.
      c. Sealant Primers for Porous Substrates: 775 g/L.

C. Tests:
   1. Penetration Systems: Provide firestopping materials which have been tested in accordance with ASTM E814 or UL 1479 to achieve the rating required. For penetrations of pipe materials, etc. that have not been tested in accordance with ASTM E814, provide a written certification from the firestop manufacturer stating that the firestop material will meet the requirements for successfully passing the tests in ASTM E814.

2. Joint Systems: Provide materials which have been tested in accordance with ASTM E1966 or UL 2079.

D. Source Limitations: Provide materials for each kind of firestopping and through-penetration system produced by a single manufacturer for the entire project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers with manufacturer's name, labels, product identification, lot numbers, testing and inspection agency's classification marking, and mixing, curing, and installation instructions.

B. Store materials in the original, unopened containers under cover and protected from damage, and as recommended by the manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install firestop systems when ambient or substrate temperatures are outside limits permitted by system manufacturer, or when substrates are wet due to rain, frost, condensation, or other causes. Do not install firestopping materials until building is sufficiently enclosed and protected against temperature extremes and moisture, and adjacent construction is thoroughly dry.

B. Follow manufacturer's printed instructions for mixing and installing foam seals. Use manufacturer's recommended precautions when using materials considered to be toxic or otherwise hazardous. Ventilate area where systems are installed in accordance with manufacturer's written instructions by natural means or by forced-air circulation where necessary.

1.07 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, and cut openings to accommodate through-penetration firestop systems.

C. Install firestopping after installation of items penetrating the surface, but prior to concealing the opening. In gypsum board assemblies, complete firestopping work before beginning gypsum board finishing operations.

PART 2 - PRODUCTS

2.01 THROUGH-PENETRATION FIRESTOP SYSTEMS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. 3M Fire Protection Products.
2. Hilti Construction Chemicals Inc.

3. RectorSeal
4. Specified Technologies Inc.
5. Tremco

B. General:
1. VOC Content: Comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. Sealants: 250 g/L.
   b. Sealant Primers for Nonporous Substrates: 250 g/L.
   c. Sealant Primers for Porous Substrates: 775 g/L.

C. Firestopping Intumescent Putties: Non-hardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds; RectorSeal "Flame-Safe FSP 1000 Putty", Hilti "CP 618 Firestop Putty", 3M "Fire Barrier Moldable Putty", or Specified Technologies Inc. "Specseal Putty".

D. Intumescent Wrap Strips: Single-component intumescent elastomeric strips faced on both sides with a plastic film; RectorSeal "FlameSafe FSWS Wrap Strip", 3M Construction Markets "Fire Barrier FS-195 Wrap Strip", or Specified Technologies Inc. "RED2 or BLU2 Wrap Strip".

E. Silicone Firestopping Foams: Two-component, silicone elastomer type, that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam; 3M "Fire Barrier 2001 Silicone RTV Foam", Specified Technologies Inc. "Pensil 200 Foam", or equal.
1. Forming/Damming Materials: Mineral fiberboard or other material recommended by foam firestopping manufacturer.
2. Primer, Sealant and Solvent Cleaner: As recommended by foam firestopping manufacturer.

F. Silicone Firestopping Sealant: Moisture-curing, single-component, silicone-based, neutral-cure elastomeric sealant:
1. Grade: Pourable (self-leveling) for openings in floors and horizontal surfaces; nonsag for openings in vertical surfaces, unless otherwise required by manufacturer=s listed system.
2. Manufacturers: Hilti "CP 601S Elastomeric Firestop Sealant", 3M "Fire Barrier 2000 or 2003 Sealant or Caulk Type CP25", Specified Technologies Inc. "Pensil or SIL", or Tremco "Fyre-Sil Silicone".

G. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture; RectorSeal "Flamesafe FS900", Specified Technologies Inc. "SSS or LCI Intumescent Sealant", Tremco "Tremstop Acrylic", or equal.

H. Accessories: As appropriate to penetration being filled, and approved by system manufacturer, testing and inspection agency, and code authority having jurisdiction. Items include:
1. Permanent forming, damming and backing materials, including slag/rock wool fiber insulation, sealants used in combination with other forming materials to prevent leakage of fill materials in liquid state, fire-rated form boards, and fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars and steel sleeves.

2.02 FIRE-RESISTANT JOINT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. A/D Fire Protection Systems Inc.
   2. Hilti Construction Chemicals Inc.
   3. RectorSeal.
   4. Tremco.
   5. United States Gypsum Company.

B. General: Provide fire-resistant joint systems which are listed in UL's "Fire Resistance Directory" under product Category XHBN, or listed by other acceptable testing agency.

C. Mineral-Fiber Firestopping: Semi-rigid type, with a minimum density of 4 pounds per cubic foot, containing no asbestos fibers; A/D Fire Protection Systems "Firebarrier Mineral Wool", Tremco "Cerablanket F.S.", U.S. Gypsum "Thermafiber Safing", or equal.
   1. Support Clips: U.S. Gypsum "Thermafiber Safing Impaling Clips", or equal; or clips may be custom designed and fabricated from galvanized sheet steel to suit the conditions of installation.

D. Elastomeric Spray: Flexible, water-based, fire-rated mastic for construction joints, up to 50 percent movement capability, suitable for application by standard spray equipment, tested to UL 2079; RectorSeal "FlameSafe FS3000", Hilti "CP 672 Firestop Joint Spray", or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the openings and voids to be sealed. Verify that conditions are satisfactory for the installation of firestopping materials. Do not commence work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean contact surfaces immediately before installing fire-resistive systems to comply with fire-resistive system manufacturer=s written instructions and as follows:
   1. Remove foreign materials that could interfere with adhesion of fill materials.
   2. Clean substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended by system manufacturer using manufacturer=s recommended products and methods. Do not allow spillage and migration onto exposed surfaces.

C. Protect adjacent surfaces and surfaces to remain exposed in the finish Work with masking tape or other acceptable temporary masking material.

3.03 INSTALLATION

A. Install firestopping in accordance with the approved fire listed and rated assembly, specified performance requirements, and manufacturer's printed instructions as applicable to the conditions of installation.

B. Provide firestopping for conditions specified, whether or not firestopping is indicated; and if indicated, whether such material is designated as insulation, safing or otherwise. Do not install insulation types specified in other Sections in lieu of firestopping materials specified herein.

C. Provide firestopping whether or not there are sleeves, clips, angles, plates or other items bridging or interconnecting building elements, and whether or not such items are continuous.

D. Install forming/packing/backing materials and other accessories as required to support fill materials and to product cross-sectional shapes and depths required to achieve fire ratings indicated.

E. Install fill materials by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
   2. Apply fill materials so they contact and adjere to substrates formed by joints.
   3. For fill materials that will remain exposed after completion of Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

F. Penetrations:
   1. Includes conduit, cable, wire, pipe, ducts and other elements which pass through one or both outer surfaces of a floor, roof, wall or partition.
   2. Except for floors on grade, where a penetration occurs through a structural floor or roof, and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide firestopping to completely fill such spaces, and for the full depth of the structural floor or roof.
   3. Where a penetration occurs at a fire-rated wall or partition of solid-type construction, provide firestopping to completely fill spaces around the penetration, and for the full depth of the wall or partition.
   4. Where a penetration occurs at a fire-rated wall or partition of hollow-type construction, provide firestopping to completely fill spaces around the penetration, on each side of the wall or partition, and for a depth not less than the thickness of the wall or partition finish materials.
   5. Provide firestopping to fill miscellaneous voids and openings in fire-rated construction in a manner essentially the same as specified hereinbefore.

3.04 CLEANUP

A. Remove spilled and excess materials from firestopping installation without damaging adjacent surfaces. Leave finished Work in neat, clean condition, with no evidence of spill-overs or damage to adjacent surfaces.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Preparation of sealant substrate surfaces, and providing of sealant and backing materials, complete.

B. Related Sections:
1. Section 07 60 00 - Flashing and Sheet Metal: Sealants used in conjunction with roofing and metal flashings.
2. Section 08 80 00 - Glazing: Sealants used in conjunction with glazing.
3. Section 09 29 00 - Gypsum Board.

1.02 SUBMITTALS

A. Product Data: Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability for each condition and use. Manufacturer's Data: Submit manufacturer's specifications, recommendations, and installation instructions, including cleaning of joint surfaces, for each type of material required.
1. Include printed statement of VOC content. Indicate VOC content in g/L calculated according to 40 CFR 59.

B. Samples: Submit samples of each color required for each type of exposed sealant. Samples will be reviewed by Engineer for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Qualification Data: Submit installer qualifications.

D. Product Certificates: Submit manufacturer's certificate for each product that sealants meet or exceed specified requirements.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Experienced and specializing in applying the Work of this Section, and approved by sealant manufacturer.

B. Regulatory Requirements: Comply with CALGreen, 2010 Edition, Mandatory Measures, and VOC limits of Bay Area Air Quality Management District, Regulation 8, Rule 51.

C. Quality Control: Comply with manufacturer's printed instructions for surface preparation, priming, installation, tooling, and curing, except where more stringent requirements are specified.

1.04 PROJECT CONDITIONS

A. Do not install solvent-curing sealants in enclosed building spaces.

B. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range.

1.05 WARRANTY

A. Provide ten (10) year warranty. Include coverage of installed sealants and accessories which fail to achieve air-tight and water-tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.01 SEALANT MATERIALS

A. General:
   1. Compatibility:
      a. Before purchase of each required material, confirm its compatibility with every other material to which it will be applied in the joint system.
      b. Where more than one sealant material is in contact or potentially in contact with another, provide sealant materials which are compatible with each other.
      c. Where specified butyl-rubber sealant is to be in contact with silicone sealant, provide silicone sealant instead of the specified butyl-rubber sealant.
   2. VOC Content of Interior Sealants: Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and rule amendment date of January 7, 2005. Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59:
      a. Sealants: 250 g/L.
      b. Sealant Primers for Nonporous Substrates: 250 g/L.
      c. Sealant Primers for Porous Substrates: 775 g/L.
   3. Colors: For concealed material provide any of manufacturer's standard colors; for exposed material provide manufacturer's standard colors as selected by Architect, unless otherwise noted.

B. Exterior Concealed Sealant for Bedding Purposes: Single-component butyl sealant, solvent release, non-skinning, non-sagging; meeting FS TT-S-001657; DAP "Butyl-flex", Bostik "Chem-Calk 300", or equal.

C. Exterior Exposed Joints for General Use: Single-component nonsag polyurethane sealant; meeting ASTM C920, Type S, Grade NS, Class 25; Sika Corporation "Sikaflex-1a/15 LM", Tremco "Dymonic FC", Sonneborn "NP-1", or equal.

D. Exterior Exposed Joints of Nonporous Substrates (Glass, Metals, etc.): Single-component neutral-cure silicone sealant; meeting ASTM C920, Type S, Grade NS, Class 25; Dow Corning "795 Glass and Metal Building Sealant," G.E. "Silpruf," or equal.

E. Horizontal Traffic Joints, Interior or Exterior: Single-component pourable polyurethane sealant, self-leveling, color to match adjacent surfaces or grout color; meeting ASTM C920, Type S,

Grade P, Class 25; Tremco "Vulkem 45," Sonneborn "Sonolastic SL 1," or equal.

F. Interior Non-wet, Non-moving Joints: Single-component acrylic emulsion latex, non-staining, non-bleeding, non-sagging; color as selected; meeting ASTM C834; DAP "Acrylic Latex Caulk", Pecora "AC-20", Tremco "Tremflex 834", or equal.

G. Interior Toilet Rooms and Wet Areas: Single-component silicone sealant, non-sagging, mildew-resistant, chemical curing, non-staining, non-bleeding; color as selected; meeting ASTM C920, Type S, Grade NS, Class 25; Dow Corning #786 Mildew-Resistant Silicone", G.E. "Sanitary 1700 Sealant", or equal.

H. Interior Acoustical Joints: Single-component acoustical sealant, permanently flexible SBR latex sealant, non-drying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable, specifically designed for sealing gypsum board, capable of spanning 1/2-inch wide x 3/8-inch deep gaps; meeting ASTM C834; Presstite Products No. 579.64 Acoustical Sealant, Tremco "Acoustical Sealant", W.W. Henry "Sound Control Sealant No. 413", or equal.

2.02 ACCESSORIES

A. Primer: Non-staining type, VOC compliant, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, VOC compliant, recommended by sealant manufacturer; compatible with joint-forming materials.

C. Joint Backing Rod: Preformed; compressible; resilient; non-staining round backer rod; compatible with joint substrates, sealants, and primers; as recommended by sealant manufacturer for type of sealant; oversized 30 to 50 percent larger than joint width; meeting ASTM D1056.
   1. Typical Joints: Closed cell polyethylene or polyurethane foam.
   2. Horizontal Joints Exposed to Water: Closed cell polyethylene foam, non-absorbent to water, non-outgassing in unruptured state.

D. Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

E. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick x full width of sill plate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrates and the conditions under which sealant work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer. Start of installation means the condition of existing surfaces has been accepted.

3.02 PREPARATION

A. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture, and other substances which could interfere with bond of sealant compound. Etch concrete joint surfaces as recommended by sealant manufacturer. Use cleaning solvent to clean all joint surfaces. Wipe joints free of solvent using clean, dry, white cotton cloths or white, lintless paper. Do not permit solvent to air dry.

B. Prime or seal the joint surfaces. Do not allow primer/sealer to spill or migrate onto adjoining surfaces. All anodized aluminum surfaces to receive sealant shall be primed with primer recommended by the sealant manufacturer, unless sealant manufacturer certifies in writing that primer is not required.

C. Install sealant backer rod for elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown, or when backed by other solid substrate.

D. Install bond-breaker tape wherever backer rod is not used and wherever required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

E. Verify that joint backing and release tapes are compatible with sealant.

F. Protect elements surrounding the work of this Section from damage or disfiguration.

3.03 INSTALLATION - SEALANTS

A. Install sealants in accordance with manufacturer's written instructions, unless more stringent requirements are indicated or specified.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Installation Standard: Comply with recommendations in ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Measure joint dimensions and size materials to achieve required width/depth ratios.

E. Install joint backing to achieve a neck dimension no greater than 1/2 the joint width. Neck dimension to be a minimum 1/4 inch and a maximum 1/2 inch. Install bond breaker where joint backing is not used.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove so that joint will not

trap moisture and dirt.

H. Install sealant around all doors and windows between the unit and the building frame, under sill plate at perimeter walls, and around all observable sources of air leakage from the building.

I. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength, and surface durability.

3.04 INSTALLATION - SILL SEALER GASKETS

A. Install sill sealer gaskets under sill plates. Install in continuous strips the full width of sill plates with no gaps. Cut around anchor bolts and penetrations; do not double up or crease so that sill plates nest tightly against concrete.

3.05 CLEANING AND REPAIRING

A. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces or to migrate into the voids of adjoining surfaces. Clean the adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

B. Repair or replace defaced or disfigured finishes caused by work of this Section. Protect sealants until cured.

END OF SECTION

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Hollow metal steel doors and frames, complete.
   2. Door louvers and accessories for doors as required.

B. Related Sections:
   1. Section 08 14 00 - Wood Doors.
   2. Section 08 71 00 - Door Hardware.
   3. Section 09 91 00 - Painting: Field painting of doors and frames.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings indicating frame configuration, anchor types and spacings, location of cutouts for hardware, reinforcement, and finish. Show door elevations, internal reinforcement, closure method, and cut outs.

B. Schedule: Submit schedule showing location of each door and frame assembly.

C. Product Data: Submit manufacturer's product data and specifications on metal doors and frames, and manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

A. Standards:
   1. Doors and Frames: Conform to ANSI/SDI A250.8.
   2. Installation: Conform to ANSI/SDI A250.11.

B. Regulatory Requirements: Conform to 2010 California Building Code, Section 715 - Opening Protectives, for fire-rated doors, frames, and openings.
   1. Fire-Rated Door and Frame Construction: Tested in accordance with NFPA 252 or UL 10C, and meeting the requirements for smoke and draft control. Permanently affix label to door or frame in accordance with NFPA 80.
   2. Smoke and Draft Control: Assemblies tested in accordance with UL 1784. Show the letter "S" on the fire-rating label.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metalwork cartoned or crated to provide protection during transit and job storage. Break seal on-site to permit ventilation.

B. Inspect hollow metalwork upon delivery for damage. Repair and replace damaged items as required.

C. Store hollow metalwork on raised platforms in vertical positions with blocking between units to allow air circulation. Keep stored material covered and protect form damage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide metal doors and frames manufactured by Amweld Building Products, Ceco Door Products, Curries Co., Windsor Republic Doors, Steelcraft, or equal.

2.02 MATERIALS

A. Cold-Rolled Steel Sheets: ASTM A1008, Commercial Steel (CS), Type B; suitable for exposed applications. Provide steel with minimum 27 percent post-consumer recycled content.

B. Hot-Rolled Steel Sheets: ASTM A1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled. Provide steel with minimum 27 percent post-consumer recycled content.

C. Metallic-Coated Steel Sheets: ASTM A653, Commercial Steel (CS), Type B, with minimum A40 (ZF120) zinc-iron-alloy (galvannealed) metallic coating. Provide steel with minimum 27 percent post-consumer recycled content.

D. Frame Anchors: ASTM A591, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A1008 or ASTM A1011, hot-dip galvanized according to ASTM A153, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread of 25 and smoke-development index; passing ASTM E136 for combustion characteristics.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat, inert-type noncorrosive compound, free of asbestos fibers, sulfur components, and other deleterious impurities.

H. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate-free, complying with ANSI/SDI A250.10 acceptance criteria; compatible with substrate for field-applied coatings despite prolonged exposure.

2.03 STANDARD HOLLOW METAL DOORS AND FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Exterior Doors: Meeting ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level, as follows:
   1. Face Sheets: Metallic-coated steel sheet
   2. Level and Performance: Level 2 and Physical Performance Level B (Heavy Duty), 0.042-inch (18-gage) face sheets.
   3. Type: Model 2 - Seamless edge design.
   4. Core: Fully insulated.

C. Exterior Frames: Meeting ANSI/SDI A250.8, fabricated from metallic-coated steel sheet.
   1. Level 2 - 0.053-inch (16-gage) thick steel.
   2. Fabricate with corners mitered or coped, full profile welded and ground smooth. Knocked down and face welded frames not acceptable.

D. Interior Frames: Meeting ANSI/SDI A250.8, fabricated from cold-rolled steel sheet.
   1. Level 2 - 0.053-inch (16-gage) thick steel.
   2. Fabricate with corners mitered or coped, continuously welded, and ground smooth. Knock-down type frames not acceptable.

E. Hardware Reinforcement: Fabricated according to ANSI/SDI A250.6, with reinforcing plates from same material as door face sheets.

F. Frame Anchors: Minimum 0.053-inch (16-gage) thick steel, UL listed as required for fire rating, as follows:
   1. Wood Stud Anchors: U-shaped anchor, welded to frame, 1 inch wide, with 2 pre-punched holes in nailing flange.
   2. Floor Clips: Adjustable 2-piece angle anchor, full width of frame, 0.067-inch thick steel.

G. Door Louvers:
   1. Manufacturer: Air Louvers Inc. "Model 800A1", Anemostat "AFDL", or equal.
   2. Type: Inverted "Y" blade, non-vision louver.
   3. Material: 18-gage cold-rolled steel frame, 20-gage cold-rolled steel blades.
   4. Finish: Manufacturer's standard baked on prime coat.
   5. Screens: Stainless steel insect screen mesh, in manufacturer's standard stainless steel frame.

2.04 FABRICATION

A. Frames: Fabricate as welded unit type.
   1. Fabricate with hardware reinforcement plates welded in place.
   2. Use concealed connectors, finished to match adjacent members.
   3. Provide adjustable clip angles at bottom of frames for proper frame alignment and height adjustment.
   4. Door Silencers: Prepare frames for resilient rubber, snap-in type silencers. Drill frames for 3 silencers at single doors on strike side, and for 2 silencers on frame head at double doors without mullions. Omit at rated frames and frames with gasketing.
   5. Frames Wider Than 48 Inches: Provide roll-formed steel channels fitted tightly into frame head, flush with top.

B. Doors:
   1. Fabricate with hardware reinforcement plates welded in place.

2. Close top edge of exterior doors flush with inverted steel channel closure. Seal joints watertight.

C. Fire Rated Doors and Frames:
1. Fabricate to meet requirements of CBC Section 715.
2. Attach approved testing agency labels to each rated door and frame opening assembly.

D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
1. Locate hardware according to ANSI/SDI A250.8, unless otherwise indicated.
2. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
3. Provide reinforcing, drilling, tapping, and cutouts in accordance with the referenced standards, approved shop drawings, and door and frame schedule. Coordinate locations of conduit and wiring boxes for electrical connections with other Sections.

E. Stops and Moldings: Provide stops and moldings where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Fixed Stops and Moldings: Form integral with door and frame, unless otherwise indicated. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Removable Stops and Moldings: Provide on inside of hollow metal work. Secure with screws spaced uniformly not more than 12 inches on center.
a. Material: Not less than 20-gage steel sheets, galvanized for exterior and cold rolled for interior.
b. Fasteners: Phillips head machine screws.

F. Tolerances: Comply with SDI 117 "Manufacturing Tolerances for Standard Steel Doors and Frames".

2.05 FINISH

A. Prime Finish: Manufacturer's standard shop primer, fast-curing, lead and chromate-free, complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install steel doors, frames, and accessories according to shop drawings, manufacturer=s data, and as specified.

B. Frames: Install in accordance with ANSI/SDI A250.11, unless otherwise indicated. Set in place before construction of walls. Set accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Fire-Rated Assemblies: Install in accordance with CBC Section 715.4 and NFPA 80, and with manufacturer's fire test report installation data.
2. Abutting Frames: Install roll formed steel reinforcement channels between frames. Anchor to structure and floor.

C. Frame Anchors: Coordinate setting of frames with wall construction for wall thickness and anchor placement. Provide anchors as follows:
1. Stud Partitions: Minimum 3 wall anchors per jamb for frames up to 7'-6" high, and an additional anchor for each additional 18 inches. Install adjacent to hinge location on hinge jamb and at corresponding height on strike jamb. Attach to studs with screws.
2. Floor Anchors: One anchor each jamb for interior doors. Where wall construction will not allow placement of floor anchor, provide additional jamb anchor as close to floor as possible.

D. Door Installation: Install in accordance with ANSI A250.8. Fit hollow metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary.
1. Fire Rated Doors: Install within clearances specified in NFPA 80.
2. Smoke Control Doors: Install in accordance with NFPA 105.

E. Install door louvers.

3.02 TOLERANCES

A. Maximum Diagonal Distortion: 1/8-inch measured with straight edge, corner to corner.

3.03 ADJUSTING AND CLEANING

A. Adjust hardware for smooth and balanced door movement. Remove and replace defective work, including doors or frames which are warped, bowed, or otherwise damaged.

B. Sand smooth any rusted or damaged areas of prime coat, and apply touch-up of compatible air-drying primer.

END OF SECTION

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SECTION 08 14 00

WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Solid-core flush wood doors and accessories, complete.

B. Related Sections:
   1. Section 08 11 13 - Hollow Metal Doors and Frames.
   2. Section 08 71 00 - Door Hardware.

1.02 SUBMITTALS

A. Shop Drawings: Submit schedule of doors, using the same reference numbers for openings as those on the Drawings, indicating the core type, veneer grade, size, location, and extent of hardware blocking, cutouts for glazing, fire ratings, sound rating, and other pertinent data.

B. Product Data: Submit manufacturer's product data on each type of door specified.
   1. Submit certificates of chain-of-custody signed by door manufacturers certifying that wood products were obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria". Include evidence that door manufacturer is certified for chain-of-custody by an FSC-accredited certification body.
   2. Submit adhesive and composite wood product data indicating urea-formaledhyde content.

C. Samples: Submit samples of typical fire-rated solid-core door; samples shall be 12 x 12 inch illustrating a corner of the door.

D. Certifications:
   1. Fire Rating: Submit manufacturer's certificate for all fire-rated doors certifying that doors meet or exceed specified requirements.
   2. Woodwork Institute (WI) Certified Compliance Certificate: Submit WI Certified Compliance Certificate for all work and materials specified herein, identifying the products to be furnished, and certifying they meet the requirements.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Conform to 2010 California Building Code (CBC), Section 715.4 - Fire Door and Shutter Assemblies, for fire-rated doors and panels.
   1. Fire-Rated Doors and Panels: Tested in accordance with NFPA 252 or UL 10C, and meeting the requirements for smoke and draft control. Permanently affix label to door indicating applicable fire-rating, in accordance with NFPA 80.
   2. Smoke and Draft Control Doors: Tested in accordance with UL 1784. Show the letter "S" on the fire-rating label.
   3. Installation of Door Assemblies: Install in accordance with CBC Section 715 and NFPA 80.

B. Standards: Meet or exceed applicable requirements of Woodwork Institute (WI) "Architectural Woodwork Standards" for grade of door, core, construction, finish, and other requirements.
   1. Provide WI Certified Compliance Certificate indicating that doors meet requirements of grades specified.
   2. Provide WI Certified Compliance Certificate for installation.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect doors against dampness, damage, soiling, and deterioration during transit, storage, and handling.

B. Store doors in well-ventilated space not exposed to substantial changes of temperature and humidity. Comply with the storage and handling recommendations of Window and Door Manufacturers Association (WDMA) pamphlet, "How to Store, Handle, Finish, Install and Maintain Wood Doors," and with manufacturer's written instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide wood doors, modified to comply with the requirements specified herein, manufactured by Algoma, Eggers, Marshfield DoorSystems Inc., or equal.

2.02 MATERIALS

A. Solid-Core, Flush, Transparent Grade Face Veneer Wood Doors:
   1. Thickness: 1-3/4-inch thick, unless otherwise noted.
   2. Core: FSC-certified particleboard, meeting ANSI A208.1, Grade LD-1 or LD-2, made with binder containing no urea-formaldehyde.
   3. Construction: Five plies with stiles and rails fully glued and bonded to core, then entire unit abrasive planed before veneering.
   4. Fire-Rated Construction: Manufacturer's standard construction and core as required to provide fire rating indicated.
   5. Bond: Type I - moisture proof, fully adhered.
   6. Face Veneer Panels: Transparent finish, minimum 1/50-inch thick prior to sanding at jobsite.
   7. Grade: WI Custom Grade, with Grade AA faces.
   8. Species: Douglas fir.
   9. Match Between Veneer Leaves: Book match.
   10. Match Within Door Faces: Running match.
   11. Finish: Factory finished water-based stain and UV cured topcoat, AWI Finish System TR-6 - Catalyzed Polyurethane, and meeting EPA Title 5 guidelines for VOC emissions limitations; Marshfield "Enviroclad UV".

2.03 FABRICATION

A. Non-Rated Doors: Fabricate in accordance with ANSI/WDMA I.S.1-A-04 and WI "Custom Grade" requirements.

B. Fire-Rated Doors: Fabricate in accordance with ANSI/WDMA I.S.1-A-04 and UL requirements. Attach fire-rating label to door edge.

C. Provide flush doors with edge strips to match face veneers.

D. Hardware Reinforcement Blocking: Solid wood blocking for all door hardware, especially for door closers, so that no through bolts will be required to permanently mount hardware on door. If blocking is not practical, provide stave-core wood doors.
   1. Reinforce all doors for closers even if they are not scheduled to receive closers.
   2. Provide rated doors which have UL label when mortised for door bottoms as specified in Section 08 71 00.

E. Select the core material and door construction such that the internal components and construction will not telegraph through the veneer when viewed under any light condition at any angle.

F. Pre-fit and pre-machine all wood doors at the factory. Bevel strike edge 1/8-inch in 2 inches. Chamfer all exposed edges of the face veneer. Sand exposed edges of veneer smooth to touch.

G. Comply with the tolerance requirements of WDMA for pre-fitting. Machine doors for hardware requiring cutting of doors.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine door frames, and verify that frames are the correct type and have been installed as required for proper handing of corresponding doors. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's written instructions.

B. Fire-Rated Doors: Install doors, including hardware and operational characteristics in accordance with CBC Section 715 and NFPA 80.
   1. Smoke Doors: Install in accordance with NFPA 105.

C. Prepare doors to receive finish hardware in accordance with ANSI/WDMA requirements. Pilot drill screw and bolt holes. Machine cut relief for hinges and required hardware and core for locksets and cylinders.

D. Trim door width by cutting equally on both jamb edges. Trim fire-rated door width from lock edge only, to a maximum of 3/16-inch.

E. Trim door height by cutting equally on top and bottom edges to a maximum of 3/4-inch. Trim fire-rated door height at bottom edge only.

F. Door Hardware: Install accurately and securely without marking or defacing hardware or finish work. Test to assure correct alignment and operation. Fasten at all points at which fasteners are indicated or required. Protect hardware with suitable coverings until completion of Project.

3.03 INSTALLATION TOLERANCES

A. Maximum Diagonal Distortion: 1/8 inch measured with straight edge, corner to corner.

B. Clearances:
   1. Non-Fire-Rated Doors: 1/8 inch at jambs and heads, 1/8 inch at meeting stiles for pairs of doors, and 3/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is indicated or scheduled, provide 1/8 inch clearance from bottom of door to top of threshold.
   2. Fire-Rated Doors: Comply with limitations of authority having jurisdiction. At toilet room doors, provide maximum undercut allowed by code, but still meeting requirements to maintain fire rating.

3.04 ADJUSTING AND CLEANING

A. Adjust doors for smooth and balanced door movement. Rehang or replace doors which do not swing or operate freely, as requested by the Engineer.

B. Repair or replace doors damaged during installation, as requested by Engineer.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fire-resistive rated and non-rated access doors, panels, and frames, complete.
   1. Not all access doors are explicitly indicated on Drawings. Provide all access doors required by the various trades and coordinated as to location and size, whether specifically indicated or not.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Wall and ceiling framing.
   2. Section 09 91 00 - Painting.
   3. Division 22 - Plumbing.
   4. Division 23 - HVAC.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's catalog cuts and product data on each type of access door. Include sizes, types, finishes, scheduled locations, and details of adjoining work. Submit manufacturer's recommended installation instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Recessed Access Doors in Drywall Substrates:
   1. Manufacturer: J. L. Industries "Style WB"; Karp Associates "Type KDW"; Milcor "Style DW"; or equal.
   2. Features:
      a. Frame: 16-gage steel with an integral galvanized steel drywall bead.
      b. Door: 14-gage steel, fitted flush with integral bead.
      c. Hinges: Concealed spring hinges permitting 175 degree opening.
      d. Lock: Flush screwdriver operated cam locks for all access doors except provide flush key operated cylinder locks for access doors in all public areas.

B. Stainless Steel Access Doors in Ceramic Tile Substrates:
   1. Manufacturer: J. L. Industries "Style TMS"; Karp Associates "Type DSC-214M Stainless Steel"; Milcor "Style MS"; or equal.
   2. Features:
      a. Frame: 16-gage stainless steel with a nominal 1-inch exposed frame flange. Provide galvanized steel anchors appropriate for substrate.
      b. Door: 14-gage stainless steel, fitted flush with frame flange. Reinforce access doors over 24 inches wide to prevent sagging.
      c. Hinges: Concealed spring hinges permitting 175 degree opening.

d. Lock: Flush key operated stainless steel cylinder locks.

C. Fire Rated Steel Access Doors: UL 1-1/2-hour labeled, "Class B" fire-rated, and as follows:
1. Manufacturer: J. L. Industries "Style FD"; Karp Associates "Type KPR-150 FR"; Milcor "Insulated Fire-Rated Doors"; or equal.
2. Features:
a. Frame: 16-gage steel with a nominal 1-inch frame flange and integral appropriate anchors.
b. Door: 2-inch thick, fabricated of 20-gage steel face sheets, sandwich construction, with a non-combustible insulation core.
c. Hinges: Continuous stainless steel piano type hinge with stainless steel pin for the length of the door. Provide an automatic spring door closer for all doors.
d. Lock: Automatic latching device with operating turn ring and interior latch release. Provide flush key operated cylinder lock in all public areas.

D. Ceiling Access Doors: Aluminum access door, nominal 1'-6" x 1'-6" size, unless otherwise indicated on Drawings.
1. Manufacturer: Milcor "Type CF", Babcock-Davis, or equal.
2. Features:
a. Frame: 1/4-inch thick aluminum extrusions with mitered and welded corners and complete with hanger brackets attached.
b. Cover: 1/8-inch thick aluminum plate mounted to the frame with continuous stainless steel hinge, downward swinging.
c. Latch: Automatic snap latch with removable outside handle.
d. Finish: Primed for field painting under Section 09 91 00.

E. Access Doors in Sound-Rated Construction: Same as fire-rated access doors:
1. Door Panel: Double wall insulated.
2. Insulation: Minimum 1-1/2-inch thick mineral wool.
3. Hinge: Continuous piano hinge.

F. Weatherproof Access Door at Exterior:
1. Manufacturer: Cierra Products "Style C-XT"; Larsen=s "Type L-XT"; Nystrom "ST Series"; or equal.
2. Features:
a. Frame: Minimum 0.060-inch thick extruded aluminum.
b. Door: 20-gage galvanized steel.
c. Hinges: Continuous stainless steel piano type hinge.
d. Lock: Key-operated handle on outside.
e. Insulation: 2-inch thick fiberglass.

2.02 FABRICATION

A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Fabricate steel access doors and frames of continuous welded steel construction, unless otherwise indicated. Weld, fill, and grind joints smooth with adjacent surfaces to assure flush and square unit.

C. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

D. Furnish all access doors and panels keyed alike.

2.03 FINISH

A. Galvanized Steel Doors: Manufacturer's standard prime paint.

B. Stainless Steel Doors: Buffed #4 satin finish.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this section will be installed. Verify rough openings for doors and frames are correctly sized and located.

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

3.02 INSTALLATION

A. Install drywall access doors flush with the contiguous surfaces.

B. Install stainless steel access doors after surrounding tile work is completed; set flange tight against the face of tile.

C. Install frames plumb and level in floor, wall and ceiling openings.

D. Position to provide convenient access to concealed work requiring access. Coordinate installation with work of other trades.

E. Secure rigidly in place in accordance with manufacturer's instructions.

3.03 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames which are warped, bowed or otherwise damaged.

END OF SECTION

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SECTION 08 35 13

FOLDING DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Provide sliding/bifolding wood and glass opening system, including frames, thresholds, panels, passage door, hardware, and weatherstripping, complete.

B. Related Sections:
1. Section 06 10 00 - Rough Carpentry.
2. Section 08 71 00 - Door Hardware.
3. Section 08 80 00 - Glazing.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing layout of systems. Include plans, elevations, and large scale details of connections, anchorages, hardware, and accessory items. Indicate location of each unit with building, conditions at openings, typical and special details, and location and installation requirements for hardware.

B. Product Data: Submit manufacturer=s literature, and test data from independent testing laboratory on the performance criteria.

C. Qualification Data: Submit installer qualifications.

D. Project Closeout Submittals: Submit maintenance manual including information on operation and maintenance of systems.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Firm specializing in opening systems with not less than 2 years of experience in manufacture of openings similar to those required for this project.

B. Single Source Responsibility: Provide complete, precision-built, engineered, pre-fitted systems supplied by a single manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings clearly labeled with identification of manufacturer.

B. Store materials in original undamaged packages protected from weather, moisture, soiling, laid flat, blocked off ground to prevent sagging and warping. Do not subject wood components to extreme or rapid changes in heat or humidity. Condition wood components to average prevailing relative humidity before installation.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Folding Door System: Aluminum-clad wood folding panel opening systems manufactured by Kolbe "Ultra Series", Nana Wall Systems, Marvin, or equal.

2.02 MATERIALS

A. Frame and Panels:
   1. Profiles: Manufacturer's standard profiles, with configuration and dimensions as indicated on Drawings; bottom rail width of minimum 8 inches in accordance with ADA guidelines.
   2. Wood Interior: Solid, triple-laminated, kiln dried western hemlock or meranti, with matching solid wood glazing stops, primed for field painting.
   3. Exterior: Extruded aluminum cladding.

B. Glass: 3/4 inch thick sealed insulating glass units, clear tempered glass, in accordance with requirements of Section 08 80 00.

C. Sliding/Bi-Folding Hardware: Manufacturer=s standard combination sliding and bi-folding hardware with top and bottom tracks.
   1. Sill Track: Clear anodized extruded aluminum, ADA compliant, recessed flush with finish floor, and weeps for water drainage.
   2. Upper Track: Aluminum, with matching wood cladding on both sides.
   3. Carriers: For each pair of bi-folding panels, provide four-wheeled running carriages at upper track and lower track, coated with toughened Polyamide coating.
   4. Hinges: Manufacturer's standard white anodized aluminum hinges with stainless steel pins.
   5. Adjustment: Provide system capable of specified amount of adjustment without removing panels from tracks.

D. Locking Hardware and Handles: Manufacturer's standard nylon lever handles and multiple-point latching hardware at folding panels.
   1. Handle Finish: Clear anodized aluminum.
   2. Nylon Handle Color: Match other handle colors.
   3. Locking Rods: Aluminum, capped by Polyamide at top and bottom tracks.
   4. Handle Height: Center at 41-3/8-inch from bottom of panel.
   5. Lockset at Single Entry/Exit Door: Refer to Section 08 71 00 - Door Hardware.
   6. Overhead Door Holder/Stop at Single Entry/Exit Door: Refer to Section 08 71 00.

E. Miscellaneous Components:
   1. Weatherstripping: Manufacturer's standard double layer EPDM seals at both inner and outer edge of door panels or on frame for sealing between panels and between panel and frame. Adjust for tight air seal and maximum sound reduction.
   2. Frame Component Connectors: Tapered pins or machine screws.

F. Accessories: Provide matching side lites, posts, and doors, as indicated on Drawings.

2.03 FABRICATION

A. Fabricate operable systems to sizes and dimensions required. Fabricate systems for smooth movement and operation as shown on the Drawings.

B. Factory pre-assemble units to ensure proper fit, and ship with all components and installation instructions.

2.04 FINISHES

A. Exterior Aluminum: Powder coat finish, meeting AAMA 2603 except with a minimum 1.5 mils (0.04 mm) dry film thickness. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Color: As selected by Engineer from manufacturer's full range of colors.

B. Interior Wood: Factory primed for field painting.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine site at which opening systems will be installed. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square, with no unevenness, bowing, or bumps on floor.

B. Verify structural integrity of the header, with the deflection limited to less than L/720 of the span with a maximum deflection of 3/8-inch.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install frames in accordance with manufacturer's written recommendations and installation instructions.

B. Provide anchorage devices; securely and 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.

C. If necessary, provide drain connections from lower track.

D. Install panels, handles, and locksets in accordance with manufacturer=s recommendations and installation instructions. Adjust to operate properly and move freely without excess binding or force.

3.03 ADJUST AND CLEAN

A. Adjust and lubricate bearings and all movable parts; adjust to ensure smooth, easy operation.

B. Clean, touchup, repair, or replace all surfaces and components which are soiled, abraded, or damaged.

C. Protect partitions against damage during construction period.

D. Demonstrate proper operation and maintenance procedures to City's personnel.

END OF SECTION

SECTION 08 41 12

ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Aluminum-framed entrance doors, with accessories, complete.

B. Products Installed But Not Supplied Under This Section:
   1. Section 087100 - Door Hardware: Door hardware items other than specified in this Section.

C. Related Sections:
   1 Section 08 80 00 - Glazing.

1.02 PERFORMANCE REQUIREMENTS

A. Air Infiltration: Tested in accordance with ASTM E283.
   1. Doors: Not exceeding 0.3 cfm/sq.ft. of door area for single doors and 1.0 cfm/sq. ft. for double doors, at a pressure differential of 75 pascals or 1.57 pounds/sq. ft.

B. Thermal Movements: Design, fabricate, and install all components capable of withstanding thermal expansion and contraction movements for the ambient temperatures from 20 to 120 degrees F. The glass shall not break owing to thermal or other stresses.

C. Seismic Movement: Design, fabricate, and install the doors and glass bite to accommodate +/- 3/4 inch movement in any direction without failure or detrimental effect to the frame, glass or gasketing.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings, product data, and samples under provisions of Section 01 33 00. Show details of framing, attachments, reinforcement, glazing, and manufacturer's standard profiles.

B. Product Data: Submit performance data from an independent testing laboratory showing compliance with specified performance requirements. Submit manufacturer's installation instructions.

C. Samples: Submit samples, minimum 3 x 4 inches in size, illustrating prefinished aluminum surfaces.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect the finished surfaces from damage and abrasion during delivery, storage, and handling. Any surface having noticeable and objectionable damage or abrasion, as determined by the Engineer will be rejected. Field touch-up painting of damaged finish is not acceptable.

1.05 WARRANTY

A. Warrant for a period of five (5) years from the Date of Substantial Completion that the entrances shall be free of defects in material and workmanship and will not leak water, deteriorate excessively, or otherwise fail to perform as required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum: Alloy and temper as recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B209; 3003 alloy, minimum 25 percent combined recycled content for organic finish; 5005 alloy, minimum 8 percent combined recycled content for anodized finish.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221, minimum 80 percent recycled content.
   3. Extruded Structural Pipe and Tubes: ASTM B429.
   4. Structural Profiles: ASTM B308.
   5. Welding Rods and Bare Electrodes: AWS A5.10.

B. Steel Reinforcement:
   1. Structural Shapes, Plates, and Bars: ASTM A36
   2. Cold-Rolled Sheet and Strip: ASTM A1008.
   3. Hot-Rolled Sheet and Strip: ASTM A1011.

C. Steel Reinforcement Primer: Manufacturer=s standard corrosion-resistant primer complying with SSPC-PS Guide No. 12, applied immediately after surface preparation and pretreatment.

D. Fasteners and Accessories:
   1. Aluminum to Aluminum: Aluminum or austenitic stainless steel fasteners and accessories.
   2. Aluminum to Other Materials: Stainless steel or cadmium-plated steel fasteners and accessories. Provide anodic corrosion isolation where required.
   3. Exposed Fasteners: Phillips flathead machine screws, countersunk.
   4. Do not use exposed fasteners, except where unavoidable for the application of hardware. Match the finish of the metal surrounding the fastener.

E. Glass and Glazing: Comply with Section 08 80 00.

F. Glazing Gaskets: Manufacturer's standard, unless otherwise indicated; neoprene gaskets complying with ASTM D735, Class SC; molded PVC gaskets complying with ASTM D2287; molded expanded neoprene gaskets complying with ASTM C509, Grade 4; or EPDM molded gaskets. Color: black.

2.02 FABRICATED COMPONENTS

A. General:

1. Framing Members: Extruded aluminum, minimum 0.125-inch thick for main members and minimum 0.062-inch thick for secondary members. Provide with internal steel reinforcement where required for additional strength.
2. Flashings, Break Shapes and Glazing Stops: Aluminum sheet, 5005-H34 alloy and temper, shop fabricated before coating with finish to match extrusions. Fabricate to sizes required and shown.
   a. Flat Widths Less Than 8 Inches: Minimum 0.063 inch thick.
   b. Flat Widths Over 8 Inches: Minimum 0.090 inch thick.

B. Aluminum Swinging Entrance Doors:
1. Manufacturer/Model: Kawneer "500 Series" wide-stile entrance doors, Oldcastle, or equal.
2. Size: Nominal 5 inch wide head and jambs and10-inch high bottom rail, dual glazed.
3. Glazing Stops: Beveled design, non-removable on outside of doors.
4. Weatherstripping, Sill Sweep Strips: Manufacturer's standard type to suit application, black finish.
5. Hardware: Refer to Section 08 71 00 for additional hardware.

2.03 FABRICATION

A. Check openings and dimensions in the construction work, and take accurate field measurements before fabrication. Coordinate installation tolerances to ensure proper fit of storefront.

B. Fabricate units with main corners and intersections of frames mortised and welded or riveted and permanently sealed to prevent any air or water leakage. Fabricate secondary joints similarly.

C. Provide mullions complete with anchors for support to structure and for installation of glass. Allow for erection tolerances, and provide for movements of glass due to thermal expansion and building deflections. Provide concealed reinforcing and stiffener as required.

D. Provide reinforcement for all finish hardware specified herein and in Section 08 71 00.

E. Fabricate entrance doors with minimum 10-inch high door bottom rail plate of 0.125-inch thick aluminum for smooth, uninterrupted surface in accordance with ADA requirements.

2.04 FINISH

A. Aluminum: Powder coat finish, meeting AAMA 2603 except with a minimum 1.5 mils (0.04 mm) dry film thickness. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color: As selected by Engineer from manufacturer's full range of colors.

B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A123 to 2.0 oz./sq. ft.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the adjacent framing and wall construction in which the work is to be performed. Do not begin work until unsatisfactory conditions have been resolved.

3.02 INSTALLATION

A. Install framing, doors, glazing and hardware in accordance with manufacturer's instructions.

B. Use anchorage devices to securely attach assemblies to structure.

C. Set units plumb, level and true to line without warp or rack of frames. Anchor securely in place.

D. Glazing: Comply with Section 08 80 00 for all glazing requirements.
   1. Inspect each piece of glass immediately before installation, and eliminate all which have observable damage or imperfections.
   2. Provide continuous glazing tape and sealant applied on each side of the glass. Use neoprene spacers for glazing separation. At no point shall glazing come into contact with metal parts of the assembly.
   3. Clean and trim excess glazing materials from frames promptly after installation, and eliminate stains and discolorations.

H. Install operable doors and hardware to operate properly, smoothly, and quietly.

3.03 CLEANING, REPAIR AND TOUCH-UP

A. Remove protective material from prefinished aluminum surfaces.

B. Wash clean all components of doors using nonabrasive cleaner and apparatus.

C. Touch-up-paint all minor damage on the finish coating. Touch-up paint shall be field-applied-type fluorocarbon paint with exact color, gloss, and appearance match and shall be reviewed by Engineer prior to use. Touch-up-paint only the actual damage area with very little overlap to undamaged area.

D. Repair or replace all defective components, including components having damaged paint finish and glazing which is broken, chipped, cracked, abraded, or damaged.

END OF SECTION

SECTION 08 52 00

WOOD WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Prime-coated wood windows, with glazing, operators, and accessories, complete.

B. Related Sections:
1. Section 06 10 00 - Rough Carpentry.
2. Section 07 92 00 - Joint Sealants.
3. Section 08 80 00 - Glazing.
4. Section 09 91 00 - Painting.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing window elevations and details of construction. Include stile and rail reinforcement, internal blocking, anchors, and hardware.

B. Product Data: Submit manufacturer's standard product data for each type of wood window, showing standard construction details, fabrication methods, profiles, dimensions, data on hardware, accessories, and finishes.

1.03 QUALITY ASSURANCE

A. Standards:
1. Comply with WDMA I.S.2 for standards of performance and fabrication workmanship for wood windows.
2. Grade: Meet or exceed the requirements of WDMA I.S.1 Series for Grade 40, with allowable tolerances complying with WDMA I.S.1.2.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver windows individually protectively wrapped, identified with manufacturer's name, and name and type of window. Identify each window with the same symbol used on the Door Schedule.

B. Avoid extremes of heat and humidity in areas in which windows are stored; relative humidity shall be between 30 and 60 percent in storage area.

1.05 WARRANTY

A. Warrant each window against defects in materials and workmanship for the life of the installation. Warranty shall include costs of rehanging and finishing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide wood hopper type windows manufactured by Marvin Windows, Kolbe Windows & Doors, or equal.

2.02 MATERIALS

A. Frame: Kiln dried Western Ponderosa pine, water repellent preservative treated in accordance with WDMA I.S. 4., factory cut and assembled, 4-9/16-inch wide standard frame width, 11/16-inch head and jamb frame thickness.
   1. Frame Thickness: 3-1/16 inch at head jamb and side jambs; 1-11/16 inches at sill.
   2. Subsill Thickness: 1-1/4 inch.
   3. Frame Width: 2-13/32 inches.
   4. Provide special jamb extensions to accommodate wall thickness.

B. Sash: Same materials as frame, preservative treated.
   1. Sash Thickness: 2-1/4-inch.
   2. Corners slot and tenoned, assembled with concealed screw fasteners and adhesive. Removable interior glazing stops.

C. Divided Lites: True divided lites, 7/8 inch wide, pine.
   1. Pattern: Rectangular; custom lite layout as indicated on Drawings.
   2. Finish: Match sash finish.

D. Hopper Window Hardware: One operating pistol grip handle; oil rubbed bronze finish.

E. Glazing: Single glazed, 1/4 inch thick, select quality, complying with ASTM C1036.

F. Screens: Not required.

G. Weatherstripping: Manufacturer's standard weatherstripping on all four sides of frame with flexible gaskets. Leaf-type weatherstripping around sash.

H. Glazing Seal: Silicone bedding glazed by means of removable wood stops.

2.03 FINISH

A. Exterior Wood: Factory prime-coated white acrylic latex.

B. Interior Wood: Factory prime-coated white acrylic latex.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine openings before beginning installation. Verify that opening sizes are correct, and that sill plates are level. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Condition windows to average prevailing humidity in installation areas prior to hanging.

B. Fit windows to frames and prepare for hardware to whatever extent not previously prepared at factory, as required for proper and uniform edge clearance and operation.

C. Coordinate window installation with wall flashings and other built-in components.

3.03 INSTALLATION

A. Install window units, hardware, operators, and other window components in accordance with the manufacturer's written instructions and recommendations, the approved shop drawings, and as indicated.

B. Set units plumb, level, true to line, and without warp or rack of frames or sash. Provide proper support and anchor securely in place.

C. Adjust operating sash and hardware to provide a tight fit at contact points and weatherstrippping, and to provide smooth operation and a weathertight closure. Lubricate hardware and moving parts.

D. Install windows flat within allowable tolerances, plumb in all positions of swing, and to operate smoothly, quietly and free from binding.

3.04 CLEANING

A. Clean interior and exterior surfaces promptly after installation. Take care to avoid damage to protective coatings and finishes. Remove excess glazing, sealants, dirt, and other substances.

B. Clean glass of pre-glazed window units promptly after installation. Wash and polish glass on both faces. Comply with manufacturer's recommendations for final cleaning and maintenance. Remove non-permanent labels from glass surfaces.

C. Exposed surfaces shall be uniform in appearance, clean and free from scratches, tool marks, dents, discoloration, stains and other damage and defects.

D. Protect window units from damage or deterioration until acceptance of the Project.

END OF SECTION

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SECTION 08 52 13

METAL-CLAD WOOD WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Provide metal-clad wood windows and doors with operating hardware and glazing, complete.

B. Related Sections:
1. Section 06 20 00 - Finish Carpentry.
2. Section 07 60 00 - Flashing and Sheet Metal.
3. Section 07 92 00 - Joint Sealants.
4. Section 08 80 00 - Glazing.
5. Section 09 91 00 - Painting.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings and manufacturer's catalog cuts showing profiles, types, materials, and sizes. Include wall opening sizes, component dimensions, wall opening tolerances, anchorage and fasteners, affected related work, and installation requirements.

B. Product Data: Submit NFRC verified performance values for windows.

C. Samples: Submit color samples of all prefinished color options.

D. Installation Instructions: Submit manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

A. Air Leakage, Water Leakage, and Wind Load Resistance: Comply with NWWDA I.S.1 Rating of Grade 40. Apply NFRC sticker verifying performance to all windows.

B. Preservative Treatment of All Wood Components: Comply with NWWDA I.S.4.

C. Glass: Comply with ASTM C1036, select quality.

D. Insulating Glass Units: Manufactured and tested to comply with ASTM E774.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver windows to jobsite with NFRC stickers intact. Do not accept windows without NFRC rating stickers.

B. Protect finished surfaces from damage and abrasion during delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Metal-Clad Wood Windows and Doors: Marvin Windows "Ultimate Series", Loewen Windows, or Lincoln Windows.

2.02 MATERIALS

A. Wood Components: Solid materials.

B. Exposed Interior Surfaces: Clear Douglas fir.

C. Exposed Exterior Surfaces: Heavy duty extruded aluminum metal cladding complete with nailing flange.

2.03 COMPONENTS

A. Frame: Assembled with machined corners, fastened with 1-3/4 inch staples and sealed with joint sealant.
   1. Exterior Surfaces: Heavy duty extruded aluminum cladding.
   2. Corner Joints: Reinforced with aluminum corner keys, foam gasket seals and secured with screws.
   3. Jamb Width: Provide jamb extensions as indicated on Drawings and required by wall conditions.

B. Sash: Laminated wood components, 1-3/8 inch thick, with exterior metal cladding.
   1. Corners: Mortise and tenon jointed and fastened with 1-1/4 inch long nails.
   2. Stiles and Rails Forming the Sash: Grooved, providing a hidden drainage channel to vent the glazing cavity at each corner of the sash.

C. Stops: Interior stops to be solid wood.

D. Screens: Roll formed aluminum components with vinyl corner keys, screened with 18 x 16 anti-glare flberglass mesh. Screen retained in frame by spring loaded pins.
   1. Color: Match window frame color.

E. Window Weatherstripping: Manufacturer's standard weatherstripping on all four sides of sash. Vinyl bubble at bottom sash, meeting rail and head. Chimney and pocket plug open cell foam.

F. Window Hardware: Provide with manufacturer's standard hinges, weatherstripping, and as required.
   1. Double Hung Windows:
      a. Balance system: Coil spring block and tackle with nylon cord and fiber filled nylon clutch.
      b. Jamb carrier: Vinyl extrusion with wood and aluminum inserts, beige color.
      c. Lock: High pressure zinc die-cast cam lock and keeper.
   2. Casement Windows: Crank operation with fold-back lever; restrictors at designated locations.

3. Accessible Awning Windows: Crank operation with fold-back lever; restrictors at designated locations.
4. Clerestory Awning Windows: Provide with operable hardware and pole for pole crank operation.

G. Swinging Door Hardware: Manufacturer's standard gasketing. Prepare doors for hardware as specified under Section 08 71 00.

H. Glazing: Foam dual adhseive glazing tape on the exterior combined with interior wood stops bedded in joint sealant.
1. High performance insulating glass units; factory hermetically sealed units, conforming to IGMAC certification, tempered where required.
2. Construction: Dual seal, double glazed with 1/2 inch air space and dessicant, simulated divided lite with spacer bar; "Heat-Smart Plus 1" system.

I. Fasteners and Accessories:
1. Aluminum to Aluminum: Aluminum or austenitic stainless steel.
2. Aluminum to Other Materials: Stainless steel or cadmium-plated steel. Provide anodic corrosion isolation between dissimilar metals where required.
3. Do not use exposed fasteners, except where unavoidable for the application of hardware.

2.04 FINISH

A. Exterior Aluminum: Powder coat finish, meeting AAMA 2603 except with a minimum 1.5 mils (0.04 mm) dry film thickness. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color: As selected by Engineer from manufacturer's full range of colors.

B. Interior Wood: Field-applied clear finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install window and door frames, glass and glazing, and hardware in accordance with manufacturer's written instructions.

B. Use anchorage devices to securely attach frames to structure.

C. Align window and door frames plumb and level, free of warp or twist. Maintain dimensional tolerances, aligning with adjacent work.

D. Coordinate attachment and seal of air and vapor barrier materials. Install all flashings per details.

E. Install glass in accordance with Section 08 80 00.

F. Install perimeter polyurethane type sealant, backing materials, and installation requirements in accordance with Section 07 92 00 between wood trim and metal window frame. Omit sealant at head to permit weepage.

G. Adjust windows for smooth operation and tight fit of sash.

3.02 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

D. Repair or replace all defective components, including components having damaged paint finish and glazing which is broken, chipped, cracked, abraded, or damaged.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All necessary door hardware to complete the Project, except those items specifically mentioned to be furnished by other Sections.
   2. Wherever items of door hardware are not definitely specified but are required for proper completion and/or operation of doors, or a hardware item may no longer be available, furnish hardware in type, quality, and finish suitable for the service required and comparable to that specified for similar conditions, and notify the Engineer immediately.

B. Products Supplied But Not Installed Under This Section: Furnish templates to Sections 08 11 13, 08 14 00, 08 35 13, and 08 52 13 for door and frame preparation.

C. Related Sections:
   1. Section 08 11 13 - Hollow Metal Doors and Frames.
   2. Section 08 14 00 - Wood Doors.
   3. Section 08 35 13 - Folding Doors.
   4. Section 08 52 13 - Metal-Clad Wood Windows: Metal-clad wood doors.
   5. Division 26 - Electrical: Power supply to electric hardware devices.

1.02 SUBMITTALS

A. Hardware Schedule: Submit a complete schedule of door hardware for review. Reference items clearly to groups specified, door-type designations shown, location, and other pertinent data. Verify suitability, function, thickness of members, or other factors affecting appropriate selection. List manufacturer's names or suitable abbreviation to facilitate reviewing, opposite each item scheduled.
   1. List only readily obtainable hardware that appears in current catalogs. Do not deliver hardware until schedule has been accepted by the Engineer.
   2. After the hardware schedule is accepted by the Engineer, provide one copy of the accepted hardware schedule to each trade whose work may be affected.

B. Product Data: Submit catalog cuts and product data on each different type of hardware included in hardware schedule. Indicate locations and mounting heights of each type of hardware. Submit manufacturer's parts lists, templates, and installation instructions.

C. Samples: Prior to delivery of any hardware to the site, submit one sample of each class or type of hardware to the Engineer for final review. Affix labels to fully identify manufacturer, class or type, and location on the Project. After review, accepted samples may be obtained from the Engineer for installation on the Project, providing such samples are picked up within seven days of notification of acceptance.

D. Operation and Maintenance Data: Submit operation and maintenance data. Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.03 QUALITY ASSURANCE

A. Supplier Qualifications: Company experienced and specializing in supplying commercial door hardware. The hardware supplier shall employ a member of the Door Hardware Institute (DHI) who is a Certified Architectural Hardware Consultant (AHC) to prepare the hardware schedule submittal and be available for consultation with the City and Engineer. Upon completion of the building, check the installation and disclose any misapplication of hardware.

B. Installer Qualifications: Experienced installer who has completed installations similar in material, design, and extent to that required for this Project and with a record of successful in-service performance.

C. Regulatory Requirements:
1. Fire-Rated Door Assemblies: Comply with 2010 California Building Code and NFPA 80 for requirements applicable to fire-rated doors and frames, tested according to NFPA 252. Provide fire-labeled hardware at fire-rated openings.
2. Egress Doors: Comply with CBC Section 1008 and applicable requirements of NFPA 101 "Life Safety Code".
3. Electrified Door Hardware: Comply with CBC Section 1008; provide hardware listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction
4. Accessibility: Comply with CBC Section 1133B.2 and Americans with Disabilities Act (ADA), "2010 ADA Standards for Accessible Design".

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver hardware with items packed separately, complete and ready for installation with necessary fittings, trim, fasteners, and accessories. Mark packages clearly for identification in accordance with Hardware Schedule. Deliver hardware so that work may progress without delay or interruption.

B. Package all items of hardware and each lockset, latchset, exit device, and door control/closer in its individual package marked with manufacturer's name, type number, and name of item. Furnish each item complete with necessary fastenings, wrenches, spanners, installation instructions, and templates. Indelibly, legibly, and carefully mark each package with an item number corresponding to the door number and hardware group number as indicated on the opening schedule, the approved door Hardware Schedule, and the Drawings and details.

C. Protect hardware from damage before, during, and after installation.

1.05 COORDINATION

A. Coordinate work of this Section with other directly affected Sections involving manufacturer of any internal reinforcement for door hardware.

B. Manufacture all hardware to template. Provide templates and, if necessary, the physical hardware to fabricator of doors and frames in ample time to facilitate the work.

C. Coordinate electrical and security requirements of hardware items with related sections.

1.06 WARRANTY

A. Provide extended warranty for the following hardware items in accordance with requirements of Division 1. Warrant that hardware shall be free of defects in material and workmanship and that it will not deteriorate excessively, or otherwise fail to perform as required.
   1. Hinges: Life of building.
   2. Door Closers: Ten years.
   3. Locks: Five years.

1.07 MAINTENANCE MATERIALS

A. Provide special wrenches and tools applicable to each different or special hardware component.

B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. General: Numbers in Hardware Schedule refer to those of the first named manufacturer below. Equivalent products by the other named manufacturers are also acceptable.

B. Butt Hinges: Stanley (STA), Hager, Lawrence, McKinney.

C. Locksets and Latchsets: Schlage (SCH) (City-furnished, Contractor-installed)

D. Cylinders: Schlage (SCH) (City-furnished, Contractor-installed)

E. Exit Devices: Von Duprin (VON), Precision Hardware Inc.

F. Overhead Closers: LCN, Dorma, Norton.

G. Manual and Automatic Flush Bolts: Ives (IVE), Trimco, Door Controls Inc.

H. Stops: Ives (IVE), Trimco, Rockwood.

I. Overhead Holders/Stops: Glynn-Johnson (GLY), Rixson, Rockwood.

J. Gasketing and Thresholds: Pemko (PEM), NGP, Reese.

K. Protection Plates and Push/Pull Plates: Ives (IVE), Trimco, Rockwood.

2.02 HINGES

A. Standard: Meeting ANSI A156.1, Grade 1.

B. Type: Butt hinges of the five-knuckle, full mortise type, minimum of two bearings, stainless steel pins, and as follows:
   1. Fire-Rated Doors: Steel hinges with steel pins, minimum of two ball bearings, and plated to match required finish.
   2. Outswinging Doors to the Exterior: Stainless steel or non-ferrous material, with nonremovable pins (NRP) of the setscrew type.

C. Hinge Size:
   1. Doors 1-3/4" thick and up to 37" wide: 4-1/2 x 4-1/2 inch butt hinges provided with at least two ball bearings or life-span bearings.
   2. Doors over 1-3/4" thick or over 37" wide: 4-1/2 x 4-1/2 inch extra-heavy duty butt hinges provided with at least four ball bearings.
   3. Butt hinges for doors thicker than noted above or with unusual trim conditions which would interfere with the full opening of the door shall be provided with hinges of sufficient size to adequately support the door weight and of sufficient width to clear adjacent trim.

D. Number of Hinges Per Door Leaf:
   1. Doors up to 60 Inches High: Two hinges per door leaf.
   2. Doors up to 90 Inches High: Three hinges per door leaf.
   3. Doors over 90 Inches High: Three hinges plus one additional butt hinge for each additional 30 inches in height over 90 inches, or fraction thereof.

2.03 LOCKSETS, LATCHSETS, AND CYLINDERS

A. Standards:
   1. Cylindrical Locks: Meeting ANSI A156.2, Series 4000, Grade 1.
   2. Mortise Locks: Meeting ANSI A156.13, Grade 1.
   3. Deadbolt Locks: Meeting ANSI A156.5, Grade 1.

B. Lock Type: Where locksets or latchsets are scheduled, provide Schlage "ND" Series cylindrical type locks with "HD" Type Small Format Interchangeable Core (SFIC) cylinders, with backsets of 2-3/4 inches, unless otherwise noted. Provide all locks from the same manufacturer.

C. Design: Lever handles, of the Schlage "Rhodes" design, unless otherwise noted.

D. Strikes: Provide each lockset, latchset, and deadlock with a strike and a strike box. Provide standard type strikes with extended lips where required to protect adjacent trim from being marred by latch bolt. Verify cutout types provided in metal frames.

E. Construction Cylinders: City shall provide Construction Cylinders for the duration of construction. City shall replace Construction Cylinders upon substantial completion.

2.04 DOOR CLOSERS

A. Standards: Meeting ANSI A156.4, Grade 1.

B. Type: Rack and pinion construction, steel spring, fully hydraulic action, non-handed, cast iron or cast aluminum body, non-gumming, non-freezing hydraulic fluid requiring no seasonal adjustment for temperature.

C. Closer Force: Capable of having spring force increased by 50 percent by adjustment without removing from the door, and effecting a maximum operating pressure on the door as follows:
   1. Interior Doors: 4.75 lbf.
   2. Exterior Accessible Doors: 4.75 lbf..
   3. Exterior Non-Accessible Doors: 8.25 lbf.
   4. Fire-Rated Doors: 14.75 lbf.

D. Overhead Surface-Mounted Closers:
   1. Out-swinging Doors to the Exterior: Parallel arm closers, with the closer mounted on the inside of the door.
   2. In-swinging Doors into Rooms: Mount closers on the room side on the door. Corner brackets are not permitted. Supply drop plates where required.

E. Features: Positive back-check action near the outer limit of the opening cycle, located to protect door, frame, trim, and hardware; separate adjustments for latch speed, general speed, and back check; hydraulic regulation by tamperproof, noncritical screw valves adjustable only with a hex wrench. Where specified, provide with hold-open arm and built-in positive stop.

2.05 EXIT DEVICES (PANIC HARDWARE)

A. Standards: Meeting ANSI A156.3, Grade 1; as required to fulfill all requirements of NFPA 80 "Fire Doors and Windows", NFPA 101 "Life Safety Code", and UL.

B. Single Doors: Rim-type exit devices, typical, unless otherwise scheduled.

C. Pairs of Doors: Wherever possible, provide pairs of doors with two concealed vertical rod devices to avoid use of an astragal and coordinator. Provide coordinators where astragals are required.

D. Outside Trim and Levers: Compatible with other door hardware in style and finish.

2.06 FLUSH BOLTS

A. Standards:
   1. Manual Flush Bolts: Meeting ANSI A156.16, Grade 1.
   2. Automatic Flush Bolts and Coordinators: Meeting ANSI A156.3.

B. Flush Bolts: Provide at top and bottom edge of the inactive leaf of pairs of doors. Provide bottom rod with 12 inch long operating rod and top rod of sufficient length so that operating lever is less than six feet above the floor.

C. Dustproof Strikes: Provide for bottom bolts, of type required for appropriate finish floor condition.

D. Coordinators: Flat bar type with head filler, mounted to the head frame on top of the metal stop, unless otherwise scheduled. Provide a carry bar at each pair of doors equipped with overlapping

astragal. Coordinators to be mechanically operated, and capable of holding the active door of a pair open until the inactive leaf has preceded it in the closing cycle.

2.07 AUXILIARY HARDWARE

A. Standards: Meeting ANSI A156.16.

B. Door Stops: Floor type or wall bumper type as scheduled. Provide each door leaf with a stop of proper size and height to prevent door from hitting wall or fixed objects. Built-in stops in door closers and overhead stops, where called for, shall satisfy this requirement.
   1. Wall Stops: No visible fasteners.
   2. Floor Stops: Of height required by floor conditions, fastened by means of machine screws and expansion anchors.

C. Silencers: Gray rubber, non-marring configuration for metal or wood doors. Provide each door with a pressed-metal frame with tamper resistant rubber silencers. Provide each single door with three silencers, each pair of doors with four. Omit at doors to receive gasketing.

2.08 THRESHOLDS, DOOR BOTTOMS, AND GASKETING

A. Provide as scheduled and detailed. Install with countersunk, flat-head screws, of same material and finish as item being attached at all applied thresholds, door bottoms, stops, and door gasketing.

B. Fire-Rated Doors: Provide UL-listed smoke seals on three sides of door frames at head and jambs.

C. Threshold Height: Maximum 1/2 inch. Bevel raised thresholds with a slope of not more than 1:2.

2.09 DOOR PLATES

A. Standards: Meeting ANSI A156.6.

B. Protection Plates: Stainless steel, with all edges beveled. Provide as scheduled and detailed.
   1. Thickness: Minimum of 0.050-inch.
   2. Width: Protection plates shall be 1-1/2-inch less than door width at single doors, 1-inch less than leaf width at pairs of doors. Mop plates shall extend the full width of the door.
   3. Height: Kickplates shall be 10 inches high; mop plates shall be 6 inches high.

C. Combination Push-Pull Plates: Minimum 0.050-inch thick, stainless steel, beveled edges.

D. Install plates using countersunk spanner-type stainless steel #6 oval head screws.

2.10 KEYS AND KEYING

A. City will provide a construction keying system for Contractor's and/or City's use as required during construction.

B. City will remove construction cylinders and install permanent cylinders.

2.11 FINISHES

A. Typical Hardware:
   1. Typical Interior Locations: BHMA 626 or 652 (US26D) - dull chromium-plated, unless otherwise noted.
   2. Exterior Locations, Unheated Spaces Exposed to the Weather, and Where Scheduled: BHMA 630 (US32D) - satin stainless steel, unless otherwise noted.

B. Exposed Overhead Door Closers: BHMA 689 - spray lacquer aluminum color, unless otherwise noted.

C. Thresholds: BHMA 719 - mill finish extruded aluminum.

D. Weatherstripping and Gasketing: BHMA 628 (US28), clear anodized aluminum, unless otherwise noted.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine doors, frames, and other surfaces to receive door hardware and report all defects which might adversely affect the installation or function of the hardware. Do not begin installation until unsatisfactory conditions have been resolved.

B. Coordinate and be responsible for the proper fabrication of all work or material to receive hardware. No extra cost will be allowed because of changes or corrections necessary to facilitate the proper installation and operation of the hardware.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and requirements of ANSI/NFPA 80, and DHI. Use templates provided by hardware item manufacturer.

B. Accessibility: Conform to CCR Title 24 and ADA requirements for positioning and installing hardware.

C. Hardware Attachments: Provide with all necessary screws, bolts, and other devices or fastenings of suitable size and type to secure the hardware in position for heavy use and long life as recommended by the manufacturer, harmonizing as to material and finish. Secure to concrete with expansion sleeve anchors; plastic or "Rawl" plugs not acceptable. Provide full-threaded "Phillips" head screws of sufficient length to firmly engage backing, finished to match hardware. Install closers on hollow metal doors with through-bolts.

D. Thresholds: Set in bead of sealant.

E. Keying:
   1. Coordinate with the City the changeover to permanent cores at completion of project.

3.03 MAINTENANCE RELATED ITEMS

A. Furnish one set of installation and adjusting tools and one set of maintenance manuals for locksets, exit devices, door controls/ closers, and floor hinges to the City.

3.04 ADJUSTMENTS AND INSPECTION

A. Closers: Regulate and adjust to comply with fire and accessibility requirements prior to final inspection.

B. During the installation of hardware a periodic inspection shall be made by the Contractor in company with a representative of the Engineer and the hardware supplier or his agent. Any hardware improperly installed shall be removed and reinstalled at the Contractor's expense. At completion of the work a final inspection shall be made by the above parties. Make any and all adjustments recommended by any of the above parties.

3.05 HARDWARE SCHEDULE

A. General: The accompanying Hardware Schedule is furnished for whatever guidance and assistance it may afford the Contractor but shall not necessarily be considered as entirely inclusive.

B. Examine the Drawings and the Specifications to determine the extent, quality, and function of hardware required. Furnish all necessary architectural finish hardware to complete the work.

C. Should any door or item be inadvertently omitted from the scheduled hardware, provide such door or item with the same hardware as required for similar purposes. Should it be determined that the hardware scheduled is not suitable due to detail or size of member, provide hardware of proper size, type and function, similar in operation and equivalent to that specified.

D. Whether listed or not, provide latching lockset, door closer, and smoke gasketing at fire-labeled doors.

3.06 DOOR HARDWARE SCHEDULE

<u>HARDWARE SET 1</u> (Single Alum. Office Door)

STA	2	Pr. Butts	FBB191 x NRP	630
SCH	1	Lockset	ND53HD RHO, SFIC (City-furnished, Contractor-installed)	626
LCN	1	Closer/Stop	4041, Cush-N-Stop	689
PEM	1	Threshold	253X4AFG	719
Sentrol	1	Magnetic Switch	Sentrol 1076 C-1	B-
	1	Set Gasketing	By door manufacturer.	B

HARDWARE SET 2 (Single Alum. Classroom Door)

STA	2	Pr. Butts	FBB191 x NRP	630
SCH	1	Lockset	ND70HD RHO, SFIC (City-furnished, Contractor-installed)	626
LCN	1	Closer	4041	689
PEM	1	Threshold	253X4AFG	719
IVE	1	Wall Bumper	WS401CCV	626
Sentrol	1	Magnetic Switch	Sentrol 1076 C-1	B-
	1	Set Gasketing	By door manufacturer.	B

HARDWARE SET 3 (Single Toilet Door)

STA	1-1/2	Pr. Butts	FBB191 x NRP	630
IVE	1	Push Plate	8200 - US32D - 4 x 16	630
IVE	1	Pull Plate	8302 - 8 - US32D - 4 x 16	630
IVE	1	Kick Plate	8400 US32D - 10 x 1-1/2" LDW	630
SCH	1	Deadbolt Lock	L496, SFIC, "OCCUPIED" indicator (City-furnished, Contractor-installed)	626
LCN	1	Closer	4011	689
PEM	1	Threshold	255X5AFG	719
IVE	1	Wall Bumper	WS401CCV	626

HARDWARE SET 4 (Single Janitor's Closet Door)

STA	1-1/2	Pr. Butts	FBB191 x NRP	630
SCH	1	Lockset	ND80HD RHO, SFIC (City-furnished, Contractor-installed)	626
LCN	1	Closer/Stop	4111, Cush-N-Stop	689
IVE	1	Mop Plate	8400 US32D - 10" x 1" LDW	630
PEM	1	Threshold	253X4AFG	719
IVE	1	Wall Bumper	WS401CCV	626

HARDWARE SET 5 (Single Rated Storeroom Door)

STA	2	Pr. Butts	FBB179	652
SCH	1	Lockset	ND80HD RHO, SFIC	626
			(City-furnished, Contractor-installed)	
LCN	1	Closer	4011	689
PEM	1	Set Gasketing	S88	628
IVE	1	Wall Bumper	WS401CCV	626
Sentrol	1	Magnetic Switch	Sentrol 1076 C-1	B

HARDWARE SET 6 (Single Exterior Storeroom Door)

STA	2	Pr. Butts	FBB191 x NRP	630
SCH	1	Lockset	ND80HD RHO, SFIC	626
			(City-furnished, Contractor-installed)	
IVE	1	Lock Guard	LG1	SP313
LCN	1	Closer	4111	689
PEM	1	Set Gasketing	S88	628
PEM	1	Threshold	253X4AFG	719
PEM	1	Door Shoe/Drip	216APK	719
IVE	1	Floor Stop	FS444	626
Sentrol	1	Magnetic Switch	Sentrol 1076 C-1	B

HARDWARE SET 7 (Single IT / Telecom Door)

STA	1	Pr. Butts	FBB179 x NRP	652
STA	1	Elec. Hinge	CEFBB179 x NRP	652
SCH	1	Elec. Lockset	L9080EU-06, SFIC, 24V	626
			(City-furnished, Contractor-installed)	
IVE	1	Lock Guard	LG1	SP313
LCN	1	Closer	4111	689
IVE	1	Wall Bumper	WS401CCV	626
		Card Reader by City		

HARDWARE SET 8 (Single Alum. Clad Wood Folding Door)

VON	1	Exit Device	35L	626
SCH	1	Cylinder	Mortise, SFIC	626
			(City-furnished, Contractor-installed)	
GLY	1	Overhead Holder/Stop	GJ 100A	626
PEM	1	Threshold	254A	719
PEM	1	Threshold	168A	719
Sentrol	1	Magnetic Switch	Sentrol 1076 C-1	B
		Remainder of hardware and track by door manufacturer.		B

HARDWARE SET 9 (Blacksmith Shop Sliding/Swinging Main Entry Door)

LCF	2	Pulls	Lynn Cove Foundry #AL SP1	Black
STA	1	Hasp	CD941BP	626
Sentrol	1	Magnetic Switch	Sentrol 1045 W	B
		Verify condition and operability of existing hardware. Remove, clean, lubricate, and reinstall as necessary.		

HARDWARE SET 10 (Blacksmith Shop Pair 2'-0" x 6'-5" Side Doors)

--	4	Existing Gate Hinges	Clean and lubricate	--
	2	Surface Bolts, head and sill, inactive leaf		Black
	1	Surface Bolt, active leaf		Black
LCF	2	Pulls	Lynn Cove Foundry #AL SP1	Black
GLY	2	Overhead Holder/Stops	702 H - SPBLK	Black
Sentrol	2	Magnetic Switches	Sentrol 1045 W	B

HARDWARE SET 11 (Single Hallway Door)

STA	2	Pr. Butts	FBB179	652
SCH	1	Lockset	ND10HD RHO	626
			(City-furnished, Contractor-installed)	
LCN	1	Closer	4011	689
PEM	1	Set Gasketing	S88	628
IVE	1	Wall Bumper	WS401CCV	626

HARDWARE SET 12 (Alum. Entry/Exit Door)

STA	2	Pr. Butts	FBB191 x NRP	630
VON	1	Exit Device	35L	626
SCH	1	Cylinder	Mortise, SFIC	626
			(City-furnished, Contractor-installed)	
LCN	1	Closer	4111	689
PEM	1	Threshold	253X4AFG	719
IVE	1	Wall Bumper	WS401CCV	626
Sentrol	1	Magnetic Switch	Sentrol 1076 C-1	B
	1	Set Gasketing	By door manufacturer.	B

HARDWARE SET 13 (Single Toilet Door)

STA	1-1/2	Pr. Butts	FBB191 x NRP	630
IVE	1	Push Plate	8200 - US32D - 4 x 16	630
IVE	1	Pull Plate	8302 - 8 - US32D - 4 x 16	630
IVE	1	Kick Plate	8400 US32D - 10 x 1-1/2" LDW	630
SCH	1	Deadbolt Lock	L496, SFIC, "OCCUPIED" indicator	626
			(City-furnished, Contractor-installed)	
LCN	1	Closer	4011	689
IVE	1	Wall Bumper	WS401CCV	626

END OF SECTION

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SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Glass and glazing for windows, doors, and mirrors, complete.

B. Related Sections:
1. Section 07 92 00 - Joint Sealants: Sealant and back-up materials.
2. Section 08 52 00 - Wood Windows.
3. Section 08 52 13 - Metal-Clad Wood Windows.

1.02 SUBMITTALS

A. Product Data: Submit product data indicating structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
1. Submit data for glazing sealants indicating VOC content of each product in g/L calculated according to 40 CFR 59, Subpart D.
2. Submit data for each glass product indicating visible light transmittance (Tvis) values.

B. Samples: Submit two samples, 6 x 6 inches in size, illustrating each type of glazing unit.

C. Certification Data: Submit certification that glazing materials used on the Project conform to all applicable requirements of CSPE "Safety Standard for Architectural Glazing Materials", and the requirements of the California Building Code.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Strength and Safety: Comply with 2010 California Building Code (CBC) Chapter 24 - "Glass and Glazing".
   a. Safety Glazing: Comply with CBC Section 2406 - "Safety Glazing". Provide glazing tested in accordance with ANSI Z97.1 or CPSC 16 CFR 1201 "Safety Standard for Architectural Glazing Materials". Identify glass in accordance with Section 2406.3; permanently etch glass surface on a corner so as to be visible after glass is installed.
2. Fire and Smoke: Comply with CBC Section 715 - "Opening Protectives".

B. Glazing Standards: Comply with recommendations of the following, except where more stringent requirements are indicated:
1. Glass Association of North America (GANA) "Glazing Manual" and "Sealant Manual" for glazing installation methods.
2. Sealed Insulating Glass Manufacturers Association (SIGMA) TM-3000 "Vertical Glazing Guidelines".

C. Insulating Glass Certification Program: Provide insulating glass units permanently marked with appropriate Insulating Glass Certification Council (IGCC) certification label.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in manner to prevent damaging, as recommended by the manufacturer.

B. Deliver glass affixed with manufacturer's labels and do not remove labels prior to installation, inspection, or final approval.

C. Protect glass from edge damage during handling and installation, and subsequent operation of glazed components of the work. During installation, discard units with significant edge damage or other imperfections.

PART 2 - PRODUCTS

2.01 GLASS MATERIALS

A. Clear Float Glass: ASTM C1036, Type I - Transparent, Class 1 - Clear, Quality q3 - Glazing select, 1/4-inch thick, unless otherwise indicated.

B. Tempered Float Glass: ASTM C1036, Type I, Class 1, Quality q3; tempered where shown and required in accordance with ASTM C1048, Kind FT - Fully Tempered, Condition A - Uncoated surfaces.

C. Obscure Glass at Restroom: ASTM C1036, Type II - patterned, Class 1 - Translucent, Quality q8 - glazing, patterned one side, tempered where shown and required in accordance with ASTM C1048, 1/4-inch thick, unless otherwise indicated.
   1. Pattern: Reed pattern, to be selected by Engineer.

D. Fritted Glass at Bird Safe Areas: ASTM C1048, Kind HS - Heat Strengthened, Condition B - Spandrel type glass, Type I - Transparent, Class 1 - Clear, 3/16-inch thick, with a layer of ceramic frit fire-fused to the interior surface of the glass.
   1. Manufacturer/Pattern: Viracon "Viraspan, Design Silk-Screen Pattern #2256-V907", black color, 1/8" wide lines spaced 1/2" apart, 20 percent glass coverage, tempered surface.

E. Laminated Safety Glass: ASTM C1172, Kind FT, factory lamination of tempered glass meeting ASTM C1036, Type I, Class 1, Quality q3; overall 1/4-inch thick, consisting of the following:
   1. Outer Lite: 1/8-inch thick clear, fully tempered glass.
   2. Interlayer: 0.030-inch thick clear polyvinyl butyral sheet.
   3. Inner Lite: 1/8-inch thick clear, heat strengthened glass.

F. Translucent Laminated Safety Glass: ASTM C1172, Kind FT, factory lamination of tempered glass meeting ASTM C1036, Type I, Class 1, Quality q3; overall 5/16-inch thick, consisting of the following:
   1. Outer Lite: 1/8-inch thick, clear, fully tempered glass.
   2. Laminate Interlayer: 0.030-inch thick clear polyvinyl butyral sheet.
   3. Patterned Interlayer: Saflex "Vanceva Polar White"; or Imaging Sciences LLC. "Imagine Glass Pearls Series", pattern to be selected by Engineer.
   4. Laminate Interlayer: 0.030-inch thick clear polyvinyl butyral sheet.

3. Inner Lite: 1/8-inch thick, clear, heat strengthened glass.

G. Insulating Glass Units: 3/4 inch thick sealed insulating glass units. Provide fully tempered outer lites, and fully tempered inner lites only where safety glazing is required.
   1. Standard: Comply with ASTM E774, Class A, and Insulating Glass Manufacturers Alliance Document SIGMA TM-3000.
   2. Manufacturer/Type: PPG "Solarban 60 (2) Clear", Guardian Industries "SunGuard SuperNeutral SN 68 Clear", Viracon, or equal.
   3. Outer Lite: 3/16 inch thick clear, fully tempered glass, low-e coating on #2 face.
   4. Air Space: 3/8 inch thick, consisting of the following:
      a. Sealing System: Dual seal with polyisobutylene primary seal and silicone secondary seal, black color.
      b. Spacer material: Manufacturer's standard, black color.
      c. Dessicant: Manufacturer's standard; either molecular sieve or silica gel, or a blend of both.
      d. Fill: Argon filled.
   5. Inner Lite:
      a. Typical Windows and Doors: 3/16 inch thick clear float glass.
      b. Restroom Window: 3/16 inch thick obscure float glass.
      c. Bird Safe Windows: 3/16 inch thick fritted glass, with frit pattern on #3 surface.
   6. Solar Heat Gain Coefficient (SHGC): Minimum 0.38.
   7. Visible Light Transmittance (Tvis): Minimum 68 to 70 percent.

2.02 GLAZING ACCESSORIES

A. Elastomeric Glazing Sealant for Nonporous Substrates: Silicone type, meeting ASTM C920, Type S, Grade NS, Class 25, medium modulus, neutral cure; Dow Corning "795", G.E. "Silglaze II SCS2800 Sealant", or equal.
   1. Provide sealants and sealant primers for use inside the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D.
   2. Color: To be selected by Engineer.

B. Setting Blocks: ASTM C509; closed cell preformed silicone or neoprene rubber, 80-90 Shore "A" durometer hardness, size as required to set glass properly. Where glazing block is in contact with silicone sealant, provide silicone glazing block compatible with the silicone sealant.

C. Spacer Shims: Silicone or neoprene elastomeric blocks or continuous extrusions; 50-80 Shore "A" durometer hardness; size as required to set glass properly.

D. Preformed Glazing Tape: ASTM C1281; preformed butyl-polyisobutylene tape sealant, 10-15 Shore A durometer hardness, coiled on release paper, size as required to set glass properly, black color; Presstite, Hapco, or equal.

E. Glazing Clips: Manufacturer's standard type.

F. Glazing Compound for Fire-Rated Glass: UL listed glazing compound, especially tested and approved by the testing agency for use with fire-rated glass; Nippon Electric Glass Company "Metacaulk", GE "Series 1000" silicone sealant, "Norton 990" closed cell foam tape, or equal.

G. Glazing Sealant at Wood Window Frames: ASTM C669, modified oil, non-hardening, knife-grade consistency, grey color.

2.03 FABRICATION

A. Glazing channel dimensions as shown are intended to provide for necessary minimum bite on the glass, minimum edge clearance, and adequate sealant thickness, with reasonable tolerances. Correctly size the glass for each opening, within the tolerances and necessary dimensions established.

B. Factory-label each pane of glass; do not remove labels until final acceptance is obtained.

C. Tong marks on tempered glass shall not be permitted; use horizontal tempering process.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify surfaces of glazing channels or recesses are clean, free of obstructions, and ready for work of this Section. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces to receive glass immediately before glazing with solvent and wipe dry.

B. Seal porous glazing channels or recesses. Prime surfaces scheduled to receive sealant.

3.03 INSTALLATION

A. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified.

B. Setting Blocks: Install of proper size in sill rabbet; locate at one-fourth of glass width, measured from each jamb.

C. Spacers: Provide at inside and outside, of proper size and spacing for glass sizes larger than 50 united inches, except where preshimmed tape or gaskets are used for glazing. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width, except with butyl-rubber sealant tape, use thickness 1/32-inch less than final compressed thickness of tape.

D. Wet Sealants:
   1. Force sealants into channel to eliminate voids and to ensure complete "setting" or bond of sealant to glass and channel surfaces.
   2. Prevent exudation of sealant or compound by forming voids or installing filler rods in channels at heel of jambs and heads (do not leave voids in sill channels), except as otherwise indicated.

3. Tool exposed surfaces of sealant to provide a substantial "wash" away from the glass. Where pressurized tape is used for exterior glazing, provide silicone cap bead sealant; no portion of tape shall be exposed to weather.

E. Clean and trim excess glazing materials from the glass and stops of frames promptly after installation and eliminate stains and discolorations.

3.04 PROTECTION AND CLEANING

A. After installation, mark accessible side of pane with an "X" by using plastic tape or removable paste, to prevent persons from bumping into glass.

B. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged during construction, including natural causes, accidents, and vandalism.

C. Remove glazing sealant, compound, dust, dirt and other foreign materials from finish surfaces. Remove labels after work is completed. Wash glass on both faces not more than 4 days prior to date scheduled for Substantial Completion.

END OF SECTION

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SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metal support framing systems and accessories, complete. The work includes suspended-ceiling grillage for gypsum board.

B. Related Sections:
1. Section 09 29 00 - Gypsum Board.
2. Section 09 51 00 - Acoustical Ceilings.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each item of support framing and accessories.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect metal framing units from rusting and damage. Deliver to the Project site in manufacturer's unopened container or bundles fully identified with name, brand, type, and grade. Store off the ground in a dry, ventilated space or protect with suitable waterproof coverings.

PART 2 - PRODUCTS

2.01 SUSPENDED METAL GRILLAGE

A. Manufacturer: Subject to compliance with requirements, provide products manufactured by Dietrich Metal Framing, U.S. Gypsum, National Gypsum, Western Metal Lath Company, or equal.

B. Main Runners: 1-1/2-inch steel channel, 0.475 pound per foot, cold rolled channel; rust-inhibitive coated.

C. Cross Furring: ASTM C645 hat-shaped rigid furring channels, 7/8-inch deep x 2-1/2-inch wide x 0.0209-inch thick (25-gage); or 3/4-inch deep, 0.3 pound per foot cold- or hot-rolled channel.

D. Resilient Furring Channels: 1/2-inch deep steel sheet members designed to reduce sound transmission, hat shaped.

E. Hanger and Tie Wires: ASTM A641, Class 1 zinc-coated, soft temper, annealed galvanized wire:
1. Hanger Wire: 0.162-inch diameter (8-gage).
2. Diagonal Bracing Wire: 0.106-inch diameter (12-gage).

3. Tie Wire: Two strands of 0.040-inch diameter (18-gage); USG Furring Channel Clip may be used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine all parts of the supporting structure to which metal support framing systems are to be applied and the conditions under which the systems are to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION - GENERAL

A. Installation Standards: Install metal support systems in accordance with ASTM C754 and the California Building Code.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install supplementary framing, blocking, and bracing to support equipment, services, furnishings, and similar construction requiring attachment to the system.
   2. Install bracing at terminations in assemblies.
   3. Where type of supplementary support is not indicated, comply with the manufacturer's recommendations, considering the weight or loading resulting from the item supported.

3.03 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components and assemblies according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Do not pass hangers through ducts.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for

structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Space hangers not more than 4 feet on center.
6. Provide extra hangers within 6 inches of ends of main runners and as required by the California Building Code to support light fixtures, ceiling diffusers and grilles, loudspeaker enclosures, access panels, and other items resting in or on the ceilings.

D. Provide main runners spaced not more than 4 feet on center. Locate main runners within 6 inches of parallel walls to support ends of cross furring. Support main runners from hangers by saddle tying wire hangers to runners.

E. Space cross-furring channels at not more than 16 inches on center, and in accordance with manufacturer's instructions. Locate cross furring perpendicular to main runners and not more than 2 inches from parallel walls. Attach to main runners at each intersection with two strands of 18-gage wire or other approved ties.

F. Seismic Bracing: Sway-brace suspension systems with hangers used for support. Provide supplemental seismic fasteners for support and bracing of hangers, runners, and furring in accordance with systems approved by the California Building Code.

G. Splice main runners and furring channels by overlapping (with flanges of channels interlocked) and wire-tie each end of splice with not less than double loops of 16-gage wire. Overlap not less than 12 inches for main runner splices and not less than 18 inches for cross-furring splices.

H. Provide additional ceiling framing as required to form openings and to frame openings. Coordinate support framing with the work of other trades.

I. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet.

END OF SECTION

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SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Gypsum board, gypsum sheathing board, cement board, and accessories, complete.
2. Taped and finished joint treatment, and acoustical treatment.

B. Related Sections:
1. Section 07 21 00 - Thermal Insulation.
2. Section 07 84 00 - Firestopping: Sealing of penetrations in fire-rated assemblies.
3. Section 07 92 00 - Joint Sealants.
4. Section 09 22 16 - Non-Structural Metal Framing.

1.02 SUBMITTALS

A. Product Data: Submit product data for each component, including metal accessories, gypsum board, joint tape, and acoustical sealant. Submit other data as may be required to show compliance with these Specifications.

B. Qualification Data: Submit for installer.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Company experienced and specializing in gypsum board systems work.

B. Regulatory Requirements: Comply with fire-resistance ratings as indicated. Provide materials, accessories, and application procedures which have been listed by UL or tested according to ASTM E119 for the type of construction shown.

C. Sole Source Responsibility: For all gypsum board work throughout the Project, provide materials, including wallboard, accessories, fasteners, and finishing materials produced by one manufacturer, unless otherwise noted.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide gypsum board manufactured within 500 miles of the jobsite by one of the following, or equal:
1. Gold Bond Division of National Gypsum, Richmond, CA.
2. G-P Gypsum Corp, Antioch, CA.
3. Pabco Gypsum, Las Vegas, NV.

4. US Gypsum, Empire, NV.

2.02 GYPSUM BOARD MATERIALS

A. Gypsum Board: ASTM C36; fire resistive type, UL-rated Type X; 5/8-inch thick typical, unless noted otherwise; maximum permissible length; ends square cut, with long edges tapered to receive manufacturer's standard joint treatment.

B. Water Resistant Gypsum Board: ASTM C630; 5/8-inch thick, water resistant board and fire-resistant rated where required, maximum permissible length; ends square cut, tapered edges.

C. Tile Backerboard: Glass mat gypsum sheathing board meeting ASTM C1177; 5/8-inch thick, gypsum sheathing with glass mats both sides and long edges and silicone-treated water-resistant gypsum core, UL fire-rated Class A, maximum required length; ends square cut; same as G-P Gypsum Corporation "DensGlass Sheathing", or equal.

D. Cement Board: Cementitious Fiber-Mat Reinforced Sheathing meeting ASTM C1325; 1/2-inch thick; maximum required length; ends square cut; same as US Gyspum "Durock Cement Board", or equal.

2.03 GYPSUM BOARD ACCESSORIES

A. Corner Beads: ASTM C1047, 30-gage galvanized sheet steel with 1-1/4-inch wide perforated flanges; US Gypsum "Dur-A-Bead", Beadex "B-1XW", or equal.

B. Edge Trim: ASTM C1047, "LC-Bead" channel type and "L-Bead" angle type as applicable, 30-gage galvanized sheet steel with perforated flanges, same thickness as gypsum drywall; US Gypsum "200B", or equal.

C. Control Joints: ASTM C1047, 30-gage galvanized sheet steel with perforated flanges; US Gypsum "No. 093", Western Metal Lath, or equal.

D. Joint Materials: ASTM C475; joint tape, premixed joint compound, and fasteners.
   1. Joint Tape at Paper-Faced Gypsum Board: Perforated paper joint tape, 2 inch wide.
   2. Joint Tape at Water Resistant and Glass-Mesh Faced Gypsum Board: Glass-mesh joint tape, 2 inch wide, 10 x 10 glass mesh.

E. Fasteners into Metal: ASTM C1002, Type S, Phillips-head, self-drilling, self-tapping, steel, drywall screws: provide 1-inch length for single layer application, 1-5/8-inch length for double-layer application, and 1-1/4-inch length for single-layer coreboard application.

E. Fasteners into Wood: ASTM C1002, Type W, bugle-head screws, 1-1/4-inch length to penetrate wood not less than 3/4 inch. Smooth-finish cement-coated drywall nails not acceptable.

2.04 SOUND ISOLATION MATERIALS

A. Acoustical Batt Insulation: Refer to Section 07 21 00.

B. Acoustical Sealant: Refer to Section 07 92 00.

C. Electrical Box Pads: Wrap back and sides of outlet, switch, and telephone boxes recessed in walls with acoustical insulation.
   1. Non-Fire Rated Partitions: Harry A. Lowry & Associates "Lowry's Electrical Box Pads", Tremco "Sheet Caulking", 3M "Electrical Box Pad", or equal.
   2. Fire Rated Partitions: EGS Electrical Group/ Nelson Firestop Products "FSP Firestop Putty Pads", Specified Technologies "Fire Putty Pads", or equal.

D. Backing Rod: Closed-cell bead or rod polyethylene foam.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine all parts of the supporting structure to which gypsum board systems are to be applied and the conditions under which gypsum board systems are to be installed.

B. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings. Do not begin Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION - INSTALLATION OF SOUND-ISOLATION SYSTEM

A. Install acoustical insulation in sound-insulated partitions. Completely fill space between studs to full height of partition, and fasten to framing to prevent slipping.

B. Pack insulation batts around perimeter of piping and electrical boxes in wall/ceiling cavities. Fit carefully behind electrical outlets and other work which penetrates partition. Stagger end joints.

C. Outlet Boxes: Verify that outlets on opposite sides of walls are offset by a minimum 16 inches. Clean outside of electrical boxes and wrap with self-adhering sound pads. Install in accordance with manufacturer's written instructions.
   1. Fire-Rated Walls: Install in accordance with UL-approved File R10764.

D. Fill all gaps with compressible neoprene tape where gypsum board partitions abut window mullions or other surfaces, as shown on Drawings.

3.03 INSTALLATION - GYPSUM BOARD

A. General: Install gypsum board on walls and ceilings in accordance with ASTM C840 and the Gypsum Association Specification GA-216, "Recommended Specifications for the Application and Finishing of Gypsum Board," unless more stringent requirements are indicated.
   1. Fire-Rated Assemblies: Install in accordance with requirements of UL test reports.

B. Erect single layer gypsum board in non-fire rated walls in most economical direction, with ends and edges occurring over firm bearing. Neatly fit ends of edges where they abut.

C. Erect single layer fire-rated gypsum board vertically, with edges and ends occurring over firm bearing.

D. Stagger gypsum board so corners of any four wallboards do not meet at the same point. No horizontal or vertical joints permitted within 12 inches of corners or openings.

E. Water-Resistant Gypsum Wallboard: Install where gypsum is used as a backing for ceramic tiles and in certain "wet" areas where water resistant board is indicated.
   1. Install in the same manner as regular gypsum board.
   2. Treat cut edges and holes in board with sealant.

F. Fasteners:
   1. Space fasteners not to exceed 8 inches on center for partitions and 7 inches on center for ceiling at abutting edges and 12 inches in field. Space fasteners not less than 3/8-inch from edges and ends.
   2. Use screws when fastening gypsum board to metal furring or framing.
   3. Drive fasteners until heads rest in a shallow dimple-like depression; take care not to crush core or break paper surface.

G. Tile Backerboard: Install in accordance with ANSI A108.11.
   1. Fasten to studs with corrosion-resistant fasteners, spaced at maximum 8 inches on center. At horizontal and vertical joints, corners of panels, and junctions with dissimilar materials, provide gap of 1/8-inch to 3/16-inch, and completely fill with dry-set or portland cement mortar.
   2. Cover joints and corners with 2-inch wide fiberglass mesh tape embedded in skim coat of portland cement mortar.

3.04 PENETRATIONS IN SOUND-RATED CONSTRUCTION

A. Make cutouts regular and with accuracy to meet the following requirements. Do not fracture the core or tear covering of gypsum board. Make penetrations of insulated wall and ceiling constructions only where necessary.

B. Seal gypsum board penetrations and perimeter joints airtight using acoustical sealant. Seal penetrations and joints through gypsum board in accordance with ASTM C919.
   1. Perimeter Joints: Hold gypsum board back 1/4 inch from perimeters and intersections; seal airtight with acoustical sealant.

C. Clearances: Provide the following through sound-rated or sound-insulated walls:
   1. Where conduit or piping is 3 inches or less in diameter, provide a clearance of 1/4 inch +/- 1/8 inch between the conduit or piping and the structure, unless otherwise indicated.
   2. Where duct or piping is greater than 3 inches in diameter, provide a clearance of 1-inch +/- 1/4 inch at the perimeter of the penetration.

D. After the ductwork, conduit, or piping has been installed, repair the gypsum board perimeter clearance to the specified tolerances.
   1. Where clearance is 3/8 inch or less, caulk airtight with acoustical sealant.
   2. Where clearance is between 3/8 inch and 3/4 inch, use a flexible backing rod to caulk against.
   3. Where clearance exceeds 3/4 inch, provide a sheet metal sleeve within the partition packed with safing insulation batts and caulk both sides airtight with acoustical sealant.

E. Electrical Boxes: Caulk perimeter face at gypsum board with acoustical sealant.

F. Access Doors: Provide fire-rated doors. Seal door flanges with Pemko S88 smoke seal at perimeter. Seal entire assembly to gypsum board with acoustical sealant.

3.05 SURFACE TREATMENT

A. General:
1. Conceal joints and fastener depressions as specified. Mix joint compound following manufacturer's written instructions.
2. Apply tape and joint compound in accordance with manufacturer's recommendations.

B. Corner and Edge Treatment:
1. Internal Corners: Treat as specified for joints; fold reinforcing tape lengthwise through middle, fit neatly into corner.
2. External Corners: Apply metal corner beads in single lengths with joint treatment as specified for joints.
3. Edges: Provide metal casing bead at all exposed edges and at intersections with dissimilar materials. Use longest practical length.

C. Joint and Fastening Concealment:
1. Embed tape in joint compound, followed by application of joint compound in accordance with Gypsum Association recommendations.
2. Sand all coats after each application has dried. Take care not to scuff paper surface of wallboard when sanding.
3. Glass Mesh Mortar Units: Secure, tape, and finish in accordance with ANSI A108.11, for wet conditions.

D. Finish of Gypsum Board: Finish gypsum board in accordance with Gypsum Association Document GA-214 "Recommended Levels of Gypsum Board Finish", as follows:
1. Level 2: For fire taping in concealed areas.
2. Level 3: Where wallboard forms substrate for tile or is concealed by casework.
3. Level 4 - Smooth: For surfaces scheduled to receive flat or textured painted finish.
4. Level 5 - Skim Coat: For surfaces exposed to view and scheduled to receive gloss or semigloss painted finish.

3.06 TOLERANCES

A. Construction Tolerances: Do not exceed 1/8-inch in 8-feet variation from plumb or level in any exposed line or surface. Do not exceed 1/16-inch variation between planes of abutting edges or ends. Shim as required to comply with specified tolerances.

END OF SECTION

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SECTION 09 30 00

TILING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Ceramic tile for floors and walls at Environmental Education Center toilet room.
2. Waterproof membrane at new toilet room floor.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete: Floor substrate.
2. Section 07 92 00 - Joint Sealants.
3. Section 09 29 00 - Gypsum Board: Water-resistant board for tile backing.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data on all materials and accessories.
1. Submit data for waterproofing membranes and adhesives, including printed statement of VOC content.
2. Submit data for tile setting adhesives and grout, including printed statement of VOC content.

B. Samples:
1. Tile: Submit tile color samples for selection by Engineer. After colors have been selected, submit three sample tile panels for each type, pattern, and color of tile selected. For 4-1/4-inch or larger tiles, submit a minimum of four tiles per panel; for ceramic mosaic tiles, submit tile panel a minimum of 8 inches square. Adhere tiles to hardboard or plywood panel, with the specified grout color filled into joints.
2. Grout: Submit grout color samples for selection by Engineer.

C. Qualification Data: Submit for installer.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Experienced, who has completed tile installations similar in material, design, and extent to that required for this Project, and with a record of successful performance.

B. Standards:
1. Tile: Certified by Tile Council of North America (TCNA) to meet or exceed ANSI A137.1 Standard Grade requirements.
2. Slip Resistance: Tile static coefficient of friction, wet or dry, to be a minimum of 0.6 for walking surfaces and a minimum of 0.8 for ramps, when tested in accordance with ASTM C1028.
3. Tile Setting Adhesive and Grout: Meet South Coast Air Quality Management District (SCAQMD) Rule 1168; VOC limits effective July 1, 2005 and rule amendment date of January 7, 2005.

4. Installation Standard: Comply with the "Handbook for Ceramic Tile Installation" published by TCA for installation methods specified, unless otherwise shown or specified.

1.04 EXTRA MATERIALS

A. Submit to the City upon completion of work extra tiles, and trim for future repair and maintenance work. Submit not less than 1percent additional tiles and ten trim pieces for each type and color installed. Package the extra materials in a cardboard box suitable for storage. Clearly label and identify the contents in the box.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ceramic Tile at Environmental Education Center Toilet Room:
   1. Manufacturer: Quarry Tile Company "Eco-Body" distributed by DalTile, or FireClay Tile "Debris Series".
   2. Walls: 3 x 6 inch ceramic tiles, glazed finish; colors to be selected by Engineer.
   3. Floors: 2 x 2 inch ceramic mosaic tiles, unglazed, non-slip finish with minimum wet and dry coefficient of friction of 0.60 when tested in accordance with ASTM C1028; colors to be selected by Architect.
   4. Cove Base: 6 x 6 inch ceramic tile cove base, glazed finish, with finished edge at floor; colors to be selected by Engineer.

B. Trim: Matching stops, returns, surface bullnoses, trimmers, and other shapes required to produce a complete and finish installation. Trim shall match the tile in size, color, and finish, unless otherwise shown or specified.

C. Grout:
   1. Manufacturer: Custom Building Products, Hydroment, Mapei, or equal.
   2. Floors: ANSI A118.6 latex portland cement grout, sanded.
      a. Color: To be selected by Engineer.
   3. Walls: ANSI A118.6 latex portland cement grout, unsanded.
      a. Color: To be selected by Engineer.

2.02 ACCESSORY MATERIALS

A. Urethane Waterproof Membrane at Floors:
   1. Manufacturer: Mer-Kote Products, Inc., "Mer-Krete B.F.P. Membrane"; Mapei "PRP 315"; Laticrete "9235", or equal.
   2. Standard: Meeting ANSI A118.10, reinforced one-part liquid applied membrane with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Floor Tile Bond Coat at Waterproof Membrane:
   1. Manufacturer: Mer-Kote Products, Inc. "Mer-Krete Tile Bonding Adhesive"; Mapei "Ultra/Flex II"; or equal. Bond coat shall be by same manufacturer as waterproof membrane and be compatible with the waterproofing membrane.

2. Standard: Meeting ANSI A118.4. Use ceramic tile adhesive that complies with the following limit for VOC content when calculated according to 40 CFR 59, Subpart D.
   a. Ceramic Tile Adhesives: 65 g/L.

C. Mortar Bed Mix: ANSI A108.1; bond coat consisting of portland cement paste on a mortar bed that is still workable, or latex portland cement mortar on a cured bed.
   1. Portland Cement: ASTM C150, Type I
   2. Sand: ASTM C144.
   3. Lime: ASTM C206.

D. Metal Lath: ASTM C847, except steel need not be copper bearing and may be painted.

E. Thinset Mortar at Wall Tile: ANSI A118.4 - Latex portland cement mortar, thinset.

F. Tile Backerboard: Refer to Section 09 29 00 - Gypsum Board.

G. Edge Protection and Divider Strips: Stainless steel, height to align with tile thickness, 1/8-inch wide top edge, bottom edge designed for anchorage in tile setting bed; Schlutter Systems Inc., or equal.

H. Joint Sealants: Mildew-resistant silicone type at showers, polyurethane self-leveling type at floors, as specified in Section 07 92 00.

I. Grout Sealer: Low VOC sealer, specifically designed for sealing tile grout joints; Miracle Sealants Company "511 H2O Plus - Water Base Penetrating Sealer", or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that the substrates and installation conditions for the installation of ceramic tile are satisfactory. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Tile Backerboard:
   1. Install in accordance with ANSI A108.11.
   2. Fasten to studs with corrosion-resistant fasteners, spaced at maximum 8 inches on center. At horizontal and vertical joints, corners of panels, and junctions with dissimilar materials, provide gap of 1/8-inch to 3/16-inch, and completely fill with dry-set or portland cement mortar.
   3. Cover joints and corners with 2-inch wide fiberglass mesh tape embedded in skim coat of portland cement mortar.

B. Prior to setting tile, apply sealant around all pipes and conduits penetrating tile substrate surfaces using specified sealant.

3.03 INSTALLATION - WATERPROOF MEMBRANE

A. Install the waterproof membrane in accordance with manufacturer's written installation instructions, except where more stringent requirements are indicated. Install waterproof membrane on top of concrete substrates which are over metal deck.

B. Apply primer to substrate if recommended by the waterproofing membrane material manufacturer.

C. Install the membrane in uniform thickness of 1/16-inch minimum. Provide gage or other positive means of controlling and measuring the thickness of the membrane as work progresses. Extend membrane up a minimum 4 inches at vertical surfaces, unless otherwise noted.
   1. At floor drain terminate membrane inside of flashing ring of floor drain.

D. Install fiberglass reinforcement with sides and ends of sheets properly lapped to form a continuous reinforcing for the membrane. The fiberglass reinforcement shall be fully embedded and bonded between layers of waterproofing material.

E. Finish the membrane suitably to receive the bonding material and to achieve the bonding strength between the two materials.

3.04 INSTALLATION - TILE

A. Installation Methods: Comply with the following TCNA installation methods:
   1. Full Setting Bed Floors on Grade: F112-09; ANSI A108.1, portland cement mortar bed.
   2. Thinset Walls on Glass Mat Gypsum Board: W243-09; ANSI A108.5, thinset method, latex portland-cement mortar bond coat.
   3. Expansion Joints: EJ171-09.

B. General: Do not use units with chips, cracks, voids, stains, or other defects which could be visible in the finished work.

C. Contiguous Work: Provide drain and cleanout openings as shown. Close up openings in tile work after other work is in place. Use materials and set to match surrounding tile.

D. Preparation of Substrate: Clean substrate to remove dirt, dust, debris, and loose particles.

E. Installing Tile:
   1. Lay out tile units with fields centered; avoid use of units less than one-half size. Unless otherwise noted, align units square, parallel, and straight. Joint widths shall be the same in each area, approximately 1/16-inch, unless otherwise shown or specified.
   2. When cutting is required, grind edges smooth. Accurately cut units around work of other trades so that edges of tile will be completely covered; terminate tile at centerlines of doors, unless otherwise shown or specified.
   3. Firmly embed units in setting material and bring finished surfaces to true planes. Make inside corners square and outside corners bullnose.
   4. Do not start floor tile installation in spaces requiring both floor and wall tile until wall tile installation has been completed.
   5. Omit tile where floor and wall areas will be covered by permanently built-in items such as toilet fixtures and toilet accessories.

F. Grouting:

1. Grout joints in accordance with ANSI A108.10.
2. Perform grouting as soon as possible after initial set of setting bed. Force grout into joints, strike flush, and tool slightly concave. Wet joint surfaces, if dry, prior to grouting.
3. Provide means to prevent grout staining the exposed face of tile and pavers.

G. Sealant: Seal intersection of interior wall tile and dissimilar materials with silicone sealant. Clean all joints free of loose mortar, dirt, and debris. Neatly tool all sealants.

H. Expansion Joints: Provide expansion joints in width to match grout-joint width, and seal with polyurethane sealant in color to match grout. Provide expansion joint between intersection of wall and floor, and at construction pour joints.

3.05 CLEAN, CURE AND PROTECT

A. Clean tile and adjacent surfaces of adhesive and grout as work progresses. Upon completion, thoroughly clean tile surfaces in manner not to affect glazing.

B. Curing: Provide proper temperature and humidity conditions for curing the work. Damp-cure cement grouts for not less than 72 hours. Add dampness as required, and cover with nonstaining membrane.

C. Grout Joints: Seal tile joints with grout sealer in accordance with manufacturer's written recommendations.

D. Protect tile work from damage until final acceptance of entire Project.

END OF SECTION

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SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Suspended metal grid ceiling systems, acoustical panels, and perimeter trim, complete.

B. Related Sections:
1. Division 21 - Fire Suppression: Sprinklers in ceiling system.
2. Division 23 - HVAC: Air diffusion devices in ceiling system.
3. Division 26 - Electrical: Light fixtures in ceiling system.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawing details and reflected ceiling plans of the acoustical ceiling systems specified in this section. Indicate on shop drawings the grid layout and related dimensioning, junctions with other work or ceiling finishes, seismic bracing, and interrelation of mechanical, electrical, and other items related to system, and special detail conditions.

B. Product Data: Submit manufacturer's specifications and product data on metal grid system components, acoustic units, and all other products to be used. Submit manufacturer's installation instructions.

C. Samples: Submit samples 12 x 12 inch in size or full size units, illustrating material, texture, color, and finish of acoustic units. Submit samples 12 inches long, of suspension system main runner, cross runner, edge trim, and all special shapes required.

D. Qualification Data: Submit for installer.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company with documented experience and approved by manufacturer.

B. Regulatory Requirements:
1. Fire and Smoke: Conform to 2010 California Building Code (CBC) for fire-rated assemblies and for combustibility requirements for materials.
2. Seismic: Conform to 2010 CBC, Section 803.9 "Acoustical Ceiling Systems". Install acoustical ceiling systems in accordance with the provisions of ASTM C635 and ASTM C636.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling materials to the jobsite in original, unopened packages, bearing the manufacturer's name and label identifying each type of material.

B. Comply with acoustical material manufacturer's recommendations for storage of materials to be used in the work.

1.05 EXTRA MATERIALS

A. Provide the following materials to the City for maintenance and repair work:
   1. Acoustical Panels: Five (5) percent of each type and pattern of acoustical panel, but not less than one carton.
   2. Grid Runners: One (1) percent of each type, but not less than two pieces of main runners 10 feet long, and ten pieces of cross runners 4 feet long.

PART 2 - PRODUCTS

2.01 SUSPENSION SYSTEM MATERIALS

A. Ceiling Grid:
   1. Manufacturer: Armstrong, Chicago Metallic, USG Interiors "Donn", or equal.
   2. Type: ASTM C635, heavy duty, exposed T/two direction components, die-cut and interlocking.
   3. Recycled Content: Average 25 percent.
   4. Profile/Size: 9/16-inch wide, Armstrong "Silhouette XL, Bolt-Slot System" 1/4 inch reveal bottom flange.
   5. Finish: Manufacturer's standard.

B. Hanger and Tie Wires: ASTM A641, Class 1 zinc-coated carbon steel, soft temper, prestretched.
   1. Hanger Wire: Minimum 12-gage for ceilings weighing not more than 4 pounds per square foot, yield stress a minimum of 3 times design load.
   2. Diagonal Bracing Wire: 12-gage.
   3. Tie Wire: 16-gage.

C. Accessories: Manufacturer's standard stabilizer bars, splices, and wires required for suspended grid system.

D. Edge Moldings, Seismic Gaps, and Trim: Commercial quality cold-rolled steel with galvanized coating, white painted, same material and finish as exposed runners. Comply with seismic requirements of ASCE 7-05 Section 13.5.6.2.2.
   1. Perimeter Wall Closure Strips: Minimum 2 inches wide.
   2. Perimeter Wall Seismic Gap: 3/4 inch wide.

E. Compression Posts: Electrical metallic tubing (EMT), diameter as indicated; Armstrong, USG Interiors "Donn", or equal.

F. Support Channels and Hangers: Galvanized steel; size and type to suit application, to rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of L/360.

2.02 ACOUSTIC UNIT MATERIALS

A. Acoustic Panels:

1. Manufacturer: Armstrong, USG Interiors, or equal.
2. Classification Type: ASTM E1264, Type XII, Form 2, Pattern E; mineral fiber.
3. VOC/Formaldehyde: Meets California Department of Health Services CHPS for low emissions; no added formaldehyde.
4. Fire Rating: Class A, flame spread under 25.
5. Acoustical Performance: NRC: 0.95; AC:190.
6. Size: 24" x 96" x 1" thick.
7. Edge Profile: 9/16 inch, square tegular edge lay-in.
8. Texture: Same as Armstrong "Optima Open Plan - Non-traditional Sizes".
9. Recycled Content: Average 82 percent.
10. Color: Manufacturer's standard white.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that existing conditions are ready to receive work and that layout of hangers will not interfere with other work. Do not begin installation until major above-ceiling work has been completed and unsatisfactory conditions have been corrected.

3.02 INSTALLATION - GENERAL

A. Install systems in accordance with ASTM C635 and ASTM C636, and as supplemented in this Section.

B. Install systems capable of supporting imposed loads to a deflection of 1/360 of its span maximum.

C. Hanger Wires: Provide hangers for installation in existing structure. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
   1. Provide hanger wires at 4 foot centers, maximum.
   2. Fasten hanger wires with not less than 3 tight turns within a distance of 1-1/2 inches.
   3. Maintain 6 inches minimum clearance between all wires and unbraced ducts, pipes and conduit.

D. Seismic Bracing:
   1. Comply with ASTM E580 "Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint". Bracing assembly consists of compression posts and wires securely fastened to suspension system main runners and structure above.
   2. Install seismic bracing in all rooms larger than 144 sq. ft. Provide bracing at 12 x 12 feet intervals, beginning at the perimeter of the room.
   3. Lateral Bracing: Four 12-gage wires secured to the main runners within 4 inches of the cross runner intersection, and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the ceiling plane. Provide horizontal restraints within 4-feet of surrounding walls, at 12-foot intervals in each direction, and wherever walls or partitions terminate at underside of ceiling.
   4. Fasten bracing wires with four tight turns within a distance of 1-1/2 inches.

E. Hang systems independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members. Locate systems on room axis according to reflected ceiling plan.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6-inches of each corner, or support independently. Do not eccentrically load system, or produce rotation of runners.

H. Edge Molding: Install at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions. Install tight to partitions, free from curves, breaks, and irregularities.

I. Acoustic Panels: Fit in place, free from punctures, damaged edges or other defects detrimental to appearance, function, and cleanliness. Install level, in uniform plane, and free from twist, warp and dents.

3.03 TOLERANCES

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

B. Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees maximum.

C. Deflection: Not to exceed a maximum of L/360 of span.

3.04 CLEANING AND PROTECTION

A. Clean exposed surfaces of acoustical ceilings, including trim edge moldings, and suspension members. Comply with the manufacturer's instructions for cleaning and touch-up of minor finish damage.

B. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Resilient rubber wall base and accessories, complete.

B. Related Sections:
1. Section 09 29 00 - Gypsum Board.

1.02 SUBMITTALS

A. Product Data: Submit product data on specified products describing physical and performance characteristics, sizes, patterns and colors. Include data on the adhesive to be used including printed statement of VOC content.

B. Samples: Submit samples of all required materials.

C. Qualification Data: Submit for installer.

D. Maintenance Data: Submit manufacturer's cleaning and maintenance data.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Minimum three (3) years documented experience in installing materials similar to that required for this Project.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Deliver materials to the jobsite in manufacturer's unopened containers. Store materials for three days prior to installation in area of installation to achieve temperature stability.

B. Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

1.05 EXTRA MATERIALS

A. Provide 10 percent extra of each type and color of base material used on the Project.

B. Furnish extra materials from the same production lots as the installed materials, factory packaged and labeled with the contents, and the City's and project's names, and the location in the Project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide rubber base manufactured by BurkeMercer Flooring Products Div. of Burke Industries, Marley Flexco (USA) Inc., R.C. Musson Rubber Co., or equal.

2.02 MATERIALS

A. Rubber Base:
   1. Type: ASTM F1861, Type TS - Thermoset vulcanized SBR rubber, Group 1 - Solid. Type TP - Thermoplastic base and Type TV - Vinyl base not acceptable.
   2. Style: Style B - Cove at concrete and hard surface flooring.
   3. Size: 1/8 inch thick x 4 inch high, unless otherwise indicated.
   4. Colors: To be selected by Engineer.

B. Base Accessories: Provide premolded inside and outside corners and end stops of same material, size, and color as base.

C. Adhesives: Water resistant type as recommended by manufacturer to suit resilient products and substrate conditions. Asphalt emulsion and non-waterproof type adhesives not acceptable.
   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D.
      a. Cove Base Adhesives: 50 g/L.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 1/8-inch in 10 feet, and are ready to receive Work.

B. Do not begin installation until unsatisfactory conditions have been resolved.

3.02 INSTALLATION

A. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends use premolded units.

C. Install base on solid backing. Bond tight to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.03 CLEANING

A. Remove excess adhesive from base and wall surfaces without damaging material or adjacent surfaces.

B. Clean base surfaces in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 09 67 23

RESINOUS FLOORING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Resinous epoxy floor coating system, to match epoxy flooring system in existing restrooms, complete.

B. Related Sections:
   1. Section 03 30 00 - Cast-in-Place Concrete: Floor substrate.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, and complete list of all materials to be used.
   1. Submit data indicating chemical composition and VOC content. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.

B. Samples:
   1. Submit manufacturer's color charts for initial selection showing colors and finishes available. Match existing colors and texture.
   2. Submit manufacturer's product sample, minimum 2-1/2 x 4 inches, showing entire assembly and indicating color, thickness, and texture of non-slip surface.

C. Qualification Data: Submit for manufacturer and applicator.

D. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain materials from same manufacturer as existing epoxy flooring.
   1. Single Source Responsibility: Obtain all materials used in the flooring system from a single manufacturer.

B. Applicator Qualifications: Firm and installation crew with a minimum of 5 years experience in the application of resinous flooring systems similar in size, material, design, and complexity to that required for this Project, and approved by the material manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the site in the original unbroken packages bearing brand name, type of material, and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's directions to prevent deterioration from moisture, heat, cold, direct sunlight, and other detrimental effects. Comply with all applicable safety regulations. Keep all materials sealed until ready for use.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Comply with manufacturer's directions for installing materials under satisfactory ambient and substrate temperature, moisture, humidity, ventilation, and other environmental conditions required. Apply materials only at atmospheric and surface temperatures within the manufacturer's recommended ranges, and in all cases above 50 degrees F.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Crown Polymers, 11111 Kiley Drive, Huntley, IL (www.crownpolymers.com), to match existing epoxy flooring system manufacturer.

2.02 MATERIALS

A. General: Material is a trowel-applied, jointless, water-phase resin material, approximately 1/4-inch thick, resistant to a wide range of acids, solvents, detergents, and fats, and applied in a series of coats.

B. Components:
   1. Leveling Course: Crown Polymers, "CrownShield TD", Product Description Sheet No. 320-TD, Epoxy Polymer Concrete Trowel Floor Overlay.
   2. Base Coat: Crown Polymers, "CrownShield 50", Product Description Sheet No. 320, High-Build Pigmented Epoxy Floor Coating, Medium Gray Epoxy.
   3. Flakes: Gray blend full flake.
   4. Top Coat: Crown Polymers, "CrownPro 6", Product Description Sheet No. 333, High-Build 100% Solids UV Resistant Polyurea Floor Top Coating, Clear epoxy.

C. VOC Requirement: Do not exceed the VOC limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, January 1, 2004. Provide primers, resins and binders with maximum VOC of 200 g/L, when calculated according to 40 CFR 59.

D. Cleaning Agents, Primers, and Application Tools: As recommended by the coating manufacturer.

E. Color: Match existing flooring.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine sub-surfaces to be coated and report conditions that would adversely affect the performance or appearance of the resinous flooring systems.

B. Do not proceed with application of resinous flooring until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Apply materials only to clean, dry, uniform surfaces, smooth enough to allow for smooth finish but roughened as required for bond. Patch cracks with non-shrink compounds.

B. Grind down existing epoxy flooring at accessible toilet stalls. Grind surface smooth up to the toilet partition, making a straight line transition between new and old flooring.

C. Clean area of all dirt, dust, grease, oil, paint, rust, and scale. Perform all special alkali and acid cleaning as recommended by manufacturer's representative.

3.03 INSTALLATION

A. General: Proportion, mix, and apply materials in strict accord with the manufacturer's printed recommendations, including proper curing times and thickness of coats.
   1. Keep manufacturer's printed directions at the jobsite, readily accessible for reference during installation.
   2. Observe all health and safety precautions noted by manufacturer.
   3. Take care to not apply materials to surfaces not intended to receive them and remove all such applications immediately.

B. Leveling Course: Apply leveling course to regrade existing surfaces and slope floor to drain.

C. Base Coat: Mix and apply base coat over properly cured leveling course. Broadcast colored flakes into base coat to match distribution pattern and color of existing flooring.

D. Top Coat: Mix and apply clear top coat over properly cured base coat. Allow to fully cure before permitting traffic onto floor.

3.04 PROTECTION AND CLEAN UP

A. Protect adjacent materials throughout installation. Clean up all coating materials from surfaces not intended to receive them.

B. Protect coating from damage throughout installation and construction. Allow no traffic on floor materials until manufacturer's directions permit it.

C. Clean up all debris, unused materials, and unsuitable material and dispose of it each day legally off the site.

END OF SECTION

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SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Surface preparation and painting of all interior and exterior exposed items and surfaces throughout the Project, unless specifically indicated otherwise.
   2. Refer to surface finish schedule.

B. Related Sections:
   1. Refer to various other Sections for identification of shop primed items.

1.02 DEFINITIONS

A. Exposed: Exposed items and surfaces are defined as those which may be seen while standing on any floor, the roof, or in any occupied space.

B. Exterior: On the outside; exposed to the outside air or weather, either directly or indirectly.

1.03 SUBMITTALS

A. Schedule: Submit a schedule listing each coat and manufacturer's product number for all finishing products. Provide all architectural paint products manufactured by the same manufacturer, unless otherwise indicated.

B. Product Data: Submit manufacturer's product data on paints and coatings indicating VOC content. Submit manufacturer's application instructions.
   1. Include MSDS sheets for paints and coatings, including printed statement of VOC content and chemical components.

C. Samples: Submit three samples 8 x 10 inch in size illustrating each color and texture for each surface finish scheduled, made from actual paint to be used.

D. Qualification Data: Submit for applicator.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in commercial painting and finishing with documented experience, and approved by product manufacturer.

B. Regulatory Requirements:
   1. Flammability: Conform to 2010 California Building Code, for flame/fuel/smoke rating requirements.

2. VOC Content: Conform to CCR Title 24, Part 11 (CALGreen), Section 5.504.4.3 "Pollution Control - Paints and Coatings", and Bay Area Air Quality Management District for air pollution control requirements.

C. Field Samples: Provide field sample panels, 6 x 8 foot minimum size, illustrating coating color, texture, and finish. Field samples may be requested for any and all paint finishes. Locate where directed. Engineer may require one color adjustment of each field sample color on the wall at no cost to the City. Accepted samples may remain as part of the Work.

D. Pre-Installation Meeting: Convene a pre-installation meeting before application of painting materials, to be attended by the paint supplier, painting applicator, Contractor, and Engineer to discuss application methods, substrate and preparation, desired mil thicknesses, and other topics related to achieving the quality of finish desired.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptance. Remove immediately any item rejected by the Engineer.

B. Container labeling shall include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in well ventilated area, unless required otherwise by manufacturer's instructions.

D. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F (7 degrees C) for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Do not apply exterior coatings in rain, fog, mist, or snow; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces, unless required otherwise by manufacturer's instructions.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 ft candles measured mid-height at substrate surface during application and inspection of the work.

E. Mix materials in ventilated areas as directed. Remove all empty containers, waste and contaminated rags from premises at end of each working day.

1.07 MAINTENANCE

A. Extra Materials: Furnish five gallons of each color and type of paint used to City. Label each container with color and room locations, in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide all products from the same manufacturer, unless otherwise indicated.
   1. Kelly Moore "Enviro Coat".
   2. Dunn Edwards "Ecoshield".
   3. Benjamin Moore "Eco Spec".
   4. Sherwin Williams "Health Spec".
   5. Stains: AFM "Safecoat".
   6. Penetrating Clear Finish: Weather-Bos.
   7. Or equal.

B. Base the bid on providing up to 6 paint colors, with up to 3 deep tone colors, consisting of any combined mix of gloss enamel, satin enamel, eggshell enamel, or flat latex. Each wall surface, soffit, ceiling, or plane will consist of only one color or type paint, unless otherwise shown.

2.02 MATERIALS - GENERAL

A. Paints:
   1. Definition: "Paint" as used herein means coating systems including primers, emulsions, enamels, stains, sealers and fillers, whether used as prime, intermediate, or finish coats.
   2. Quality: Use only pure, unadulterated, first quality materials. If manufacturer makes more than one quality of material, use only their best quality.
   3. Compatibility: Use primers and succeeding coats of any given system from the same manufacturer, that are compatible with one another and with the substrate, and which are approved by the manufacturer, unless specifically scheduled otherwise. No thinning, reducing, or changing of mix is permitted unless specifically indicated herein.

B. For interior applications use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D, and the following chemical restrictions:
   1. Architectural paints, coatings, and primers applied to interior walls and ceilings: Do not exceed the VOC limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993.
      a. Flat Paints and Coatings: 50 g/L.
      b. Non-Flat Paints and Coatings: 50 g/L.
      c. Primers, Sealers, and Undercoats: 100 g/L.
   2. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: VOC not more than 250 g/L, established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
   3. Clear wood finishes, floor coatings, stains, sealers and shellacs applied to interior elements: Do not exceed the VOC limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, January 1, 2004.
      a. Floor Coatings: 50 g/L.

b. General Purpose Sealers: 200 g/L.
c. Stains: 250 g/L.
d. Waterproofing Sealers: 250 g/L.
e. Sanding Sealers: 275 g/L.
f. Clear Wood Varnishes: 350 g/L.
g. Lacquers: 550 g/L

4. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
5. Restricted Components: Paints and coatings shall not contain any of the following:
   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.

C. General Purpose Filler: Standard spackling compound or gypsum wallboard joint compound or latex patching compound; for patching plaster, gypsum wallboard, and wood surfaces to receive opaque paint finishes.

D. Cementitious Filler: Nonshrink formulation; white portland cement with fine silicate aggregate, zinc-oxide pigment, and reinforcing chemical binder as approved.

E. Wood Filler: Paste filler recommended by manufacturer for wood type used, in color to match color of stain finish selected.

F. Accessory Materials: Paint thinners, turpentine, linseed oil, shellac, and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality, as recommended by each manufacturer for his respective product.

G. Equipment: Provide scaffolding, staging, drop cloths, covers, brushes, rollers, and spraying and other equipment of type, grade, and size required for proper execution of the Work.

2.03 COLORS AND FINISHES

A. Use only materials capable of achieving the finishes and colors specified and scheduled.

B. Finish Sheens: Within MPI Standard; reflectance tested at 60 degrees in accordance with ASTM D523.
   a. Gloss Level 1 - Flat: <3
   b. Gloss Level 2 - Low Sheen: 5-10
   c. Gloss Level 3 - Eggshell: 10-15
   d. Gloss Level 4 - Satin: 25-35
   e. Gloss Level 5 - Semi-Gloss: 50-55
   f. Gloss Level 6 - Gloss: 70-80
   g. Gloss Level 7 - Gloss: >85

C. If the Contractor chooses to use a manufacturer's materials other than those for which specific color selections are made, match the specified colors exactly.

D. Paint colors are intended to be correct for next-to-last coat. Final approved color selections will be close to, but may vary slightly from, samples indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Concrete: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

D. Do not begin work until unsatisfactory conditions have been resolved.

3.02 PREPARATION

A. General:
   1. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
   2. Correct minor defects and clean surfaces which affect work of this Section.
   3. Shellac and seal marks which may bleed through surface finishes.

B. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

C. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

D. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

E. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

F. Shop Primed Steel Surfaces: Touch-up primed steel frame immediately after erection, including end of beam plates. Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

H. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.

I. Concrete Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

J. Wood:
   1. Painted Surfaces: Sand smooth and dust clean. Touch sand after prime coat. Carefully putty exposed end grains, nailholes, cracks or other defects after prime coat, with putty matching the color of the paint. Cover knots or sappy areas with shellac or approved knot sealer.
   2. Existing Painted Surfaces To Be Stripped, Stained and Lacquered: Remove existing paint down to bare wood. Use water-rinsable type chemical paint removers specifically designed for the purpose.
      a. Repeat procedure until all paint and other residue is removed, as directed by the manufacturer's printed instructions.
      b. Rinse as required by the manufacturer of the remover.
      c. Note existing paint may contain lead. Comply with governing Federal and State safety and health standards and manufacturer=s written instructions for use of paint remover.
      d. Dispose of removed paint in accordance with requirements of regulatory agencies.
      e. Allow sufficient time to permit surface to dry before proceeding with sanding and recoating.
   3. Exterior Blacksmith Shop - Stain and Lacquer or Varnished Surfaces: Lightly sand surfaces smooth with the grain and dust clean; cross sanding is not acceptable. Prepare surfaces such that no mottling of stain color results. Fill open pore woods such as oak, with a filler tinted as directed, and wipe off all excess material. After completion of

staining and application of first coat of lacquer or varnish, fill nail holes, cracks or other minor defects with putty or plastic wood tinted to match the stained wood, and immediately remove all excess filler material.

4. Puttying: Apply putty by means of a putty knife; thumb puttying is not acceptable.

K. Existing Surfaces to be Repainted: Scrape and sand to remove gloss, loose paint, rust, scale, chips, etc. down to firm substrate. Clean dirty and greasy surfaces with trisodium phosphate, or approved equal degreasing/cleaning agent. Prime bare surfaces as scheduled and specified herein. Repaint using same paint system specified herein to match new surfaces.

1. Hazardous Materials: There may be the presence of lead in old paint. Comply with worker protection procedures described by Office of Safety and Health Act (OSHA).
2. Do not sand or scrape dry lead paint, except with equipment using a HEPA filter. Do not burn lead paint with an open flame torch.

3.03 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

B. Neatly mask door and frame rating labels and equipment labels.

3.04 APPLICATION

A. General: Apply paints and coatings by brush, roller, spray, or other applicators in accordance with manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied. Do not apply finishes to surfaces that are not dry.

1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
2. Provide finish coats that are compatible with primers used.
3. Apply each coat to uniform finish and mil thickness. Apply each coat following manufacturer's recommended minimum Dry Film Thickness (DFT).
4. Apply each coat of paint slightly darker than preceeding coat unless otherwise approved.
5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, and similar components are in place. Extend coatings in these areas as required to maintain system integrity and provide desired protection.
6. Paint surfaces behind movable equipment and furniture the same as similar exposed equipment. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
10. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method.
2. Allow each coat to dry before next coat is applied, as recommended by manufacturer.
3. If sanding is required to produce a smooth, even surface, sand between applications.
4. Omit primer over metal surfaces that have been shop primed and touchup painted.
5. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color and appearance. Ensure that edges, corners, crevices, welds, and exposed fasteners receive the same dry film thickness as flat surfaces.

C. Painting Mechanical and Electrical Equipment:
1. Paint shop primed equipment. Do not paint identification markings on mechanical or electrical equipment.
2. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
3. In occupied spaces, prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are prefinished. Such items are not required to be painted in mechanical rooms.
4. Paint interior surfaces of air ducts, and convectors that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convectors to match louver face panels.
5. Paint exposed conduit and electrical equipment occuring in finished areas.
6. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

D. Painting Doors and Frames:
1. Paint doors and frames same color on both sides and edges, unless otherwise noted on the door schedule.
2. Where doors are scheduled to be painted two colors, paint the edges to match the face toward which the door swings.
3. Where frames are scheduled to be painted two colors, the joint between colors shall occur behind the edge of the door where the stop meets the frame.

3.05 FIELD QUALITY CONTROL

A. Site Tests: Provide testing of mil thickness of coatings and finishes. All field painting is subject to verification of mil thickness.

3.06 CLEANING

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered. Repair damage to other surfaces caused by work of this Section.
B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site. Remove empty paint containers from site.

3.07 SCHEDULE - EXTERIOR PAINT SYSTEMS (Dunn Edwards numbers)

A. Shop-Primed Ferrous Metal (Gloss Latex):
   1. Touch-up damaged priming: WB SYN-LUSTRO Premium Interior/Exterior Rust Preventative Metal Primer, 100% Acrylic
   2. 2nd Coat: DE SPARTAGLOSS W7600V Interior/Exterior Acrylic Gloss
   3. 3rd Coat: Same as 2nd coat.

B. Galvanized Metals (Gloss Latex):
   1. 1st Coat: WB SYN-LUSTRO Premium Interior/Exterior Rust Preventative Metal Primer, 100% Acrylic
   2. 2nd Coat: DE SPARTAGLOSS W7600V Interior/Exterior Acrylic Gloss
   3. 3rd Coat: Same as 2nd coat.

C. Concrete (Flat Latex):
   1. 1st Coat: DE FLEX-PRIME W6315 Flexible Crack-Resistant Primer
   2. 2nd Coat: DE ACRI-HUES W720 Exterior Acrylic Flat
   3. 3rd Coat: Same as 2nd coat.

D. Mineral Fiber Cement Siding and Adjacent Wood Trim (Painted Low-Sheen Latex):
   1. 1st Coat: DE ULTRA-GRIP Premium Interior/Exterior Multi-Purpose Primer
   2. 2nd Coat: DE SPARTASHEEN W7300 Interior/Exterior Acrylic Low Sheen
   3. 3rd Coat: Same as 2nd coat.

E. Exterior Painted Wood (Semi-Gloss Finish):
   1. 1st Coat: DE ULTRA-GRIP Premium Interior/Exterior Multi-Purpose Primer
   2. 2nd Coat: DE SPARTAGLO W7500V Interior/Exterior Acrylic Semi-Gloss
   3. 3rd Coat: Same as 2nd coat.

F. Blacksmith Shop and Where Indicated - Exterior Wood (Semi-Transparent Finish):
   1. 1st Coat: AFM "DuroStain"
   2. 2nd Coat: AFM "DuroStain"

G. Exterior Wood (Transparent Finish):
   1. 1st Coat: The Boss, Weather-Bos, or Penofin Verde
   2. 2nd and 3rd Coat: Same as 1st coat.

3.08 SCHEDULE - INTERIOR PAINT SYSTEMS (Dunn Edwards numbers)

A. Shop-Primed Ferrous Metal (Semigloss Latex):
   1. Touch-up damaged priming: DE ULTRA-GRIP Premium Interior/Exterior Primer
   2. 2nd Coat: DE W603 ECOSHIELD Low-Odor/Zero-VOC Interior Acrylic Semi-Gloss.
   3. 3rd Coat: Same as 2nd coat.

B. Gypsum Board at Typical Rooms (Eggshell Latex):
   1. 1st Coat: DE W600 ECOSHIELD Low-Odor/Zero-VOC Interior Latex Primer
   2. 2nd Coat: DE W602 ECOSHIELD Low-Odor/Zero-VOC Interior Latex Low Sheen.
   3. 3rd Coat: Same as 2nd coat.

C. Gypsum Board at Toilet and Janitor Closet (Semigloss Latex):
   1. 1st Coat: DE W600 ECOSHIELD Low-Odor/Zero-VOC Interior Latex Primer

2. 2nd Coat: DE W603 ECOSHIELD Low-Odor/Zero-VOC Interior Acrylic Semi-Gloss.
3. 3rd Coat: Same as 2nd coat.

D. Stained Woodwork and Wood Trim (Satin Lacquer):
1. 1st Coat (If Required): DE Stainseal II Interior Wiping Tung Oil Stain, V 109
2. 2nd Coat: DE 550 Decolac High Solids Sanding Sealer, LQ 140-0
3. 3rd Coat: DE 550 Decolac High Solids Satin Lacquer, LQ 144-0

E. Clear Woodwork, Windows, and Wood Trim (Satin Lacquer):
1. 1st Coat DE 550 Decolac High Solids Sanding Sealer, LQ 140-0
2. 3rd Coat: DE 550 Decolac High Solids Satin Lacquer, LQ 144-0

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Interior and exterior door and wall mounted signs, and accessories, complete. This includes, but is not necessarily limited to, the following:
   1. Plaque signs at doors identifying rooms.
   2. International symbol signs at toilet room.
   3. Accessibility signs.
   4. Room occupancy load signs.
   5. Blacksmith Shop entry/exit door sign.
   6. Metal letter sign on Environmental Education Center exterior building facade.
   7. Painted letter sign on Blacksmith Shop exterior building facade.

B. Related Sections:
   1. Section 08 11 13 - Hollow Metal Doors and Frames.
   2. Section 08 14 00 - Wood Doors.
   3. Section 09 29 00 - Gypsum Board.

1.02 GENERAL DESIGN REQUIREMENTS - CALIFORNIA BUILDING CODE

A. Braille Symbols: California Contracted Grade 2 Braille shall be used wherever Braille symbols are required. Dots shall be 1/10 inch (2.54 mm) on centers in each cell with 2/10 inch (5.08 mm) space between cells. Dots shall be raised a minimum of 1/40 inch (0.635 mm) above the background and be domed or rounded.

B. Proportions: Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10.

C. Character Height: Characters and numbers on signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case X. Lower case characters are permitted. Minimum character height shall be 5/8 inches.

D. Finish and Contrast of Symbols: The characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background, either light characters on a dark background or dark characters on a light background.

E. Raised Characters and Pictorial Symbol Signs (Pictograms):
   1. Letter Type: Letters and numbers on signs shall be raised 1/32-inch (1 mm) minimum and shall be sans serif uppercase characters accompanied by Grade 2 Braille.
   2. Symbol Size: Raised characters or symbols shall be a minimum of 5/8-inch (16 mm) high.
   3. Pictorial Symbol Signs (Pictograms): Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be a minimum of 6 inches (152 mm) in height.

F. Mounting Location and Height: Where permanent identification is provided for rooms and spaces, raised letter signs shall be provided and shall be accompanied by Braille. Signs shall be installed on the wall adjacent to the latch outside of the door. Where there is no wall space to the latch side, including at double leaf doors, signs shall be placed on the nearest adjacent wall, preferably on the right. Mounting height shall be 60 inches (1525 mm) above the finish floor to the center line of the sign. Mounting location shall be determined so that a person may approach within 3 inches (76 mm) of signage without encountering protruding objects or standing within the swing of a door.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing text and layout of all sign faces, details of construction, and installations. Indicate mounting heights. Provide plan showing locations of all signs. Layouts submitted shall be no less than 1/4 size.

B. Product Data: Submit manufacturer's product data and installation instructions for each signage item listed.

C. Samples: Submit samples of each color and finish for exposed materials. Furnish sample of a finished sign as specified.

D. Qualification Data: Submit for manufacturer and installer.

1.04 QUALITY ASSURANCE

A. Manufacturer/Installer Qualifications: Signs shall be fabricated and installed by a sign company regularly engaged in the execution of quality sign work, and who has successfully provided work similar to types shown and specified on previously completed projects.

B. Regulatory Requirements:
   1. Conform to California Building Code (CBC), Section 1117B.5.1 through 1117B.5.8 for accessibility requirements.
   2. Conform to Federal Requirements of the Americans with Disabilities Act (ADA). Provide signs which comply with 2010 ADA Standards for Accessible Design.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect signs from damage. Safely pack, and clearly label with sign type and name. Deliver signs for timely installation, minimizing on-site storage time. Store in a dry, ventilated space, out of weather, and protected from other trades.

PART 2 - PRODUCTS

2.01 INTERIOR PLAQUE SIGNS

A. Manufacturer: Mohawk "Series 200A", ASI Sign Systems, or equal.

B. Description:

1. Features: 1/8-inch thick sand-carved raised letters carved into 1/8-inch thick hard phenolic ES plastic laminate, letters raised 1/32-inch, sign shape with square corners and square edges, letters all caps minimum 5/8-inch high, letter style "Helvetica Medium". Size lettering and signs as small as possible to fit the required design.
2. Colors: To be selected by Engineer.

2.02 EXTERIOR PLAQUE SIGNS

A. Manufacturer: A.R.K. Ramos Signage Systems, Metal Arts, or equal.

B. Description: Individual plaque signs, square edge profile, eased edges.
1. Material: Aluminum, clear anodized finish.
2. Size: 1/8 inch thick x sizes as required and shown on Drawings.
3. Font Style: "Helvetica".
4. Lettering Color: Black, or as indicated on Drawings.

2.03 TOILET ROOM SIGNAGE

A. Toilet Door: Solid plastic, 1/4-inch thick, shaped as indicated below. Each sign shall designate in international symbols and in braille the proper gender of toilet room. Color shall contrast distinctly from that of the door, and be as specified. Center symbols on the door at a height of 60 inches above floor.
1. Unisex: 12-inch equilateral triangle inside 12-inch diameter circle, with international symbols for men and women.

B. Wall Adjacent to Toilet Door: Solid plastic, 1/4-inch thick, rectangular shape. Sign shall designate wheelchair pictogram, and appropriate icons, printed and in braille indicating the proper gender of toilet room. Color shall contrast distinctly from that of the wall, and be as specified. Center signs at a height of 60 inches above floor.

2.04 ROOM CAPACITY SIGNS

A. Mount in room on door frame or wall near main entry/exit door. Signs to be printed on a contrasting background in accordance with 2010 California Building Code. Signs to read:

1. Meeting Room A: "ROOM CAPACITY LIMITED TO 21 PERSONS FOR STUDENTS / LIMITED TO 28 PERSONS FOR ASSEMBLY".
2. Meeting Room B: "ROOM CAPACITY LIMITED TO 26 PERSONS FOR STUDENTS / LIMITED TO 35 PERSONS FOR ASSEMBLY".
3. Meeting Room C: "ROOM CAPACITY LIMITED TO 16 PERSONS FOR STUDENTS / LIMITED TO 21 PERSONS FOR ASSEMBLY".

2.05 BLACKSMITH SHOP - ENTRANCE DOOR SIGN

A. Mount inside building on door frame above main entry door. Sign to be printed on a contrasting background in accordance with CBC requirements. Sign to read: "THIS DOOR TO REMAIN UNLOCKED WHEN BUILDING IS OCCUPIED".

2.06 EXTERIOR ENVIRONMENTAL EDUCATION CENTER BUILDING WALL-MOUNTED IDENTIFICATION LETTERS

A. Manufacturer: A.R.K. Ramos Signage Systems, Metal Arts, or equal.

B. Type: Laser cut aluminum individual letters, 1/2 inch thick, square edge profile, eased edges, clear anodized finish. Sizes as shown on Drawings.
   1. Font: Helvetica Medium.
   2. Identification: "ENVIRONMENTAL EDUCATION CENTER"
   3. Mounting: Concealed mounting to structure.

2.07 EXTERIOR BLACKSMITH SHOP BUILDING IDENTIFICATION LETTERS

A. Manufacturer: Custom sign fabricator.

B. Type: Painted individual letters, on refurbished existing sign backboard.
   1. Wood Backboard: Clean, sand, and seal face and edges of existing sign board for application of new painted letters.
   2. Letter Font and Size: To be selected by Engineer.
   3. Identification: "BLACKSMITH SHOP"
   4. Letter Finish: Urethane paint coating, color to be selected by Engineer.

2.08 EXTERIOR ENVIRONMENTAL EDUCATION CENTER BUILDING WALL-MOUNTED IDENTIFICATION NUMBERS

A. Manufacturer: A.R.K. Ramos Signage Systems, Metal Arts, or equal.

B. Type: Laser cut aluminum individual letters, 1/2 inch thick, square edge profile, eased edges, clear anodized finish. Sizes as shown on Drawings.
   1. Font: Helvetica Medium.
   2. Identification: "22221D"
   3. Mounting: Concealed mounting to structure.

2.09 EXTERIOR BLACKSMITH SHOP BUILDING WALL-MOUNTED IDENTIFICATION NUMBERS

A. Manufacturer: A.R.K. Ramos Signage Systems, Metal Arts, or equal.

B. Type: Laser cut aluminum individual letters, 1/2 inch thick, square edge profile, eased edges, clear anodized finish. Sizes as shown on Drawings.
   1. Font: Helvetica Medium.
   2. Identification: "22221C"
   3. Mounting: Concealed mounting to structure.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrates and conditions under which signs are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: All installations shall be in accordance with manufacturer's printed instructions and recommendations.

B. Interior Signs: Surface mount on substrates as follows:
   1. Wood: Mechanical mounting, with zinc-plated steel wood screws.
   2. Metal: Double-faced vinyl tape.
   3. Gypsum Board: Mechanical mounting, with zinc-plated steel wood screws into wall anchors.

C. Exterior Signs: Install using vandal-resistant stainless steel screws.

3.03 CLEAN AND ADJUST

A. Remove and replace material which is broken, chipped, cracked, abraded, or damaged in any other way during the construction period, including natural causes, accidents and vandalism.

B. Clean sign material using only cleaners and methods in accordance with the manufacturer's instructions.

END OF SECTION

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SECTION 10 21 19

TOILET COMPARTMENT RENOVATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: ADA upgrades to existing metal toilet compartments.

B. Related Sections:
   1. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data showing standard components, fittings, attachments, etc.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with accessibility requirements of 2010 California Building Code, Section 1115B "Bathing and Toilet Facilities".
   2. Comply with Americans with Disabilities Act (ADA) "2010 ADA Standards for Accessible Design".

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Provide new ADA-compliant door hardware to be compatible with existing baked enamel metal toilet partition cutouts and hardware: Accurate Partition Corp.

2.02 MATERIALS

A. Door Hardware: Manufacturer's standard, ADA compliant hardware.
   1. Bottom Hinges: Gravity positioning.
   2. Latch: Concealed latch type, meeting CBC 1115B.3.1.4, reinforced with through-bolted keeper.
   3. Handles on Accessible Doors: U-shaped, through-bolted.

B. Hardware Attachments, Screws, Bolts, Etc.: All hardware 18-8, Type 304 stainless steel with satin finish; one-way vandal-resistant type fasteners.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the conditions in which the work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Typical Doors: Equip with new gravity positioning hinges.

B. Accessible Doors: Equip with new gravity positioning hinges. Provide new ADA-compliant door latch at damaged latch, and U-shaped pull on each side of door located immediately below the latch, as indicated.

C. Adjust and lubricate hardware for proper operation after installation and just prior to final inspection. Align hardware to uniform clearance at vertical edges of doors, not exceeding 1/2 inch.

D. Adjust hinges on in-swinging doors to hold doors open approximately 30 degrees from the closed position when unlatched. Adjust hinges on out-swing doors to return doors to the fully closed position.

3.03 CLEANING

A. Remove protective maskings.

B. Indoor Air Quality: Clean exposed surfaces of compartments, hardware, fittings, and accessories using non-toxic materials and methods and as recommended by the compartment manufacturer.

END OF SECTION

SECTION 10 22 26

OPERABLE PARTITIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Manually-operated, paired operable panel partitions with mechanical sealing system, complete.

1.02 PERFORMANCE REQUIREMENTS

A. Installed and tested acoustical performance shall be a minimum Noise Isolation Class (NIC) of NIC-43.

B. Laboratory Testing: Provide units which have been tested by a recognized independent acoustical laboratory for sound transmission in accordance with ASTM E90 to obtain a Sound Transmission Class (STC) rating of 51 or higher.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing layout of operable partitions. Include plans, elevations, and large scale details of anchorages, and accessory items. Indicate location of each unit in building, conditions at head, jambs, and openings, typical and special details, location and installation requirements for hardware and operators.

B. Product Data: Submit manufacturer's detailed materials and fabrication specifications and installation instructions. Include catalog cuts of hardware, fastenings, and other data as required.

C. Samples: Submit 6 inch square samples of panel facing material selected. Prepare samples from same material to be used for the work.

D. Qualification Data: Submit for manufacturer and installer.

E. Test Data:
   1. Submit copies of test data from an independent testing laboratory confirming the NIC acoustical rating and certification from the manufacturer that the operable partitions supplied on this project are of the same construction as that used by the same independent testing laboratory in determining the acoustical rating.
   2. Submit written test reports as measured by an independent acoustical consultant confirming field-measured NIC ratings on a similar project in a minimum of five (5) installations.

F. Closeout Submittals: Submit a minimum of three copies of available instruction manuals to City's representative.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm specializing in manufacturing operable partitions of type specified for this Project.

B. Installer Qualifications: Firm specializing in operable partition installation with not less than 2 years of experience in installation of operable partitions similar to those required for this Project.

C. Standards:
   1. Provide operable partitions which have an acoustical rating of STC 51 when tested in accordance with ASTM E90.
   2. Design and construct surrounding conditions in conformance with ASTM E557.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings clearly labeled with identification of manufacturer, quality or grade, and fire hazard classification.

B. Inspect operable wall components upon delivery for damage.

C. Store materials in original undamaged packages protected from weather, moisture, and soiling. Store on raised paltforms in vertical position with blocking between units for air circulation.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Provide operable partitions manufactured by Hufcor "Series 632", Modernfold, or equal.

2.02 MATERIALS

A. Track: Extruded structural aluminum or heavy-duty continuous C-channel shaped steel track configured for proper structural and acoustical properties, designed to support 900 pounds per panel; Hufcor "Type 38", or equal. Intersection design shall prevent carrier wheels from dropping into track slot, and shall maintain acoustical performance. Attach track directly to blocking below glulam beam.

B. Carriers: Provide carriers which operate the size and type of panels with the least amount of effort and will maintain alignment and acoustical rating.
   1. Attach trolleys to panels with adjustable pendant bolts.
   2. Provide two carriers for each double panel.
   3. No mechanical or electrical switching devices will be permitted.

C. Panels: Provide with appropriate and approved structural frame with insulation and panel materials to achieve specified acoustical performance.
   1. Size and Weight: Nominal 3 inches thick, weighing between 10 and 12 pounds per square foot.
   2. Materials: Noncombustible, moisture resistant, dimensionally stable, with no protruding parts.

D. Expandable Panel: Provide as final closure for each partition shown an expandable panel of same construction as panels. Expandable panel shall have mechanically operated top and bottom seals.

E. Vertical Acoustical Seals Between Panels: Deep nesting, interlocking tongue and groove astragals incorporating continuous concave/convex magnetic strip and neoprene acoustical seal, creating acoustical interlock.

F. Horizontal Acoustical Seals: Manual crank or spring loaded type, simultaneously activated by means of manual crank handle, and developing no less than 100 pounds pressure per panel at top track and floor when fully extended. Seals shall be self-compensating and be of double shell construction for acoustical isolation. Sweep type multifinger top seals and automatic type top and bottom seals are not permitted. Seals shall not contact floor or track during movement of panels.

G. Accessories: Manufacturer's standard components to comply with the operation, function, construction, and detailed requirements.

H. Panel Finish:
   1. Exposed Panel Substrate, Both Sides and Edges: Manufacturer's standard painted steel; color to be selected by Engineer.
   2. Applied Tackable Surface, Both Sides:
      a. Manufacturer: Forbo "Marmoleum Bulletin Board", Dodge Repogul, Roth Sign Company, or equal.
      b. Material: Natural granulated cork, linseed oil, resin binders and dry pigments, calendered onto a natural burlap backing, homogeneous throughout entire thickness.
      c. Class A flame spread rating.
      d. Thickness: 1/4-inch.
      e Color: To be selected by Engineer.

2.03 FABRICATION

A. Shop Assembly: Preassemble items in shop to greatest extent possible. Disassemble units to extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate partitions to meet specified STC rating. Fabricate for smooth movement and stacking as indicated on Drawings.

C. Fabricate partitions with all panels full width and equal in size. Miter exposed trim at corners.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine site at which partitions will be installed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Coordinate with the steel fabricator and installer for proper location and method of fastening the track to the supporting beam.

B. Coordinate with the stud installer for proper location and method of anchoring the panel jamb seal to the fixed walls.

C. Install operable partitions in accordance with manufacturer's written installation instructions and approved shop drawings, complying as applicable with ASTM E557, "Standard Guide for The Installation of Operable Partitions".

D. Install track level with, and parallel to floor with no more than 1/16-inch variation in 10 feet length and securely fastened to supporting beam.

E. Install panels to operate properly and move freely without excess drag beyond normal performance.

F. Inspect panels and components for damage. Repair minor damage to components, as acceptable to Engineer. Remove and replace damaged items as directed.

3.03 FIELD TESTING

A. After installation of the operable partitions is complete and to the satisfaction of the partition manufacturer or his designated representative, the partitions shall be set up by the manufacturer or his representative and then field tested.
   1. The Project's acoustical consultant will examine flanking paths through the surrounding building construction to determine that they will not significantly affect the performance of the operable partitions. The project acoustical consultant shall perform the necessary testing.
   2. The manufacturer or his representative shall be on hand to observe the field testing and to make partition adjustments as required. Cost of the field tests will be the responsibility of the operable partition manufacturer.

B. Assuming that the construction surrounding each partition is in accordance with the Contract Documents, such that the operable partitions are not significantly flanked by building construction, noise reduction shall be NIC-43 or greater.

C. Noise reduction measurements will be made in general conformance with ASTM E336 as it applies to measurement of isolation between rooms. The NIC rating will be calculated in accordance with ASTM E413.

D. Any retesting required due to product installation not meeting the acoustical performance will also be performed by the Project's acoustical consultant. The cost will be the responsibility of the Contractor.

3.04 ADJUST AND CLEAN

A. Adjust and lubricate bearings and all movable parts; adjust to ensure smooth, easy operation.

B. Clean, touchup, repair, or replace all operable partition surfaces and components which are soiled, abraded, or damaged. Avoid use of abrasive cleaners or solutions containing corrosive solvents.

C. Protect partitions against damage during construction period.

D. Demonstrate proper operation, set-up, storage, and maintenance procedures to City's personnel. Allow a minimum of a half-day training session.

END OF SECTION

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SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. New toilet accessories, and installation of City-furnished accessories at Environmental Education Center, complete, as specified and indicated on the Drawings, including attachment hardware.
2. Relocation of existing toilet accessories at Park Restrooms to meet ADA requirements.

B. Related Sections:
1. Section 06 10 00 - Rough Carpentry.

1.02 SYSTEM DESCRIPTION

A. Grab Bar Performance Requirement: Comply with ASTM International (ASTM) F446 - "Grab Bars and Accessories Installed in the Bathing Area", except capable of supporting a vertical load of 400 pounds and a horizontal load of 200 pounds applied to the bar.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each product specified herein, describing size, finish, details of function, and attachment method.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with 2010 California Building Code, Section 1115B "Bathing and Toilet Facilities", for installing work in conformance with accessibility standards.
2. Comply with Americans with Disabilities Act (ADA) "2010 ADA Standards for Accessible Design".

1.05 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Provide accessories manufactured by Bobrick Washroom Accessories, Bradley, ASI, or equal.

2.02 MATERIALS - GENERAL

A. Stainless Steel: AISI Type 302/304, with No. 4 finish.
   1. Recycled Content: Minimum 30 percent post-consumer recycled content.

B. Exposed Fasteners, Screws, and Bolts: Stainless steel, satin finish, tamperproof.

C. Concealed Fasteners, Screws, and Bolts: Stainless steel or hot-dip galvanized steel.

D. Sealant: Mildew-resistant silicone, as specified in Section 07 92 00.

2.03 FABRICATION

A. Weld and grind smooth joints of fabricated components. Form exposed surfaces from single sheet of stock, free of joints.

B. Back paint components where contact is made with building finishes to prevent electrolysis.

C. Shop assemble components and package complete with anchors and fittings. Provide steel anchor plates, adapters, and anchor components for installation.

D. Keying: Key all accessories alike; key all coin mechanisms alike but different from accessories. Provide three keys for accessories and three keys for coin mechanisms to City.

2.04 FINISHES

A. Exposed Metal: Type 304 stainless steel, with #4 satin finish, unless otherwise noted.

B. Galvanizing: ASTM A123 or A386 to 1.25-ounce/sq.ft.

C. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site at appropriate time for incorporating into construction. Provide templates and rough-in measurements as required.

B. Verify exact location of accessories for installation.

3.03 INSTALLATION

A. Install accessories at heights and locations in accordance with accessibility standards.

B. Install accessories and items securely fastened to backing plates in wall or partition, in accordance with manufacturers' written instructions. Anchorage from gypsum board with Molly bolts or similar devices not acceptable.

C. Install plumb and level, securely and rigidly anchored to substrate.

3.04 CLEAN AND REPAIR

A. Repair or replace units which are damaged as acceptable to the Engineer.

B. Clean accessories prior to acceptance of the Project.

3.05 SCHEDULE OF ACCESSORIES - ENVIRONMENTAL EDUCATION CENTER

A. Grab Bars: 1-1/2-inch diameter stainless steel grab bars, concealed mounting, satin finish, snap-flange cover plate; Bobrick B-6806 Series, Bradley, or equal. Provide in sizes indicated on Drawings.

B. Toilet Tissue Dispenser: Surface mounted multi-roll toilet tissue dispenser, stainless steel; Bobrick B-2888, Bradley, or equal.

C. Toilet Seat Cover Dispenser: City-furnished Contractor-installed: Surface mounted; Tork "Toilet Seat Cover Dispenser, Product #344088".

D. Soap Dispenser: City-furnished Contractor-installed: Surface mounted; Tork "Elevation Liquid Soap Dispenser, Product #570028A".

E. Paper Towel Dispenser: City-furnished Contractor-installed: Surface mounted; Tork "Elevation Hand Towel Centerfeed Pro Dispenser, Product #559028A".

F. Framed Wall Mirror at Lavatory: Stainless steel framed wall mirror, with 1/2" x 1/2" x 1/2" polished stainless steel channel frame, No. 1 quality 1/4" thick tempered float glass mirror, guaranteed against silver spoilage for 10 years, with protected back and edges, sizes as shown; Bobrick B-165 Series, Bradley, or equal.

G. Robe Hook: Heavy duty single robe hook, bright polished stainless steel, with concealed fasteners; Bobrick B-671, Bradley, or equal.

H. Diaper Changing Station: Meeting ASTM F2285 and the following; surface- mounted, high density polyethylene plastic, designed to withstand a 250 pound live load in the open position, steel to steel hinge, with pneumatic air pump for controlled lowering and retraction of the changing bed, safety straps, and integral sanitary liner dispenser; Koala Kare Products KB100-00, American Infant Care Products Inc. "Diaper Deck", Foundations Worldwide Inc., or equal.

I. Open-Bottom Lavatory Plumbing Insulation: Molded closed-cell vinyl cover pipe wrap with nylon fasteners; anti-fungal, anti-microbial, meeting ADA requirements; for sink drain pipe, and hot and cold water supply lines and stops; Plumberex "Pro-2000", Truebro Inc. "Lav-Guard 2", or equal.

J. Mop and Broom Holder at Janitor's Closet: Stainless steel custodian's utility shelf, with three mop and broom holders and two rag hooks; Bobrick B-224 x 30", Bradley, or equal.

3.06 SCHEDULE OF ACCESSORIES - PARK TOILET ROOMS

A. Grab Bars: Relocate as indicated on Drawings.

B. Seat Cover Dispensers: Relocate as indicated on Drawings.

C. Toilet Tissue Dispenser: Surface mounted multi-roll toilet tissue dispenser, stainless steel; Bobrick B-2888, Bradley, or equal.

D. Paper Towel Dispensers: Relocate as indicated on Drawings.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fire extinguishers, fire extinguisher cabinets, and brackets complete. Provide a fire extinguisher at each fire extinguisher cabinet and wall bracket.

B. Related Sections:
1. Section 06 10 00 - Rough Carpentry.
2. Section 09 29 00 - Gypsum Board.
3. Section 09 91 00 - Painting: Painting of cabinets.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing each size and type of cabinet required. Include fabrication details of each component with identification of material and finish. Also include all layouts of graphic messages drawn to scale with the required letter style.

B. Product Data: Submit for each type of extinguisher.
1. Include data verifying that extinguishing agent contains no halons, CFCs, or HCFCs.

1.03 QUALITY ASSURANCE

A. Standards: Fabricate and label fire extinguishers to comply with requirements of National Fire Protection Association (NFPA) 10 "Standard for Portable Fire Extinguishers".

B. Regulatory Requirements:
1. Fire Extinguishers: Comply with California Code of Regulations, Title 19, Division 1, Chapter 3. Provide extinguishers listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
2. Cabinet Fire Ratings: Provide fire-listed and labeled cabinets, meeting ASTM E814, where installed in fire-rated walls.

PART 2 - PRODUCTS

2.01 PORTABLE FIRE EXTINGUISHERS

A. Manufacturers: J.L. Industries, Larsen's Manufacturing Co., Potter-Roemer Div. of Acorn Engineering Co., or equal.

B. Typical Locations:
1. Type: Multi-purpose dry chemical.
2. Rating: U.L. rated 2A:10B:C.
3. Capacity: 5 pound nominal capacity.

4. Features: Refillable type, pressure gage, manufacturer's standard red enameled steel container, fully charged.

2.02 CABINETS

A. Semi-Recessed Cabinets:
1. Manufacturer: J.L. Industries "Ambassador Series"; Larsen's "Architectural Series"; Potter-Roemer; or equal.
2. Door and Cabinet Trim Material: Galvanized steel sheet, factory primed for field painting.
3. Door Style: Manufacturer's standard vertical duo panel with frame.
4. Door Glazing: Manufacturer's standard 1/8-inch thick clear float glass.
5. Door Hardware: Manufacturer's standard.
   a. Hinge: Concealed or continuous-type hinge, permitting door to open 180 degrees, finish to match door.
   b. Door Pull: Either lever handle with cam-action latch, or exposed door pull and friction latch.
6. Tub Size and Dimensions: Sized to fit extinguishers; 10-1/2 x 24 x 6 inches (J.L. Industries); 9-1/2 x 24 x 6 inches (Larsen's); 9 x 24 x 5 inches (Potter-Roemer).
7. Cabinets in Fire-Rated Walls: Fire-rated to same rating as wall, labeled, meeting ASTM E814.

2.03 BRACKETS

A. Utilitarian type, surface wall-mounted steel bracket, specifically designed to securely hold specified extinguisher, OSHA red enamel color.
1. Manufacturer: J.L Industries "MB Series"; Larsen's "B Series"; General Fire Extinguishing Co., or equal. Provide bracket from same manufacturer as fire extinguisher.
2. Locations: Mechanical rooms, electrical rooms, Blacksmith Shop Building, and non-occupied spaces only.

2.04 FIREMAN'S KEY BOX

A. Manufacturer: The Knox Company "#3200", GE Interlogix "Supra-Products", or equal.

B. Features:
1. Type: Recessed-mounted, 4 x 5 inches x 3-1/2 inches deep. Key as directed by local fire department.
2. Finish: Aluminum, clear anodized.

2.05 FIRE EXTINGUISHER SIGNS

A. Manufacturer/Model: Seton "Model #96399", or equal.

B. Features:
1. Profile: Wedge shaped glow-in-the-dark projecting wall sign, with images on two sides.
2. Size: "V" shaped, 6" high x 9" wide x 4" deep.
2. Material: Luminous plastic, with glow-in-dark image and lettering.
3. Wording: "FIRE EXTINGUISHER", with extinguisher symbol and arrow.

2.06 FABRICATION

A. Fabricate cabinets, panels, and plates to sizes and functions required.

B. All doors, panels, and trim shall be free of oil canning; increase metal thickness or provide laminated, noncombustible, concealed backing material as required.

C. Form exposed metal edges of trim and door stiles by welding, filling and grinding smooth to touch and appearance.

D. Glass Mounting: Fully concealed. Exposed trim or glass stops not acceptable.

E. Fabricate cabinet interior and concealed sheet components of galvanized sheet steel, 20-gage minimum. Factory finish all metal exposed when door is open with electrostatically applied white epoxy paint.

F. Predrill holes for anchorage. Provide all cutouts required at interior of cabinet. Exposed fasteners on face of cabinets or panels are not allowed.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrate in which the cabinets are to be installed. Verify rough openings for cabinets are correctly sized and located. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Cabinets: Install where shown on the Drawings, and at locations as directed by the Fire Marshal. Install level and aligned with adjacent construction as indicated on Drawings. Securely fasten to wall construction. Provide all blocking and backing required.

B. Brackets: Install fire extinguisher brackets in utility rooms and Blacksmith Shop Building as indicated and as required by Fire Marshal. Mount securely to stud wall framing or solid wall construction using manufacturer's recommended attachment method.

C. Extinguishers: Mount on the wall or in cabinets such that the top of the extinguisher is no more than five (5) feet above floor level.

D. Fireman's Key Box: Install near main entry to building.

E. Signs: Install on wall directly above extinguisher cabinets.

3.03 CLEAN AND TOUCH-UP

A. Touch up all abraded enamel finish on extinguishers and interior of cabinets with paint of exact match in color and sheen, as acceptable to Engineer. Paint all exposed fastener heads to match appearance of adjacent surface.

B. Clean glass, exposed surfaces, and interior of cabinets.

C. Clean extinguishers and cabinets with non-toxic cleaners. Do not remove or conceal labels or instructions attached to extinguishers.

END OF SECTION

SECTION 11 31 00

RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. All residential appliances, complete.
2. Ceiling fans.

B. Related Sections:
1. Section 06 40 00 - Architectural Woodwork: Casework for support of equipment items.
2. Section 07 92 00 - Joint Sealants.
3. Division 22 - Plumbing: Plumbing services and connections to equipment.
4. Division 26 - Electrical: Electrical services and connections to equipment.

1.02 SUBMITTALS

A. Product Data: Submit for each item:
1. Manufacturer's product data indicating model, configuration, sizes, materials, finishes, locations, and utility connections.
2. Energy Star compliance data on refrigerators, dishwashers, and microwave.
3. Zero use of CFC-based refrigerants in refrigerator.

B. Qualification Data: Submit for manufacturer and installer.

C. Installation Data: Submit manufacturer's installation instructions.

D. Operation and Maintenance Data: Include data on care of finished surfaces.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Companies specializing in manufacture of residential appliances with a service center capable of providing training, parts, and emergency maintenance repairs located within 100 miles of Project site.

B. Installer Qualifications: Company with workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

C. Regulatory Requirements:
1. Electrical: Provide electrical components listed and labeled by Underwriters Laboratories (UL), and that comply with NEMA standards.
2. Gas: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
3. Accessibility: Where appliances are indicated to comply with accessibility requirements, comply with Americans with Disabilities Act "Accessibility Guidelines for Buildings and Facilities" (ADAAG).

D. Energy Ratings: Provide appliances that qualify for EPA/DOE Energy Star product labeling program.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products clear of floor in a manner to prevent warping, twisting, or sagging.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Specifications are based on products manufactured by General Electric Company. Subject to compliance with requirements, provide the named products or the equivalent by Whirlpool Corp., or Frigidaire.

2.02 APPLIANCES

A. General:
1. Where model numbers specified are not current, provide equal features on equivalent model, as acceptable to Engineer.
2. Electrical Requirements: 120/220 volt, 60 Hz, single phase. Provide suitable length of cord with plugs to match building receptacles.

B. Kitchen Undercounter Refrigerator:
1. Manufacturer/Model: Frigidaire "Model FFPH25M4LB", or equal.
2. Features: Undercounter type, 2.5 Cu. Ft. compact, freestanding, black color.
3. Size: 18-5/8" W x 17-3/4" D x 24-7/8" H.
4. Energy Star Qualified and Zero CFCs.

C. Kitchen Oven:
1. Manufacturer/Model: Whirlpool "Model RBS245PRS", or equal.
2. Features: Single wall oven, 24 inches wide, 3.1 Cu. Ft. capacity, electric 240 V operation, 2 oven racks, self-cleaning, clock timer, temperature management system, oven lights.
3. Size: 23-3/4" W x 26" D x 29" H.
4. Finish: Stainless steel.

D. Kitchen Cooktop:
1. Manufacturer/Model: GE Built-in Electric Cooktop "Model JP201CBSS", or equal.
2. Features: Two coil, 6 inch 1250W electric burner, and 8 inch 2100W electric burner; front controls, "ON" indicator light, stainless steel cooktop surface.
3. Size: 21-1/4 inch wide for mounting in 30 inch wide cabinet.
4. Power: 20 Amp rating at 240 VAC.

E. Range Hood:
1. Manufacturer/Model: GE Standard Range Hood "Model JV338HWW", or equal.
2. Features: Ducted exhaust, 2-speed fan, removable grease filters, damper, one cooktop light, 120 VAC, 29-7/8 inches wide.
3. Color: White on white.

2.03 CEILING FANS:

A. Manufacturer/Model: Modern Fan Co. "Plum Series", or equal.

B. Features: Gloss white fan housing, 52 inch blade diameter, white blade color, no light, fan control option #001 - fan speed only, and 24 inch long down rod.

C. Mounting: Sloped ceiling surface, with swivel canopy.

2.04 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that outlets, service connections, and supports are correct and in required location. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install appliances and items in accordance with manufacturers' written instructions.

B. Built-In Appliances: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed. Use anchoring devices appropriate for equipment and expected usage.

C. Freestanding Appliances: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate units.

D. Neatly cut and drill backs, sides, or other elements of cabinets as required for access to service outlets, fixtures, and fittings.

E. Utilities: Sequence installation and erection to ensure plumbing, mechanical and electrical connections are achieved in an orderly and expeditious manner.

3.03 ADJUSTING AND CLEANING

A. Test each item to verify proper operation. Adjust to ensure proper working order and conditions.

B. Remove masking or protective covering from stainless steel and other finished surfaces. Wash and clean equipment. Polish glass, plastic, hardware and accessories, fixtures and fittings.

C. Remove and replace appliances and fans creating noise or vibration.

END OF SECTION

SECTION 123661

SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Solid surfacing material for countertops, integral sinks, and work surfaces, with mounting brackets and accessories, complete.

B. Related Sections:
1. Section 05 50 00 - Metal Fabrications.
2. Section 06 40 00 - Architectural Woodwork.
3. Division 22 - Plumbing: Sinks, lavatories and fittings.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings for all tops showing fabrication and installation details and locations of hardware, anchors, and fittings.

B. Product Data: Submit manufacturers' product data for installation adhesives and joint sealants, including printed statement of VOC content.

C. Samples: Submit color samples for selection. Submit samples of surfacing material in 10 x 10 inch minimum size, showing front edge detail.

D. Qualification Data: Submit for fabricator.

1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in this type of work, and approved by the solid surfacing manufacturer.

B. Source Quality Control: All surfacing material components shall match in quality, color, finish, and appearance.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect tops during transit, storage, and handling to prevent damage, soiling, and accumulation of moisture.

B. Store tops indoors in well-ventilated space with average humidity. Space stack to allow air circulation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Quartz Surfacing Countertop Material:
   1. Manufacturer: DuPont "Zodiaq", CaesarStone; Silestone by Cosetino USA, or equal.
   2. Material: Minimum 90 percent crushed quartz aggregate molded into flat slabs with resins and pigments.
   3. Indoor Air Quality Certification: Greenguard Children & Schools.
   4. Surface Burning Characteristics: Class 1, flame spread of 25 or less, when tested in accordance with ASTM E84.
   5. Stain, Chemical Resistance and Cleanability: Passes ANSI Z124.6.
   6. Thickness: Minimum 3/4 inch, unless otherwise indicated.
   7. Front Edge Profile: Radiused.
   8. Surface Finish Texture: Polished.
   9. Back and End Splashes: Same material as countertops, 3/4 inch thick, radiused profile, height as indicated on Drawings.
   10. Color: To be selected by Engineer from manufacturer's standard colors.

B. Solid Surfacing Sink Material:
   1. Manufacturer: DuPont "Corian", or equal; same manufacturer as countertop.
   2. Material: Homogeneous filled methyl methacrylate acrylic-based resin composition.
   3. Fire Rating: Class 1 flame spread rating, in accordance with ASTM E84.
   4. Thickness: 1/2 inch.
   5. Features: Semi-flat bottom, rounded inside corners, factory-fused to countertop material, and meeting ADA accessibility standards.
   6. Color: To be selected by Engineer from manufacturer's full range of colors.

C. Countertop Support Brackets: Custom fabricated steel brackets, or a manufactured product such as Rangine Corp. (508-376-4545) "Rakks Counter Support and Sill Support Brackets".

D. Wood Backing: Douglas Fir, No. 1, S4S, fire-retardant treated and kiln dried.

E. Fasteners: Stainless steel; no exposed fasteners permitted.

F. Joint Sealant: As approved by the manufacturer. Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and rule amendment date of January 7, 2005. Provide sealant with maximum VOC content of 250 g/L, when calculated according to 40 CFR 59.
   1. Where sealant is in contact or potentially in contact with mirror silvering, use polyurethane sealant.

2.02 FABRICATION

A. Countertops:
   1. Fabricate tops to sizes, shapes, and profiles shown on Drawings.
   2. Cut material dry, following manufacturer=s written recommendations.
   3. Laminate edges with seam adhesive as recommended by the manufacturer for permanent bonding of components. Make all seams tight and "invisible".
   4. Finish exposed edges and cutout holes to match the color and appearance of the top. Tops shall appear to be monolithic.
   5. Backsplashes and Side Splashes: 4 inches high, with exposed edges finished same as countertop, unless otherwise indicated on Drawings.

6. Plumbing Faucet Holes: Coordinate size and location with plumbing work. Verify layout and location in field. Locate holes to comply with ADA accessibility requirements.

B. Sinks:
   1. Fabricate to sizes shown on Drawings.
   2. Adhere sinks to tops with seam adhesive as recommended by the manufacturer for permanent bonding of components. Make all seams tight and "invisible".

C. Supports and Reinforcements:
   1. Fabricate reinforcements and supports for tops as shown and required.
   2. Reinforce and support tops to support a minimum of 300 pounds concentrated live load and 20 pounds per square foot with deflection no greater than L/180, with no failure of any components or supporting wall construction.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrates on which the work is to be installed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install tops and sinks level to maximum variation of 1/16 inch in 4 feet, aligned with surrounding finish work and securely anchored in place to meet the loading requirement specified herein.

B. Install tops to height required to meet ADA accessibility requirements, and centered laterally in space provided, unless otherwise noted.

C. Predrill screw holes prior to anchoring.

D. Seal joints between tops, and between tops and walls with sealant. Immediately remove excess sealant from work surfaces with a damp cloth.

3.03 CLEANING AND FINISHING

A. Clean tops and sinks prior to acceptance of Work by City. Use nonabrasive cleaning materials recommended by the surfacing material manufacturer.

END OF SECTION

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SECTION 12 93 13

BICYCLE RACKS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Bicycle racks with accessories, complete.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings of layout and installation details. Show anchorages and accessory items.

B. Product Data: Submit manufacturer's specifications and installation instructions.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company engaged in the manufacture of bicycle racks with a minimum of three (3) years experience.

1.04 PROJECT CONDITIONS

A. Coordination: Furnish inserts and anchoring devices. Coordinate delivery with other work to avoid delay.

PART 2 - PRODUCTS

2.01 BICYCLE RACKS

A. Manufacturer: Palmer Group, San Francisco, CA (www.bikeparking.com); The Wagner Companies; or equal.

B. Model and Features:
1. Palmer "Welle Series WSH3602-IG"
2. Material: Schedule 40 steel pipe, nominal 2 inch diameter.
3. Mounting: In ground.
4. Style: Single loop.
5. Quantity: As indicated on Drawings.
6. Finish: Hot-dip galvanized after fabrication.

C. In Ground Mounting: 3/8 inch x 6 inch steel anchor rod secured to steel pipe for mounting pipe a minimum 10 inches deep into wet concrete.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrate and conditions under which the bicycle racks are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install bicycle racks in accordance with manufacturer's written instructions and as detailed, complete with all required accesssories, fastenings, etc.
   1. Embed steel pipe a minimum 10 inches into wet concrete.
   2. Dissimilar Materials: Protect against galvanic action or other types of corrosion.
   3. Sealants: Comply with requirements of Section 07 92 00 - Joint Sealants.
   4. Welding, Metal Materials: Comply with requirements of Section 05 50 00 - Metal Fabrications

3.03 ADJUSTING AND CLEANING

A. Clean racks and make necessary adjustments for safe, efficient operation.

END OF SECTION

SECTION 21 00 00
FIRE PROTECTION (DESIGN BUILD)

PART 1 GENERAL

1.1 PROJECT DESCRIPTION

A. Project Name: McClellan Ranch Environmental Education Center

B. The project consists of 2 buildings located at McClellan Ranch Park.

1.2 SCOPE

A. Work Included: Design, furnish, and install complete and fully functioning fire protection system.

B. Design Build Documents:

1. The Design Build Contractor is the Engineer of Record for this project and is responsible for all calculations, system concepts, equipment selections, distribution routings, coordination with other trades during design, and any other tasks needed to furnish and install complete and operating systems that meet or exceed the design performance intent.
2. Changes required to meet the design performance intent including, but not limited to; recalculations, revisions to the system concepts, equipment reselections, distribution re-routings, re-coordination, and any other tasks needed to furnish and install complete and operating systems is the responsibility of the Design Build Contractor.
3. The fire protection specifications prepared by Integral Group are not complete and are conceptual in nature. Reliance on the calculations, system concepts, equipment selections, distribution routings, coordination with other trades for the complete and operating systems noted in Integral Group‘s documents is done at the risk of the Design Build Contractor.
4. Coordination issues that result from the design or installation of the selected systems, or performance of the systems engineered, designed and installed by the Design Build Contractor shall not be the responsibility of Integral Group.
5. Integral Group bears no responsibility for the final design or system performance.

C. The following related work is not included in this Section:

1. All concrete work.
2. All painting.
3. All disconnects and motor starters (except those specified herein).
4. Fire alarm panel, smoke detectors, and other life safety controls and associated wiring.
5. HVAC work including heating system piping, chilled or condenser water piping, etc.
6. All plumbing work.
7. All louvers and flues.
8. Architectural sheet metal and flashings.

9. Drywall.
10. Forming and framing of floor or wall openings.
11. Cutting, coring, patching, trenching, and backfilling.
12. Access doors and access panels in finished walls, floors, or ceilings.
13. Temporary heat, power, or restroom facilities.
14. Kitchen equipment.

1.3 DEFINITIONS AND CODES & STANDARDS

A. Specifications, standards, tests and recommended methods from following trade, industry and government organizations shall determine quantity and quality of materials and methods.

1. Underwriter's Laboratories, Inc. (UL)
2. National Fire Protection Association (NFPA)
3. National Electrical Manufacturers Association (NEMA)
4. American National Standards Institute (ANSI)

B. This project shall strictly comply with the following locally approved codes including their adopted amendments shall be used for this project:

1. 2006 International Building Code
2. 2010 California Mechanical Code
3. 2006 International Fire Code (approved by Local Fire Authority)
4. 2008 National Electrical Code
5. National Fire Protection Association (NFPA), applicable standards.
6. Local Fire Department Guidelines
7. Other applicable local codes

C. Where locally adopted codes are silent on an issue, NFPA Standards shall apply.

D. Materials and equipment shall be listed and labeled by Underwriters Laboratories or as required by authorities having jurisdiction.

E. Industry standards and manufacturers' recommendations, diagrams or requirements shall be strictly adhered to for installation of materials and equipment.

1.4 PERMITS AND FEES

A. Contractor shall secure and pay for all necessary licenses and permits required for work included in this section. City will issue a No Fee building permit.

1.5 SCOPE OF WORK COORDINATION / COORDINATION WITH OTHER TRADES

A. This section is provided in order to clarify the scope of, work included in this Section relative to work provided in other Sections. The following items identify the boundary of responsibility between the Fire Protection subcontractor and the listed subcontractor.

B. Electrical Subcontractor:

1. Starters and disconnects: Except where specified below, the electrical contractor is responsible for providing and installing all starters and disconnects for all fire protection equipment. The following shall be provided by the Fire Protection Contractor:
   a. 120V motors: Provide starters with thermal overload protection or provide motors with integral thermal overload protection.
   b. Control and interlock conduit and wiring: The Fire Protection Contractor is responsible for providing and installing control and interlock conduit and wiring as required for control of fire protection equipment and other systems controlled by the energy management and control system, regardless of voltage. The electrical contractor shall provide all power wiring to equipment, including wiring to 120V pumps through interlock control device (e.g. line voltage thermostat) where required and identified by Fire Protection Contractor.
   c. Control devices: All fire protection control devices including relays, control transformers, controllers, etc. shall be provided by the Fire Protection Contractor and located within control panels, except the following which shall be provided by the electrical contractor where directed by the Fire Protection Contractor:
      1) Transformers, HOA switches, and auxiliary contacts within electrician supplied motor starters.
      2) Time delay relays required for two-speed motor starters for change from high to low speed.
   d. Control panels: The Fire Protection Contractor shall provide all required control panels including disconnects where required. The electrician shall provide the necessary 120V power to one control panel per floor and one at roof where identified by Fire Protection Contractor. Additional panels, if required, shall be powered by the Fire Protection Contractor.
   e. The Fire Protection work includes assisting the electrical contractor in the proper connecting of all electrical equipment required for Fire Protection work.
   f. VFDs shall be provided by Plumbing Contractor and installed by Electrical Contractor.

C. Wall and Ceiling Subcontractors:

1. Architectural shafts: The Fire Protection Contractor shall identify all architectural shafts and their construction and sealing requirements to the architect for inclusion in architectural contract documents. It is the responsibility of the Fire Protection Contractor to review architectural drawings to be sure that all architectural shafts, rated enclosures, etc. required for Fire Protection systems are properly located and dimensioned. Such items not identified by the Fire Protection Contractor prior to drywall bids shall be the responsibility of the Fire Protection Contractor.

2. Access panels and doors: Access doors in inaccessible walls and ceilings shall be identified by the Fire Protection Contractor to the Architect for inclusion into the architectural drawings and provided and installed by the wall or ceiling contractor. Any access doors not so identified prior to wall and ceiling bids shall be provided by the Fire

Protection Contractor. Equipment shall be located wherever practicable over accessible ceilings to avoid access doors. It is the responsibility of the Fire Protection Contractor to review architectural drawings to be sure that all access doors required for fire protection systems are properly located and dimensioned. Those that are not identified by the Fire Protection Contractor prior to ceiling/drywall bids shall be the responsibility of the Fire Protection Contractor.

D. Miscellaneous Subcontractors:

1. Fire-stopping: The Fire Protection Contractor shall provide all required fire-stopping around pipe penetrations in floors and walls where required by code.
2. Steel supports: Steel supports for fire protection equipment (if any) shall be coordinated with structural engineer prior to steel bids. The Fire Protection Contractor shall be responsible for all steel Fire Protection equipment supports not shown on final structural drawings.
3. Floor and other structural openings: The Fire Protection Contractor shall locate and size all floor openings for piping except architectural shafts shown on architectural drawings. Any structural steel beam penetrations required for the fire protection system shall be located and dimensioned by the Fire Protection Contractor prior to structural steel bids. Any steel or steel penetrations not identified by the Fire Protection Contractor prior to steel bids shall be the responsibility of the Fire Protection Contractor. Any structural concrete beam penetrations required for Fire Protection systems shall be located and dimensioned by the Fire Protection Contractor prior to structural concrete bids. Any concrete penetrations not identified by the Fire Protection Contractor prior to concrete bids shall be the responsibility of the Fire Protection Contractor.
4. Equipment pads: The Fire Protection Contractor shall locate and dimension all concrete bases, housekeeping pads, and sleepers relating to their work, to be provided by others. Concrete fill for inertia bases shall be specifically identified, including dimensions as well as timing of base installation, to the general contractor prior to concrete bids. Concrete work that is not identified by the Fire Protection Contractor prior to concrete bids shall be the responsibility of the Fire Protection Contractor.
5. Roofing: Roofing contractor shall provide all roofing including cant strips and counter flashing at the sides of roof curbs.

E. Plumbing Contractor

1. Coordinate with plumbing contractor for drainage requirements of the fire sprinkler system.

1.6 GUARANTEE

A. The Fire Protection Contractor shall guarantee the following:

1. All equipment, material, and workmanship against all defects in material and workmanship for a period of one (1) year from final acceptance or beneficial use, whichever comes first. The Fire Protection Contractor shall furnish written guarantee to replace all defective work and materials furnished under this Section, at no cost to the Owner, for this one (1) year period.
2. That all equipment and material shall produce the results specified.

B. The Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.

C. The warranty shall not include standard maintenance items nor repairs or replacement of equipment damaged as a result of misuse, abuse, or lack of proper maintenance.

1.7 SUBMITTALS

A. The Fire Protection Contractor/engineer shall maintain a design and detailing schedule consistent with those of the architect and other engineers to produce working drawings and shop drawings in a timely and professional manner, consistent with the project construction schedule.

B. Design documents: All design drawings shall be created using AutoCAD, version 2007 or higher, or compatible format. Include at minimum, the following:

1. Equipment schedules.
2. Floor plans, scale to match architectural drawings or larger.
3. Enlarged plans and sections, 1/4" scale.
4. Riser diagrams.
5. Installation details.

C. Submittals: Shop drawings and details shall be submitted for coordination with other trades and for review and approval by the Owner and designated representatives prior to purchase. Five (5) sets of submittals organized in a tabbed booklet shall be provided in a timely manner to allow sufficient review time without delaying construction. Submittals shall contain descriptive materials such as catalog cuts, diagrams, performance curves and charts published by the manufacturer; model numbers alone shall not be acceptable. All literature shall clearly indicate the specified model number, dimensions, arrangement, rating and characteristics of the proposed equipment. All powered equipment shall include electrical ratings and wiring information. All items requiring architectural approval, such as sprinkler head type/color fixtures, shall include photographs of equipment. Shop drawings shall be submitted for each piece of purchased equipment and materials including pipes, valves, and fittings.

D. Shop Drawings:

1. Shop drawings shall be created using AutoCAD, version 2007 or higher or compatible format.
2. Shop drawings shall be based on and are a continuation of design drawings, i.e.. shop drawings shall not be a separate set of drawings from design drawings. The intent of this requirement is that one set of drawings shall comprehensively show all fire sprinkler design requirements including equipment schedules as well as piping details.
3. Fully coordinated and dimensioned plans and riser drawings.
4. Coordination plans indicating layout of pads, curbs, penetrations, openings, and other items to be provided by other trades.

E. At conclusion of construction, provide one set of reproducible shop drawings up-dated to “as-built" conditions and one set of CDs as-built shop/design drawings.

1.8 FIRE SPRINKLER SYSTEM DESIGN PROCEDURE

A. The fire suppression systems for this project are to be designed and built using a design/build approach as follows:

1. This specification is intended to:
   a. Specify system performance/design criteria. The Fire Protection Contractor's proposal shall not deviate from these Design Criteria without written approval. Questions regarding the appropriateness or correctness of requirements shall be directed to the General Contractor in writing prior to bid. Any changes in design or performance criteria shall be disseminated to all bidders.
   b. Establish the desired level of quality, including suggested design options that the Engineer feels shall meet the performance requirements and design intent. Fire Protection Contractors' proposals may be based on the suggested approaches or on any other design of similar quality. If there is a question as to the appropriateness of any alternative system ideas, the Fire Protection Contractor shall review the proposed design (in the strictness confidence) with the Engineer (Integral Group) prior to bid.

B. Once the design/build contractor has been selected, the contractor shall work with the rest of the design team, including but not limited to the architect, electrical designer, HVAC designer and structural engineer, plumbing engineer to coordinate the system and building design. The contractor shall work with the design team in an integrated manner.

C. The Fire Protection Contractor shall be responsible for final system sizing and selection of equipment.

D. The fire sprinkler system shall be designed by the contractor to provide the specified performance requirements in the most cost-optimum fashion.

1.9 GENERAL DESIGN CRITERIA

A. Loading and Seismic Criteria:

1. Live Roof Load: See structural section
2. Dead Roof Load: See structural section
3. Seismic: See structural section

B. Miscellaneous Design Criteria

1. Equipment within building: The majority of equipment will be located in the basement.
2. Ceiling clearance: Provide minimum 7’-6" clearance below any piping, etc.
3. Do not locate piping over server rooms, elevator machine rooms or electrical rooms.

PART 2 MATERIALS

2.1 FIRE SPRINKLER REQUIREMENTS

A. GENERAL

1. The Fire Protection Contractor (FPC) shall be a licensed Fire Protection Engineer and shall be a California C-16 Contractor in good standing and be the Designer and Builder of

the Fire Protection System. The FPC shall engineer, fabricate, and install a complete and approved hydraulically designed fire protection systems indicated herein to equal or exceed National Fire Protection Association (NFPA) 13, 14, 20 and 22, whichever is applicable, and in accordance with City of Cupertino Fire Marshal requirements and those authorities having jurisdiction.

2. All hydraulic calculations shall be based upon the minimum available water flow and pressure available onsite, and the static pressure, flow and residual pressure used to calculate the system shall be indicated on the plans.

3. Base the piping system and arrangement of heads upon Architectural and Structural considerations. All pipe sizes and number of heads to be used for each area or room shall conform to the requirements to the California Building Code and the National Fire Protection Association Standard 13.

4. Hydraulically calculate the entire fire protection system. Submit calculations and plans to City of Cupertino for approval and acceptance.
   a. Base Calculations on the following:
      1) Maximum area coverage per sprinkler head shall be in accordance with NFPA Standards or the UL Listing/FM Approval as appropriate.
      2) Minimum rate of water application (density) shall be:
         (a) Light Hazard - 0.10 gpm/FT²
         (b) Ordinary Hazard 1 - 0.15 gpm/FT²
         (c) Ordinary Hazard 2 - 0.20 gpm/FT²
         (d) Extra Hazard 1 - 0.30 gpm/FT²
         (e) Extra Hazard 2 - 0.40 gpm/FT²

5. Fire Protection Contractor shall obtain current water flow and pressure data from a reliable source such as the fire department or water purveyor. No test older than 6 months should be used.

6. Sprinkler head shall be positioned in accordance with their UL Listing.

7. Sprinkler head spacing shall be as required by NFPA 13, except as follows: In all locations, sprinkler heads shall be equidistant between lights, between wall and lights, between lights and air diffusers, and between wall, lights, and air diffusers. Provide uniform and repetitive pattern for each room. Center sprinkler heads on joints in acoustic tile or center in tiles in order to conform to above. Obtain approval from the Architect for the sprinkler head layout and coordinate with other trades.

8. Provide high temperature sprinkler heads with guards in all electrical rooms. Provide sectional control valve and auxiliary drain for all main electrical and high voltage rooms.

9. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

B. BURIED PIPING

1. Shall be made and manufactured in the U.S.

2. Below Grade Water Service outside of the building to a point 5'-0” outside the building: Wrapped Class 54, AWWA C104, cement-lined ductile iron with mechanical joints in accordance with NFPA 24; or Schedule 80 CPVC complying with AWWA C900.

C. ABOVE GROUND PIPING

1. Shall be made and manufactured in the U.S.
2. Steel Pipe: ASTM A 53 Schedule 40, black.
   a. Steel Fittings: ASME B16.9, wrought steel, butt welded.
   b. Above Ground and inside the building: Schedule 40, ASTM A-53 Black steel pipe with threaded, welded or cut grooved joints for sizes 2” and below. Mains may be flexible or rigid couplings. Pipe 2-1/2” and over can be mechanical flexible grooved couplings.
   c. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
   d. Malleable Iron or Ductile Iron Fittings: ASME B16.3, threaded fittings.
   e. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
3. Welded joints shall be made using factory-fabricated steel welding fittings.
4. Grooved end malleable iron fittings and bolted clamp type malleable iron couplings with rubber sealing gaskets for grooved end pipe with appropriate pressure rating, similar to Victaulic Style 75 may be used, where couplings shall be provided with rubber “flush seal” gaskets of the same manufacturer as the coupling and intended to be used together.
5. Unions: Provide ground joint type unions for 2 inch and smaller pipe, of galvanized iron with brass seats.
6. Black and hot-dipped zinc-coated (Galvanized) welded and seamless steel pipe, ASTM A 795:
   a. Between Siamese and check valve, ball drip drains, drain and test piping subject to alternate wetting and drying, test and relief piping, water motor gong piping, and normally dry piping.
   b. Fittings and couplings for galvanized shall be galvanized.
7. Provide anti-microbial internal coating protection for all pipes.

D. PIPE HANGERS AND SUPPORTS

1. Per NFPA 13.
2. Hangers for Pipe Sizes 1" to 6": Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

E. GATE VALVES

1. Listed Fire Protection Valves: UL and ULC listed and State Fire Marshal listed. Provide valves of same manufacturer, including valves furnished with equipment.

a. Gate Valves, 2 inches and smaller, bronze body (no copper alloy (brass) allowed containing more than 15% zinc), threaded ends, and 175 psig CWP rating, Nibco T-104-0 or equal.
b. Gate Valves, 2-1/2 inches and larger, cast iron or ductile iron body, bronze mounted with solid wedge, flanged ends, and 175 psig CWP rating, Nibco F-607-O or equal.

F. GLOBE VALVES

1. Listed Fire Protection Valves: UL and ULC listed and State Fire Marshal listed. Provide valves of same manufacturer, including valves furnished with equipment.
   a. Globe Valves, 2 inches and smaller, 150-pound flanged body, screwed ends, rising stem, TFE impregnated asbestos-free packing, Nibco ¼" to 1": KT65UL; & 1-1/4" to 2": KT211WUL or equal.
   b. Globe Valves, 2-1/2 inches, 150-pound flanged iron body, bronze-mounted, bronze rising stem, TFE impregnated asbestos-free packing, Nibco T211WUL or equal.

G. BUTTERFLY VALVES

1. Listed Fire Protection Valves: UL and ULC listed and State Fire Marshal listed. Provide valves of same manufacturer, including valves furnished with equipment.
   a. Butterfly Valves, 2-1/2 inches and larger, iron body lug or grooved end type, 703SS, shaft-type 316, ductile iron disc, Buna N seat-less than 180°F service, EPT seat 180°F to 250°F service, shall be Nibco or Groovelock 7700 series.

H. CHECK VALVES

1. Listed Fire Protection Valves: UL and ULC listed and State Fire Marshal listed. Provide valves of same manufacturer, including valves furnished with equipment.
   a. Check Valves, 2 inches and smaller, screw bonnet, horizontal swing Y-pattern, National pipe thread, integral, renewable Teflon disc, Nibco KT403W or equal. Check valves shall be provided at each floor control valve assembly.
   b. Check Valves, 2-1/2 inches and larger, swing type, cast iron body, flanged ends, and 175 psig CWP rating, Nibco F908-W or equal.

I. BACKFLOW PREVENTERS

1. Backflow Preventer-similar to Febco 850 and provided with supervisory switch.

J. TEST-N-DRAIN

1. Provide Test-n-Drain valve for each floor control valve and/or flow switch.

K. MAIN WATER FLOW SWITCH

1. Provide main water flow switch.

L. PREPARATION

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
2. Remove scale and foreign material, from inside and outside, before assembly.
3. Prepare piping connections to equipment with flanges or unions.

M. INSTALLATION

1. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
2. Install standpipe piping, hangers, and supports in accordance with NFPA 14.

1. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
2. Install piping to conserve building space, to not interfere with use of space and other work.
3. Group piping whenever practical at common elevations.
4. Sleeve pipes passing through partitions, walls, and floors.
5. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
6. Inserts:
   a. Provide inserts for placement in concrete formwork.
   b. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   c. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   d. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   e. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
3. Pipe Hangers and Supports:
   a. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   b. Place hangers within 12 inches of each horizontal elbow.
   c. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   d. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   e. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   f. Provide copper plated hangers and supports for copper piping.
   g. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
4. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
5. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
6. Do not penetrate building structural members unless indicated.
7. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
8. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
9. Provide drain valves at main shut-off valves, low points of piping and apparatus.

N. PIPING APPLICATIONS, GENERAL

1. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
2. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
3. Underground Service-Entrance Piping: Ductile-iron, push-on-joint pipe and fittings and restrained joints.
4. Underground Service-Entrance Piping: Ductile-iron, grooved-end pipe and fittings; grooved-end-pipe couplings; and grooved joints.

O. STANDPIPE SYSTEM PIPING APPLICATIONS

1. Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
2. Grooved-end, black, standard-weight steel pipe with square-cut-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

P. SPRINKLER SYSTEM PIPING APPLICATIONS

1. NPS 1-1/2 and Smaller: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
2. NPS 2 and Larger: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
3. NPS 2 and Larger: Grooved-end, black, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

Q. VALVE APPLICATIONS

1. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   a. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
      1) Shutoff Duty: Use butterfly or gate valves.
   b. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
      1) Shutoff Duty: Use butterfly or gate valves.
      2) Throttling Duty: Use globe valves.

R. JOINT CONSTRUCTION

1. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
2. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.
3. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

a. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
b. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
c. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

S. SERVICE-ENTRANCE PIPING

1. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building.

2. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

T. PIPING INSTALLATION

1. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   a. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

2. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

C. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

E. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

F. Install sprinkler piping with drains for complete system drainage.

G. Install sprinkler floor control valves, test and drain assembly risers adjacent to standpipes when sprinkler piping is connected to standpipes. Install check valves in all floor control assemblies.

H. Install drain valves on standpipes.

I. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building. All sprinkler drains shall be capable of handling a 2" waterflow.

J. Install alarm devices in piping system, device type Potter Electrical Signal Co. shall be used.

K. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install standpipe system piping according to NFPA 14.

2. Install sprinkler system piping according to NFPA 13.

3. Sprinkler installation shall comply with NFPA 13.

L. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Fill wet-standpipe system piping with water.

O. Fill wet-pipe sprinkler system piping with water.

P. Install flexible connectors on fire-pump and pressure-maintenance pump supply and discharge connections and in fire-suppression piping where indicated.

Q. VALVE INSTALLATION

1. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
2. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
3. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
4. All floors at control valve shall have check valve installed.

R. SPRINKLER APPLICATIONS

1. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
   a. Rooms without Ceilings: Upright sprinklers.
   b. Rooms with Suspended Ceilings: Concealed sprinklers.
   c. Wall Mounting: Sidewall sprinklers.
   d. Sprinkler Finishes:
      1) Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
      2) Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
      3) Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

S. SPRINKLER INSTALLATION

1. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
2. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

T. HOSE-CONNECTION INSTALLATION

1. Install hose connections adjacent to standpipes, unless otherwise indicated.
2. Install freestanding hose connections for access and minimum passage restriction.
3. Install hose-connection valves with flow-restricting device, unless otherwise indicated.

4. Install wall-mounting-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose.

U. FIRE DEPARTMENT CONNECTION INSTALLATION

1. Install wall-type, fire department connections in vertical wall.
2. Install ball drip valve at each check valve for fire department connection.

V. CONNECTIONS

1. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to equipment to allow service and maintenance.
3. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping.
4. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
5. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
6. Electrical Connections: Power wiring is specified in the Electrical specification.

W. LABELING AND IDENTIFICATION

1. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

24. FIELD QUALITY CONTROL
    a. Perform the following field tests and inspections and prepare test reports:
        1) Leak Test: After installation, charge system to 200 psi for 2 hours and test for leaks. Repair leaks and retest until no leaks exist.
        2) Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
        3) Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
        4) Coordinate with fire alarm tests. Operate as required.
        5) Verify that equipment hose threads are same as local fire department equipment.
        6) Report test results promptly and in writing to Architect and authorities having jurisdiction.

2.2 STANDPIPES

A. VALVES

1. Hose Connection Valve: Angle type; brass finish; 2-1/2 inch size, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of same material and finish.
2. Hose Connection Valve Cabinets:
    a. Style: Recessed mounted.
    b. Tub: 16 gage thick steel, prepared for pipe and accessory rough-in.

c. Door: 12 gage thick steel, flush, glazed with 6 mm thick wired glass full panel; hinged, positive latch device.
d. Finish: Enameled, color as selected.

B. FIRE DEPARTMENT CONNECTION

1. Type: Flush mounted wall type with brass finish.
2. Outlets: Number of connections to be determined by the design build contractor with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
3. Drain: 3/4 inch automatic drip, outside.
4. Label: "Standpipe - Fire Department Connection".

C. INSTALLATION

1. Install in accordance with manufacturer's instructions.
2. Install in accordance with NFPA 14.
3. Locate and secure cabinets plumb and level. Establish top of cabinet (inside horizontal) surface 66 inches above finished floor.
4. Locate hose station valve in cabinet at 60 inches above finished floor.
5. Connect standpipe system to water source ahead of domestic water connection.
6. Where static pressure exceeds 100 psi but is less than 100 psi at any hose station, provide pressure orifice disc in discharge of hose station valve to prevent pressure on hose exceeding 90 psi.
7. Where static pressure exceeds 100 psi at any hose station, provide pressure reducing valve to prevent pressure on hose exceeding 90 psi.
8. Provide appropriate fire department outlet connection on roof.
9. Flush entire system of foreign matter.

D. FIELD QUALITY CONTROL

1. Perform field inspection and testing in accordance with NFPA.
2. Test entire system in accordance with NFPA 14.
3. Test shall be witnessed by Fire Marshall.

2.3 FIRE SUPPRESSION SPRINKLER SYSTEMS

A. SPRINKLER SYSTEM

1. Sprinkler System: Provide coverage for entire building.
2. Occupancy: Comply with NFPA 13.
3. Water Supply: Determine volume and pressure from water flow test data.
4. Interface system with building control system.
5. Provide fire department connections where indicated.

6. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to control valve.

B. SPRINKLERS

1. General
   a. Sprinkler Heads: Provide UL and Factory Mutual (FM) approved sprinkler heads by Tyco Fire Products, Viking, Reliable or equal.
   b. All sprinkler heads which are located as to be subject to mechanical injury in either upright or pendant position shall have guards or protective covers.
   c. All sprinkler head type and location shall be reviewed and approved by the Architect.

2. Suspended Ceiling Type: Semi-recessed pendant type with matching screw on escutcheon plate.
   a. Semi-recessed type: Pendant fusible link type semi-recessed automatic spray heads with chrome ceiling escutcheons and head located in area with ceilings. Sprinklers shall be selected based upon their suitability for the construction features and occupancy conditions.
   b. Quick response sprinklers may be selected if desirable and acceptable to the City of Cupertino and those authorities having jurisdiction.
   c. Finish: Chrome plated.
   d. Escutcheon Plate Finish: Chrome plated.
   e. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Suspended Ceiling Type: Concealed pendant type with matching screw on escutcheon plate.

D. Concealed type: small, solder link and lever spray sprinklers, hidden from view by low profile, small diameter cover plates installed flush to the ceiling. Cover plates finishes shall meet the design requirements.

1. Finish: Enamel, color as selected.

2. Escutcheon Plate Finish: Enamel, color as selected.

3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

E. Exposed Area Type: Standard upright type.

1. Standard Upright: Pendant fusible link type, automatic water spray bronze heads with standard plain brass finish located in area without ceilings. Sprinklers shall be selected based upon their availability for the construction features and occupancy conditions. Quick response sprinklers may be selected if desirable and acceptable to the City of Cupertino Fire Marshal and authorities having jurisdiction.

2. Finish: Chrome plated.

3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

6. Sidewall Type: Standard horizontal sidewall type with matching screw on escutcheon plate and guard.
   a. Sidewall Type: Semi-recessed horizontal sidewall type with matching screw on escutcheon plate and guard. Finish: enamel, color as selected.
   b. Finish: Enamel, color as selected.
   c. Escutcheon Plate Finish: Enamel, color as selected.
   d. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

7. Guards: Finish to match sprinkler finish.

C. PIPING SPECIALTIES

1. Flow Switches: Shall be California State Fire Marshal listed vane-type with automatic recycle retard and DPDT contacts, Potter Electric Signal Co. 6200, 24V D.C. with two normally open electrical contacts for connections, specified under Electrical Division, to fire alarm and annunciator systems. If system is dry pipe, preaction, or deluge type, a pressure switch shall be used in lieu of a vane type switch.
2. Valve Supervision Switches: Shall be California State Fire Marshal listed and UL listed. Provide, on main fire sprinkler riser gate valve, and on all other valves controlling water supplies to fire system, a 24V D.C.electrical switch with two normally open contacts which will automatically close when valve is closed; for connection, specified in Electrical Division, to fire alarm "trouble indicator light". Supervisory switches shall be manufactured by Potter Electrical Signal Company.
3. Test and Drain Assembly: Pre-assembled indicating stainless steel quarter turn ball valve arrangement; one handle with dual control to provide positive-stop, positioning for test, drain and shut-off; self-cleaning sight-glass assembly; visual flow indicator for both alarm test and flow test; UL Listed.
4. Alarm Bells: Potter Electrical Signal Company Model 6230, System Sensor SSV 120-10, 10 inch diameter, 120 volt AC.
5. Hose Valves: Potter Roemer or equal, polished chrome.
6. Fire Department Connections: Potter Roemer or equal, polished chrome.
7. Test to be witnessed by the Fire Marshal.

D. INSTALLATION

1. Install in accordance with referenced NFPA design and installation standard.
2. Install equipment in accordance with manufacturer's instructions.
3. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
4. Place pipe runs to minimize obstruction to other work.
5. Place piping in concealed spaces above finished ceilings.
6. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
7. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
8. Flush entire piping system of foreign matter.
9. Install guards on sprinklers where indicated.
10. Hydrostatically test entire system.
11. Require test be witnessed by Fire Marshal.
12. Testing: Shall be in accordance with NFPA Standards, upon completion and prior to acceptance of the installation subject the system to a hydrostatic pressure test with no visible leakage. Remove and replace all defects due to materials or workmanship occurring during the test and re-test after corrections have been made. All testing shall be approved by City of Cupertino Fire Inspector.

E. INTERFACE WITH OTHER PRODUCTS

1. Ensure required devices are installed and connected as required to fire alarm system.

2.4 FIRE SPRINKLER SYSTEM SCOPE OF WORK

A. Scope of Work:

1. Fire department connections shall be located on the building face on each side where there is a street.
2. Fire standpipes shall be located in each required exit stairway as required by applicable code.
3. Fire standpipes shall be located on the roof as required by applicable code.
4. The fire sprinkler system shall be a complete and operational system when complete.

2.5 FIRE PROTECTION GENERAL REQUIREMENTS

A. Work Included: Furnish and install a complete, fully automatic fire protection system as described by the complete set of specifications and project drawings. This project shall be 'Design/Build'. The chosen fire protection contractor shall be responsible for preparing a complete working set of documents, including but not limited to the preparation of the permit set of drawings and shop drawings.

B. Protection Of Work: Until final acceptance of the work, protect materials from damage and provide adequate and proper storage facilities. Replace damaged or defective work, material, and equipment before requesting final acceptance.

C. Workmanship: Equipment and materials shall be installed in a neat and workmanlike manner. Materials and equipment not so installed shall, upon order of the Architect, be removed and replaced in a satisfactory manner, without change in contract price.

D. Closing In Uninspected Work

1. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested, and accepted by the Architect and the Owner's Engineer.
2. Any work enclosed or covered-up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair such materials as may be necessary to restore disturbed work to its original and proper condition at no extra cost to the Owner.

E. Equipment Anchoring: Equipment shall be securely anchored to the building structure to prevent shifting or overturning during earthquakes.

F. Preliminary Operation: Under this section, supervise and direct preliminary operation of systems should the Owner demand that any portion of the plant, apparatus, or equipment be operated previous to the final completion and acceptance of the work. Expenses will be paid by the Owner. Such preliminary operation or payment shall not be construed as an acceptance of the work.

G. "As-Built" Drawings: As-built drawings shall be furnished in an electronic format.

H. Final Inspection: At the time of final inspection, a service representative shall be available to make final adjustments.

I. Final Operation: After acceptance of the installation, instruct the Owner's representative in operation and maintenance, for a period of three (3) working days at a time requested by the Owner during the first year of guarantee. At the beginning of the instruction period, deliver to the Owner three (3) copies of a durable binder as described under "Operating Instructions".

J. Operating Instructions: Provide six (6) complete sets of Operating Instructions. These instructions shall include brochures, diagrams, maintenance, and operating instructions and parts lists. See "Final Operation". A summary of operating sequences (start-up, normal run, and shut-down), and control diagrams shall be provided in the main mechanical room.

PART 3 EXECUTION

3.1 INSTALLATION AND EXECUTION

A. Industry standards and manufacturers' recommendations, diagrams or requirements shall be strictly adhered to for installation of materials and equipment.

B. Provide protective covers, skids, plugs or caps to protect equipment and materials from damage and deterioration during construction. Protect exposed coils with plywood or other suitable rigid covers to avoid damage to fins.

C. All equipment and material shall be installed in a neat and workmanlike manner.

D. In conditions where freezing temperatures are a possibility, water systems shall be tested using air, or system testing shall be postponed until weather conditions are favorable. Contractor shall bear all responsibility for coordinating system testing such that it will not adversely affect the project construction schedule. Under no conditions shall water system be filled with water where freezing temperatures are a possibility.

E. Thoroughly clean all equipment, piping, etc. free of dust, scale, filings, plaster, grease, oil, paint and other construction debris using low- or non-VOC cleaning products only.

F. All piping and equipment shall be installed in an orderly and neat fashion. All exposed equipment and piping shall be installed without any rough edges, level to structure (where code requirements allow) and in a neat, orderly fashion.

G. Protect all equipment from weather and joist conditions during rough-in phase of construction.

H. Repair all damaged paint or protective coatings with factory approved paint or finish.

3.2 EQUIPMENT AND PIPING IDENTIFICATION

A. Equipment:

1. All fire protection equipment shall be identified by nameplates securely fastened in a clearly visible location to the equipment housing or frame. Nameplates shall include the equipment design plan mark and brief description of the area or system served, such as: "EFP-1: Electric Fire Pump 1". Where starters are provided, provide additional nameplate indicating equipment mark, such as "P-1", mounted on starter face.

2. Nameplates shall be 2-1/2" x 3/4" minimum, either 1/6" thick Bakelite with engraved white core letters and beveled edge, or aluminum with black enameled background and etched or engraved. natural aluminum lettering.
3. Manufacturer's nameplate shall be clean and legible and installed in a clearly visible location.

B. Piping:

1. Identify piping with symbol identification (e.g. FS) and direction of flow arrows, complying with ANSI A 13.1 color standards.
2. Identify piping at approximately 25' centers where unconcealed. Concealed piping above inaccessible ceilings shall be identified at each access panel. Concealed piping above accessible ceilings shall be identified within 10 feet of each wall penetration (both sides of walls).
3. Where capped piping is provided for future connections, provide legible and durable metal tags indicating symbol identification.
4. Printed labels with colored background and attaching strap: Stern, W. Brads, or equal.

C. Valves:

1. All valves, except isolation shut-off valves located at equipment, shall be tagged with brass tags not less than 1-1/2" in diameter or 1-1/4" x 1-1/4" with depressed black filled letters or numbers. Valves shall be labeled with service (e.g. FS) and number corresponding to piping diagram listing. Directory shall include service, location, normal position (e.g. NC or NO), and use, located in a bound manual or framed directory with plastic lens in the main mechanical room.
2. Valve tags shall be installed on handwheels or stems with a brass hook or nickel-plated beaded chain.

D. Warning Signs:

1. Provide warning signs at all equipment driven by electric motors which are controlled by fully automatic starters, per Article 3281, General Industry Safety Orders.

3.3 PRESSURE TESTING

A. Fire Protection Piping:

1. Below Grade: Test with water at 200 psig for 2 hours. Piping shall maintain test pressure +/- 5 psi for the duration of the test and there shall be no visible signs of leakage per NFPA 24.
2. Above Grade: Test with water at 200 psig for 2 hours and shall maintain that pressure without loss per NFPA 13.

3.4 CLOSE-OUT

A. O&M Manual: Prior to acceptance and the start of the warranty period, submit four (4) copies of operations and maintenance manuals. Manuals shall be bound in one or more 3-ring binders with index and tabs and include the following:

1. Service telephone number of the installing contractor
2. Manufacturers' equipment submittals (see previous section).
3. Equipment performance curves or capacity tables, where applicable.
4. Manufacturers' maintenance instruction sheets and parts list.
5. Address and phone number of the nearest sales and service organization for each major piece of equipment.
6. Operating instructions for installation as a whole and for each piece of equipment.
7. Copy of inspection certificates provided by the local code authorities.
8. "As-built" control shop drawings and diagrams.

END OF SECTION

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SECTION 22 05 01
PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. For the following plumbing system components and requirements see Division 23 (HVAC/Mechanical) of this specification:

1. Section 23 05 00 - HVAC and Plumbing General Requirements
2. Section 23 05 50 - Basic Mechanical Materials and Methods
3. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
4. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
5. Section 23 05 53 - Identification for HVAC Piping and Equipment
6. Section 23 07 19 - HVAC Piping Insulation

B. LEAD FREE POTABLE WATER SYSTEM

1. All plumbing components including but not limited to pumps, pipe, valves, faucets, strainers, backflow preventers and other wetted parts shall comply with California AB-1953.

END OF SECTION

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SECTION 22 08 13
TESTING PIPING SYSTEMS

GENERAL

1.1 SECTION INCLUDES

A. Pressure testing of the following systems:

1. Fire protection piping
2. Plumbing piping (sewer lines, water lines, rainwater lines)
3. Hydronic piping
4. Holiday testing (buried coated steel piping)

1.2 SUBCONTRACTOR REQUIREMENTS

A. Notify City at least 48 hours (2 working days) in advance to arrange for witnessing of the piping test.

B. For discharge requirements of water used for pressure testing comply with Water Discharge Requirements.

C. Notify City immediately in the event of any accidental discharge.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures:

1. Pneumatic/hydronic test plan for approval that includes:
   a. Material of construction
   b. Design pressure
   c. Test pressure and duration of test
   d. Test medium and method of achieving the test pressure
   e. Certification on calibration of pressure gauges
   f. Method to exclude personnel from the area containing the system to be tested.
   g. Over pressurization protection/prevention: Device make/model number, certification, pressure relief set point, point of installation in system.
   h. Test Reports: Submit test results within 10 working days of successful test.

PRODUCTS

2.1 MATERIALS

A. Furnish instruments, equipment, material and labor necessary to conduct tests.

B. Calibrate testing equipment at reasonable intervals with devices of accuracy traceable to National Institute of Standards and Technology (NIST).

C. Test gauges used in conducting test shall be in accordance with IAPMO UPC.

EXECUTION

3.1 FIELD QUALITY CONTROL

A. All piping systems installed shall be tested in accordance with this section.

B. No testing procedure here shall be considered in lieu of any more stringent code requirements.

C. Piping being tested shall remain exposed until owners representative has approved the piping test results.

D. Trenches may be backfilled between joints before testing to prevent movement of pipe during testing. Ensure that thrust blocks are sufficiently hardened before testing.

E. Piping being tested shall not leak nor show any loss in test pressure for duration specified unless otherwise noted.

F. Where portion of piping system is to be concealed before completion, the portion shall be tested separately as specified for the entire system.

G. Ensure piping supports are in place.

H. Isolate system gages, sensors, etc., from pressure tests so instruments and devices are not damaged. Test pressure shall not exceed the maximum allowable test pressure for any vessel, pump, valves, or other component in the system.

I. Hydrostatic (Water) Testing:

1. Use potable water as test medium. Do not fill system until the City has approved the source of water supply.
2. Provide vents at high points to release trapped air while filling system.
3. Provide drains at low points for complete removal of test liquid.
4. Drain system if there is a potential for freezing, i.e., no heat in building, coil in outside air stream, or other similar situations.
5. Pressurization of system for a period prior to test is recommended for hydronic loops utilizing plastic tubing, for example PEX radiant tubing, to prevent test failure from slight expansion of material upon first pressurization.

J. Pneumatic (Air) Testing:

1. Use clean dry air (Excluded from use with natural gas pipe testing) or inert gas as the test medium.
2. Barricade the area around the system to be tested.
3. Prior to application of full air test pressure, apply a preliminary test of not more than 10 psig to reveal possible major leaks.
4. After preliminary test, raise pressure in stages not more than 25 percent up to full test pressure, allowing at least 10 minutes for equalization of strain and detection of major leaks at each intermediate stage. Hold final test pressure for time specified.
5. Examine piping for leakage using soap bubble solution, or by test gage monitoring.

K. If leaks are found, they shall be eliminated by tightening, approved repair method, or replacement, as appropriate and test repeated until no leakage is found.

3.2 PRESSURE TESTING

A. Fire Protection Piping:

1. Below Grade: Test with water at 200 psig for 2 hours. Piping shall maintain test pressure +/- 5 psi for the duration of the test and there shall be no visible signs of leakage per NFPA 24.
2. Above Grade: Test with water at 200 psig for 2 hours and shall maintain that pressure without loss per NFPA 13 and FM Global requirements.

B. Plumbing Piping:

1. Sanitary Waste and Vent Piping Within Building to Building Wall, including condensate drain line from cooling coils:
   a. Test with water in accordance with the IAPMO CPC to a minimum of 10 foot head of water. Keep water in system for at least 1 hour before inspection starts.
   b. Acceptable Alternate: Test with air at 5 psig and hold pressure for at least 1 hour; note: This alternative method may not be used for plastic piping,
   c. For modifications to existing plug the outlet of the drain piping, and fill pipe with water to the point of overflow. After 15 minutes, check piping for leaks. No loss of water from the piping for the duration of the test indicates that the system meets the requirements of the project. (Per CPC)
2. Sanitary Sewer Piping Beyond Building Wall (other than Force Main): Completely fill system with water and let stand for at least 1 hour before inspection starts, then visually inspect to ensure that all joints are tight.
   a. For partial system tests, test with water in accordance with the IAPMO CPC to a minimum of 10 foot head of water. Keep water in system for at least 1 hour before inspection starts.
   b. Acceptable Alternate: Test with air at 5 psig and hold pressure for at least 1 hour
      1) Note: This alternative testing method may not be used for plastic piping.
3. Sanitary Sewer Force Main: Test with water at 1.5 times operating pressure, 25 psig minimum for 4 hour.
4. Potable Water Inside Building to Site Main: Test with water at 1.5 times operating pressure, 100 psig minimum for 4 hours.
5. Hydronic piping test
   a. Test Preparation:
      1) Temporarily restrain expansion joints so they are not damaged due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
      2) Flush with clean water, and clean strainers.
      3) Install relief valve set at a pressure no more than one-third higher than test pressure.
   b. Tests:
      1) Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig.

2) After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
3) Pipe pressure shall maintain its test pressure for a period of no less than 24 hours before testing can be terminated as successful.
4) Prepare a written report of testing.

6. Hydronic Piping (heating hot water, chilled water, make-up water and equipment drains): Test with water at [1.5 times operating pressure, 100 psig minimum] for 4 hours
   a. For modifications to existing piping bring system up to operating pressure gradually. Visually examine the piping for leaks at one-half the system operating pressure. Perform a final examination at the system operating pressure. No leaking from the piping indicates that the system meets the requirement of the project. Per ASME 31.9, paragraph 937.5.

3.3 Testing for Holidays:

A. Test the following buried coated steel piping systems for holidays:

1. Perform holiday test in accordance with the following procedure:
   a. After pipe has been welded, joints wrapped, and pipe is ready for lowering into trench, test coating for flaws (holidays). Test coated piping system throughout its length for flaws in coating system by means of a high-potential flaw detector that can impress a maximum of [8,000] volts across coating. One electrode of tester shall maintain complete circumferential contact with coating while transversing entire length of coating system and other electrode shall be the underlying metal pipe. An electrical discharge through coating detected visually or by instrument, shall constitute failure of this test.
      1) Important! Do not cut ground cable to a shorter length. The length supplied is important to proper operation of the detector. Keep as much of the cable as possible in contact with the earth. Straighten out kinks where possible and do not let it ride up over skids. In dry areas it will help to drag the cable in the ditch where there is more moisture. Thepipeshouldbegrounded.
   b. Mark holidays as they are found and repair prior to lowering pipe into trench. Repair holidays in factory coating by removing initial coating and undercoating for a minimum of 4 inches on each side of holiday. Remove coating around holiday and feather edge to pipe wall for sufficient distance to make a satisfactory repair. Apply primer (Polyken 1027) to the holiday to form a bond over the entire surface of the holiday and then spirally wrap pipe with a double layer of half-lapped 35 mil polyethylene tape (Polyken 934) for a minimum of 2 inches on each side of the holiday.
      1) Repair holidays in joint wrappings by removing field applied coating in area of holiday and rewrapping. Owner OTR or designated representative will approve all areas of joint coating.

3.4 RETESTING

A. If piping does not pass test, locate and repair leaks and repeat testing procedure until satisfactory results are obtained.

1. Make repairs to piping with new materials. Caulking on screwed joints, cracks, or holes is not acceptable.

END OF SECTION

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SECTION 22 10 05
PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.
   3. Storm water.

1.2 RELATED REQUIREMENTS

A. Section 31 20 00 - Excavation.

B. Section 31 23 33 - Trenching.

C. Section 33 10 00 - Site Water Lines.

D. Section 07 84 00 - Firestopping.

E. Section 08 31 00 - Access Doors and Panels.

F. Section 09 91 00 - Painting.

G. Section 22 05 01 - Plumbing General Requirements

1.3 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012 (ANSI B16.18).

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2010).

C. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2011 (ANSI/ASME B31.9).

D. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2009.

E. ASTM B32 - Standard Specification for Solder Metal; 2008.

F. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2010.

G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

H. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2012.

I. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter; 2003.

J. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2002 (Reapproved 2009).

K. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2009.

L. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2011

M. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; Latest issue shall apply.

N. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; Latest issue shall apply.

O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

P. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2011.

Q. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2008.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Operation and maintenance data.

D. Project Record Documents: Record actual locations of valves.

E. Field quality-control test reports.

F. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

G. Welding certificates.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State of California, standards.

1. Maintain one copy on project site.

B. All piping shall me manufactured in the United States of America.

C. Valves: Manufacturer's name and pressure rating marked on valve body.

D. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

E. Welder Qualifications: Certified in accordance with ASME (BPV IX).

F. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

G. Sanitary, Waste and Vent Piping

1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

H. Domestic Water Piping

1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," and NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for combined fire-protection and domestic water service piping to building.
3. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

I. Storm Drainage Piping

1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
2. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

J. Hangers and Supports

1. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
2. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and seismic restraint by a qualified professional engineer.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of California plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Soil Pipe

1. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.
2. Pipe and fittings shall be manufactured in the United States of America.
3. Manufacturers:
   a. AB&I Foundry
   b. Charlotte Pipe
   c. Tyler Pipe
4. Cast Iron Pipe: ASTM A74 service weight.
   a. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.
   b. Transition Couplings for Underground Pressure Piping: AWWA C219 metal, sleeve-type coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
   c. Hub-and-Spigot Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
      1) Gaskets: ASTM C 564, rubber.
5. Cast Iron Pipe: ASTM A 888 or CISPI 301, hubless.
   a. Fittings: Cast iron, ASTM A 888 or CISPI 301.

b. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
c. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
   1) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
      (a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
   2) Heavy-Duty, FMG-Approved Couplings: ASTM A 666, Type 304, stainless-steel housing; stainless-steel bands; and sleeve.
      (a) NPS 1-1/2 to NPS 4: 3-inch- wide housing with 2 bands.
   3) Heavy-Duty, Cast-Iron Couplings: ASTM A 48, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and sleeve.
   4) Heavy-Duty, Type 301, Stainless-Steel Couplings: ASTM A 666, Type 301, stainless-steel shield; stainless-steel bands; and sleeve.
      (a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
   5) Compact, Stainless-Steel Couplings: CISPI 310 with ASTM A 167, Type 301, or ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands; and sleeve.
      (a) NPS 1-1/2 to NPS 4: 2-1/8-inch- wide shield with 2 bands.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Soil Pipe

1. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.

2. Pipe and fittings shall be manufactured in the United States of America.

3. Manufacturers:
   a. AB&I Foundry
   b. Charlotte Pipe
   c. Tyler Pipe

4. Hub-and-Spigot Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
   a. Gaskets: ASTM C 564, rubber.

5. Cast Iron Pipe: ASTM A 888 or CISPI 301, hubless.
   a. Fittings: Cast iron, ASTM A 888 or CISPI 301.
   b. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
   c. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
      1) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
         (a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
      2) Heavy-Duty, FMG-Approved Couplings: ASTM A 666, Type 304, stainless-steel housing; stainless-steel bands; and sleeve.
         (a) NPS 1-1/2 to NPS 4: 3-inch- wide housing with 2 bands.
      3) Heavy-Duty, Cast-Iron Couplings: ASTM A 48, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and sleeve.
      4) Heavy-Duty, Type 301, Stainless-Steel Couplings: ASTM A 666, Type 301, stainless-steel shield; stainless-steel bands; and sleeve.
         (a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.

5) Compact, Stainless-Steel Couplings: CISPI 310 with ASTM A 167, Type 301, or ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands; and sleeve.
   (a) NPS 1-1/2 to NPS 4: 2-1/8-inch- wide shield with 2 bands.

2.3 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
   2. Joints: ASTM B 32, alloy Sn95 solder.

B. HDPE Pipe: ASTM D2239, or ASTM D2447 Schedule 40.
   1. Fittings: ASTM D2609, HDPE.
   2. Joints: Mechanical with stainless steel clamp.

C. **Ductile Iron Pipe: AWWA C151/A21.51.**
   1. **Fittings: Ductile or gray iron, standard thickness.**
   2. **Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch diameter rods.**

2.4 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
   1. Transition Couplings: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
   2. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
      a. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
      b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
      c. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
   3. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
      a. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
      b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
      c. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.5 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Soil Pipe
   1. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.

2. Manufacturers:
   a. AB&I Foundry
   b. Charlotte Pipe
   c. Tyler Pipe
3. Cast Iron Pipe: CISPI 301, hubless, service weight.
   a. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
      1) Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral center pipe stop.
         (a) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
            (1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
         (b) Heavy-Duty, FMG-Approved Couplings: ASTM A 666, Type 304, stainless-steel housing; stainless-steel bands; and sleeve.
            (1) NPS 1-1/2 to NPS 4: 3-inch- wide housing with 2 bands.
         (c) Heavy-Duty, Cast-Iron Couplings: ASTM A 48, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and sleeve.
         (d) Heavy-Duty, Type 301, Stainless-Steel Couplings: ASTM A 666, Type 301, stainless-steel shield; stainless-steel bands; and sleeve.
            (1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
         (e) Compact, Stainless-Steel Couplings: CISPI 310 with ASTM A 167, Type 301, or ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands; and sleeve.
            (1) NPS 1-1/2 to NPS 4: 2-1/8-inch- wide shield with 2 bands.

2.6 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Soil Pipe

1. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.
2. Manufacturers:
   a. AB&I Foundry
   b. Charlotte Pipe
   c. Tyler Pipe
3. Cast Iron Pipe: CISPI 301, hubless, service weight.
   a. Fittings: Cast iron.
   b. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
   c. Cast Iron Pipe: ASTM A 888 or CISPI 301, hubless.
   d. Fittings: Cast iron, ASTM A 888 or CISPI 301.
      1) Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
      2) Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
         (a) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
            (1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
         (b) Heavy-Duty, FMG-Approved Couplings: ASTM A 666, Type 304, stainless-steel housing; stainless-steel bands; and sleeve.

(1) NPS 1-1/2 to NPS 4: 3-inch- wide housing with 2 bands.

(c) Heavy-Duty, Cast-Iron Couplings: ASTM A 48, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and sleeve.

(d) Heavy-Duty, Type 301, Stainless-Steel Couplings: ASTM A 666, Type 301, stainless-steel shield; stainless-steel bands; and sleeve.

(1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.

(e) Compact, Stainless-Steel Couplings: CISPI 310 with ASTM A 167, Type 301, or ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands; and sleeve.

(1) NPS 1-1/2 to NPS 4: 2-1/8-inch- wide shield with 2 bands.

2.7 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.
2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Fittings

1. Dielectric fittings shall be brass nipples a minimum of 6" in length or 6 times the pipe diameter, whichever is longer.

2.8 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.

B. MANUFACTURED UNITS

1. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components.
   a. Manufacturers:
      1) Grinnell Corp.
      2) Piping Technology & Products, Inc.
      3) Or equal.
   b. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.

c. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
   a. Manufacturers:
      1) Grinnell Corp.
      2) Unistrut Corp.
      3) Or equal.
   b. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
   c. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

3. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) minimum compressive-strength insulation, encased in sheet metal shield.
   a. Manufacturers:
      1) Michigan Hanger Co., Inc.
      2) Pipe Shields, Inc.
      3) Or equal.
   b. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
   c. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
   d. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
   e. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
   f. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

C. MISCELLANEOUS MATERIALS

1. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

2. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

3. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, low-VOC, hydraulic-cement grout.
   a. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   b. Properties: Nonstaining, noncorrosive, and nongaseous.
   c. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Plumbing Piping - Drain, Waste, and Vent:

1. Refer to Division 23 for seismic-restraint devices.

2. Install the following:
   a. Vertical Piping: MSS Type 8 or Type 42, clamps.
   b. Individual, Straight, Horizontal Piping Runs: According to the following:
      1) 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      2) Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      3) Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   c. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   d. Base of Vertical Piping: MSS Type 52, spring hangers.

3. Support vertical piping and tubing at base and at each floor.
4. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
5. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   b. NPS 3: 60 inches with 1/2-inch rod.
   c. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   d. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
6. Install supports for vertical cast-iron soil piping every 15 feet.
7. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/4: 84 inches with 3/8-inch rod.
   b. NPS 1-1/2: 108 inches with 3/8-inch rod.
   c. NPS 2: 10 feet with 3/8-inch rod.
   d. NPS 2-1/2: 11 feet with 1/2-inch rod.
   e. NPS 3: 12 feet with 1/2-inch rod.
   f. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
8. Install supports for vertical steel piping every 15 feet.
9. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1-1/4: 72 inches with 3/8-inch rod.
   b. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   c. NPS 2-1/2: 108 inches with 1/2-inch rod.
   d. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
10. Install supports for vertical copper tubing every 10 feet.
11. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

E. Plumbing Piping - Water:
   1. Conform to ASME B31.9.

2.9 BALL VALVES

A. Manufacturers:
   1. Conbraco Industries: www.conbraco.com.
   2. Nibco, Inc: www.nibco.com.
   3. Milwaukee Valve Company: www.milwaukeevalve.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.10 SWING CHECK VALVES

A. Manufacturers:

1. Hammond Valve: www.hammondvalve.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Up to 2 Inches:

1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.

C. Over 2 Inches:

1. MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.11 SPRING LOADED CHECK VALVES

A. Manufacturers:

1. Hammond Valve: www.hammondvalve.com.
2. Crane Co.: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.12 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com.
2. Green Country Filter Manufacturing; www.greencountryfilter.com.
3. WEAMCO: www.weamco.com.
4. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Size 2 inch and Under:

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 1-1/2 inch to 4 inch:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

2.13 VALVES, GENERAL

A. Bronze Valves: NPS 2 and Smaller: Threaded ends, unless otherwise indicated.

B. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

C. Valve Actuators:

1. Handwheel: For valves other than quarter-turn types.

2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.

D. Extended Valve Stems: On insulated valves.

E. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

F. Valve Grooved Ends: AWWA C606.

1. Solder Joint: With sockets according to ASME B16.18.
   a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.

2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.14 Domestic Water Piping: Use the following types of valves:

A. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.

B. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.

C. Butterfly Valves, NPS 2-1/2 and Larger: Flangeless or single-flange, 150-psig CWP rating, ferrous alloy, with EPDM liner.

D. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 125, horizontal or vertical, bronze.

E. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.

F. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.

G. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 125 minimum.

H. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, cast iron.

2.15 Sanitary Waste and Storm Drainage Piping: Use the following types of valves:

A. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.

B. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.

C. Swing Check Valves, NPS 2 and Smaller: Type 3, Class 125, bronze.

D. Swing Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, gray iron.

2.16 Select valves, except wafer and flangeless types, with the following end connections:

A. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.

B. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.

C. For Copper Tubing, NPS 5 and Larger: Flanged ends.

D. For Steel Piping, NPS 2 and Smaller: Threaded ends.

E. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

H. Provide support for utility meters in accordance with requirements of utility companies.

I. Excavate in accordance with Section 31 20 00.

J. Install bell and spigot pipe with bell end upstream.

K. Install valves with stems upright or horizontal, not inverted.

L. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

M. Install water piping to ASME B31.9.

N. Sleeve pipes passing through partitions, walls and floors.

O. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

P. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
3. Place hangers within 12 inches of each horizontal elbow.
4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.
8. Support cast iron drainage piping at every joint.

Q. Sanitary, Waste and Vent Piping

1. Refer to Division 33 for Project-site sanitary sewer piping.
2. Refer to Division 23 for basic piping installation.
3. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
4. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 23 for sleeves and mechanical sleeve seals.

5. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 23 for wall penetration systems.
6. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   a. Encase underground piping with PE film according to ASTM A 674 or AWWA C105.
7. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 deg rees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
8. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
9. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   a. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
      1) Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
      2) Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
10. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
11. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
12. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
13. Install underground ABS soil and waste drainage piping according to ASTM D 2321.
14. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Domestic Water Piping

1. Refer to Division 33 for site water distribution and service piping.
2. Refer to Division 23 for basic piping installation.
3. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
4. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 23 or sleeves and mechanical sleeve seals.
5. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 23 for wall penetration systems.

6. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service. Refer to Division 23 for pressure gages, and to Division 22 for drain valves and strainers.
7. Install water-pressure regulators downstream from shutoff valves. Refer to Division 22 for water-pressure regulators.
8. Install domestic water piping level with 0.25 slope downward toward drain and plumb.
9. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
10. Perform the following steps before operation:
    a. Close drain valves, hydrants, and hose bibbs.
    b. Open shutoff valves to fully open position.
    c. Open throttling valves to proper setting.
    d. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
    e. Remove and clean strainer screens. Close drain valves and replace drain plugs.
    f. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
11. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
12. Check plumbing specialties and verify proper settings, adjustments, and operation.
    a. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.
13. Energize pumps and verify proper operation.

S. Hangers and Supports

1. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
2. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
3. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
4. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
5. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

6. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
7. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
8. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
9. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
10. Insulated Piping: Comply with the following:
    a. Attach clamps and spacers to piping.
        1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
        2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
        3) Do not exceed pipe stress limits according to ASME B31.9.
    b. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    c. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 deg rees.
    d. Shield Dimensions for Pipe: Not less than the following:
        1) NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
        2) NPS 4: 12 inches long and 0.06 inch thick.
    e. Insert Material: Length at least as long as protective shield.
    f. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
11. METAL FABRICATION
    a. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
        1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
        2) Obtain fusion without undercut or overlap.
        3) Remove welding flux immediately.
        4) Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
12. ADJUSTING
    a. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
13. PAINTING
    a. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted

surfaces. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm). See Division 9 for paint materials and application requirements.

b. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.4 JOINT CONNECTIONS

A. Sanitary, Waste and Vent Piping

B. Refer to Division 23 Section for basic piping joint construction.

1. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   a. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
   b. Hubless Joints: Make with rubber gasket and sleeve or clamp.
2. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. Domestic Water Piping

1. Refer to Division 23 Section for basic piping joint construction.
2. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

G. Check valves must be installed to follow any manufacturer recommendations regarding distance from pump discharge.

H. Sanitary, Waste and Vent Piping

1. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
   a. Use gate or full-port ball valve for piping NPS 2 and smaller.
   b. Use gate valve for piping NPS 2-1/2 and larger.

2. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
3. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
   a. Horizontal Piping: Horizontal backwater valves. Use normally closed type, inless otherwise indicated.
   b. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
   c. Install backwater valves in accessible locations.

I. Domestic Water Piping

1. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
2. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
3. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   a. Install hose-end drain valves at low points in water mains, risers, and branches.
   b. Install stop-and-waste drain valves where indicated.

3.6 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

F. Provide spring loaded check valves on discharge of water pumps.

G. Provide plug valves in natural gas systems for shut-off service.

H. Provide flow controls in water recirculating systems where indicated.

3.7 PIPING APPLICATIONS

A. Sanitary Waste and Vent

1. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
2. Flanges may be used on aboveground pressure piping, unless otherwise indicated.

3. Aboveground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:
   a. NPS 1-1/4 and NPS 1-1/2: Use NPS 1-1/2 hubless, cast-iron soil piping and one of the following:
      1) Couplings: Heavy-duty, Type 301, stainless steel.
      2) Couplings: Heavy-duty, FMG approved.
   b. NPS 2 to NPS 4: Hubless, cast-iron soil piping and one of the following:
      1) Couplings: Heavy-duty, Type 301, stainless steel.
      2) Couplings: Heavy-duty, FMG approved.
4. Underground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:
   a. NPS 1-1/2: Hubless, cast-iron soil piping and one of the following:
      1) Couplings: Heavy-duty, Type 301, stainless steel.
      2) Couplings: Heavy-duty, FMG approved.
   b. NPS 2 to NPS 4: Hubless, cast-iron soil piping and one of the following:
      1) Couplings: Heavy-duty, Type 301, stainless steel.
      2) Couplings: Heavy-duty, FMG approved.

B. Domestic Water Piping
1. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
2. Flanges may be used on aboveground piping, unless otherwise indicated.
3. Domestic Water Piping: Use any of the following piping materials for each size range:
   a. NPS 1-1/2 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

3.8 VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball or butterfly valves.
2. Throttling Service: Ball, butterfly, or globe valves.
3. Pump Discharge: Spring-loaded, lift-disc check valves.

3.9 HANGERS AND SUPPORTS APPLICATIONS

A. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

B. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.

3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
4. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30 (DN 15 to DN 750).
5. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
6. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
7. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

C. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.

E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb (340 kg).
   b. Medium (MSS Type 32): 1500 lb (675 kg).
   c. Heavy (MSS Type 33): 3000 lb (1350 kg).

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi (690-kPa) minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

G. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

3.10 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Sanitary, Waste and Vent Piping

1. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
2. Connect drainage and vent piping to the following:
   a. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22.
   b. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   c. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22.
   d. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

C. Domestic Water Piping

1. Drawings indicate general arrangement of piping, fittings, and specialties.

2. Install piping adjacent to equipment and machines to allow service and maintenance.
3. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.
4. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:
   a. Booster Systems: Cold-water suction and discharge piping.
   b. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   c. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22.
   d. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.11 JOINT CONSTRUCTION

A. Refer to Division 23 for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.12 FIELD QUALITY CONTROL

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

B. Sanitary, Waste and Vent Piping
   1. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   2. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   4. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
      a. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
      b. Prepare reports for tests and required corrective action.
   5. Cleaning

a. Clean interior of piping. Remove dirt and debris as work progresses.
b. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
c. Place plugs in ends of uncompleted piping at end of day and when work stops.

6. Protection
   a. Exposed ABS Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

C. Domestic Water Piping

1. Inspect domestic water piping as follows:
   a. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      2) Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Test domestic water piping as follows:
   a. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   b. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   c. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   d. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   e. Prepare reports for tests and required corrective action.

3. Cleaning
   a. Clean and disinfect potable domestic water piping as follows:
      1) Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
      2) Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
         (a) Flush piping system with clean, potable water until dirty water does not appear at outlets.
         (b) Fill and isolate system according to either of the following:

(1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
(2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

(c) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
(d) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

b. Prepare and submit reports of purging and disinfecting activities.
c. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

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SECTION 22 10 06
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof and floor drains.

B. Cleanouts.

C. Hose bibbs.

D. Thermostatic mixing valves.

E. Strainers

F. Trap seal primer valves

G. Miscellaneous piping specialties

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 40 00 - Plumbing Fixtures.

C. Section 22 30 00 - Plumbing Equipment.

D. Section 22 05 01 - Plumbing Requirements

1.3 REFERENCE STANDARDS

A. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering; 2004 (ANSI/ASSE 1011).

1.4 SUBMITTALS

A. See Section 01 33 00 - for submittal procedures.

B. Product Data: Include rated capacities and indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:

1. Backflow preventers and water regulators.
2. Balancing valves and strainers.
3. Thermostatic water mixing valves and water tempering valves.
4. Water hammer arresters, air vents, and trap seal primer valves and systems.
5. Hose bibbs and hydrants.

6. Backwater valves, cleanouts, floor drains, open receptors, and trench drains.

C. Field quality-control test reports.

D. Operation and maintenance data for the following:

1. Backflow preventers and water regulators.
2. Thermostatic water mixing valves and water tempering valves.
3. Trap seal primer valves and systems.

E. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

F. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

G. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors valves.

H. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

E. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

1.7 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig
2. Sanitary Waste and Vent Piping: 10-foot head of water.

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:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.
   3. 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.
   4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 DRAINS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   2. Josam Company: www.josam.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Area Drains (AD-1,2):
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   3. Strainer: Round nickel-bronze.

C. Floor Drain (FD-1,2):
   1. Floor Drains FD-1,2, Comply with ASME A112.21.1M.
      a. Body Material: Gray iron.
      b. Seepage Flange: Required.
      c. Clamping Device: Required.
      d. Outlet: Bottom.
      e. Exposed Surfaces and Interior Lining: Acid-resistant enamel.
      f. Sediment Bucket: Not required.
      g. Top or Strainer Material: Gray iron.
      h. Top of Body and Strainer Finish: Nickel bronze.
      i. Top Shape: Round.
      j. Dimensions of Top or Strainer: See schedule.
      k. Top Loading Classification: Medium Duty.

l. Funnel: Not required.
m. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
n. Trap Material: Cast iron.
o. Trap Pattern: Standard P-trap.
p. Trap Features: Cleanout.

2.3 CLEANOUTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   2. Josam Company: www.josam.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Cleanouts: Comply with ASME A112.36.2M.

C. Body or Ferrule Material: Cast iron.

D. Clamping Device: Required.

E. Outlet Connection: Threaded.

F. Closure: Brass plug with straight threads and gasket.

G. Adjustable Housing Material: Cast iron with threads.

H. Frame and Cover Material and Finish: Painted cast iron.

I. Frame and Cover Shape: Round.

J. Top Loading Classification: Medium Duty.

2.4 HOSE BIBBS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
   2. Watts Regulator Company: www.wattsregulator.com.
   3. Zurn Industries, Inc: www.zurn.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Exterior Hose Bibbs:
   1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with lockshield and removable key, integral vacuum breaker in conformance with ASSE 1011.

C. Interior Mixing Type Hose Bibbs:

1. Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with handwheels, and vacuum breaker in conformance with ASSE 1011.

2.5 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:
   a. ESBE: www.esbe.se/en.
   b. Leonard Valve Company: www.leonardvalve.com.
   c. Honeywell Water Controls: http://yourhome.honeywell.com.
   d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
   a. Check valve on inlets.
   b. Volume control shut-off valve on outlet.
   c. Stem thermometer on outlet.
   d. Strainer stop checks on inlets.
4. Cabinet: 16 gage prime coated steel, for recessed mounting with keyed lock.

B. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.

1. Type: Bimetal thermostat, operation and pressure rating 125 psig minimum.
2. Type: Liquid-filled motor, operation and pressure rating 100 psig minimum.

C. Thermostatic Water Mixing Valves: Unit, with the following:

D. Piping, valves, and unions. Include thermometer if not in cabinet.

E. Piping Component Finish: Polished chrome plate.

F. Cabinet: Recessed-mounting steel box with steel hinged door, white enameled finish, and thermometer in front.

G. Cabinet: Recessed-mounting stainless-steel box with stainless-steel hinged door and thermometer in front.

2.6 STRAINERS

A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch round perforations, unless otherwise indicated.

1. Pressure Rating: 125-psig minimum steam working pressure, unless otherwise indicated.
2. NPS 2 and Smaller: Bronze body, with female threaded ends.

3. NPS 2-1/2 and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
   a. Drain: Pipe plug.
5. T-Pattern Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with rubber gasket.
6. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
   a. a.Type: Simplex with one basket.
   b. Drain: Pipe plug.
7. Drainage Basket Strainers: Non-pressure-rated, cast-iron or coated-steel body; with bolted flange or clamp cover and drain with plug.
   a. Basket: Bronze or stainless steel with 1/8- or 3/16-inch- diameter holes and lift-out handle.
   b. Female threaded ends for NPS 2 and smaller, and flanged ends for NPS 2-1/2 and larger.

2.7 TRAP SEAL PRIMER VALVES

A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
   1. 3 psi pressure drop activation.
   2. 125 psig minimum working pressure.
   3. Bronze body with atmospheric-vented drain chamber.
   4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
   5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
   6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type Trap Seal Primer Valves: ASSE 1044, fixture-trap, waste-drainage-fed type, with the following characteristics:
   1. Chrome-plated, cast-brass, NPS 1-1/4 minimum, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.

2.8 DRAIN VALVES

A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
   1. Inlet: Threaded or solder joint.
   2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.
   3. Select paragraph and subparagraphs above or first paragraph below. Select above if throttling is required.

B. Hose-End Drain Valve: MSS SP-80, gate valve, Class 125, ASTM B 62 bronze body, with NPS 3/4 threaded or solder-joint inlet and ASME B1.20.7, garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.

C. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 side drain outlet and cap.

2.9 MISCELLANEOUS PIPING SPECIALTIES

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Division 23 for piping joining materials, joint construction, and basic installation requirements.

B. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.

C. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

D. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

E. Install expansion joints on vertical risers, stacks, and conductors if indicated.

F. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 deg rees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

G. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

H. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

I. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

J. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

K. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

L. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

M. Fasten recessed-type plumbing specialties to reinforcement built into walls.

N. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

O. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations.

P. Install air vents at piping high points. Include ball, gate, or globe valve in inlet and drain piping from outlet to floor drain.

Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

S. Install in accordance with manufacturer's instructions.

T. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

U. Encase exterior cleanouts in concrete flush with grade.

V. Install floor cleanouts at elevation to accommodate finished floor.

W. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

X. Pipe relief from backflow preventer to nearest drain.

3.2 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Connect plumbing specialties and devices that require power according to Division 26.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each backflow preventer.

B. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

C. Refer to Division 23 for nameplates and signs.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water heaters.

1.2 RELATED REQUIREMENTS

A. Section 22 05 01 - Plumbing Requirements

1.3 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittals procedures.

B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Provide electrical characteristics and connection requirements.

C. Shop Drawings:

1. Diagram power, signal, and control wiring.

D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in City's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on specific units indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:

1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

1.6 CERTIFICATIONS

A. Water Heaters: NSF approved.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.8 WARRANTY

A. See Section 01 77 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATER MANUFACTURERS

A. Eemax

2.2 COMMERCIAL ELECTRIC WATER HEATERS

A. Type: Factory-assembled and wired, electric, tankless.

B. Performance:

1. Energy Factor:.99.

2. Maximum working pressure: 150 psig.

C. Electrical Characteristics:

1. 208 volts, three phase, 60 Hz.

2. 208 volts, singe phase, 60 Hz.

D. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 Watts per square inch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

END OF SECTION

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SECTION 22 40 00
PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dual flush water closets.

B. Lavatories.

C. Sinks.

D. Service sinks.

E. Drinking fountains.

1.2 RELATED REQUIREMENTS

A. Section 22 05 01 - Joint Sealants: Seal fixtures to walls and floors.

B. Section 22 05 01 - Plumbing Requirements

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:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. 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.
4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 DUAL FLUSH WATER CLOSETS

A. Dual Flush Water Closet Manufacturers (WC-1):

1. Toto USA; Model CST484CEMFG: www.totousa.com.
2. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Dual Flush Water Closets: ASME A112.19.14; high efficiency and low consumption, vitreous china, dual flush, tank type.

1. Flush System: Gravity feed, wash down with a half-flush consumption of 0.9 GPF and a full-flush consumption of 1.28 GPF.
2. Bowl: Elongated.
3. Rough in: 12 inch.
4. Seat: Manufacturer's standard or recommended elongated closed front seat with lid.
5. Color: White.

2.3 LAVATORIES

A. Lavatory Manufacturers (LAV-1):
   1. Kohler Company; Model K-2028: www.kohler.com.
   2. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, 18 by 22 inch minimum, with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.
   1. Drilling Centers: 4 inch.

C. Supply Faucet Manufacturers:
   1. Delta Commercial; Model DSP-501LF-HDF: www.deltafaucet.com.
   2. Substitutions: See Section 01 25 00 - Substitution Procedures.

D. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting, water economy aerator with maximum flow of 0.35 gallons per minute, single handle lavatory deck faucet.

2.4 SINKS

A. Custom (SK-1,2,3); See architectural specification.

B. Supply Faucet Manufacturers:
   1. SK-1,2: Chicago Faucets; Model 895-317FC: www.chicagofaucets.com.
   2. SK-3: Chicago Faucets; Model 350-E35-317XKABCP: www.chicagofaucets.com.
   3. Substitutions: See Section 01 25 00 - Substitution Procedures.

C. Supply Faucet: ASME A112.18.1; chrome plated finish, water economy aerator with maximum flow of 1.5 gallons per minute, indexed wristblade handles, deck mounted faucet.

2.5 DRINKING FOUNTAINS

A. Drinking Fountain Manufacturers:
   1. Elkay Manufacturing Company; Model LK4420: www.elkay.com.
   2. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Fountain shall include pushbutton on the front. Shall include contoured-formed basin to eliminate splashing and standing water, and shall have rounded corners and edges. Projector shall be chrome-plated vandal-resistant type with integral hood guard and anti-squirt feature. Fountain shall comply with ANSI 117:1 and ADA for visual and motion disabilities. The manufacturer shall certify the unit to meet the requirements of NSF/ANSI 61, and the Safe Drinking Water Act.

2.6 SERVICE SINKS

A. Service Sink Manufacturers (MS-1):

1. Florestone Products Co., Inc; Model MSR-2424: www.florestone.com.
2. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.7 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Guard: Manufactured, plastic covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.

1. Manufacturers:
   a. Skal Guard.
   b. Trubro, Inc.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-hanging fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

   1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture.

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

M. Install toilet seats on water closets.

N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

P. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

Q. Install traps on fixture outlets.

   1. Exception: Omit trap on fixtures with integral traps.

R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 23 for escutcheons.

S. Set bathtubs, shower receptors, and service basins in leveling bed of cement grout. Refer to Division 7 for grout.

T. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 23 for sealant and installation requirements.

U. Connect water supplies from water distribution piping to fixtures.

V. Connect drain piping from fixtures to drainage piping.

W. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

X. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

Y. Install off-floor supports affixed to building substrate and attach wall-hanging fixtures, unless otherwise indicated.

Z. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

AA. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation.

AB. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

AC. Adjust drinking fountain/water cooler flow regulators for proper flow and stream height.

AD. Install each fixture with trap, easily removable for servicing and cleaning.

AE. Install components level and plumb.

AF. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 05, color to match fixture.

3.4 APPLICATIONS

A. Drinking Fountains

1. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.
2. Use mounting frames for recessed water coolers, unless otherwise indicated.
3. Set freestanding and pedestal drinking fountains on floor.
4. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.5 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 05 00
HVAC AND PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Special Conditions, And Division 1, General Requirements, apply to the Work of this section.

1.2 SUMMARY

A. Work Included: Furnish and install a complete, fully automatic heating, ventilating and air conditioning (HVAC) system as described by the complete set of specifications and project drawings. The HVAC systems and design described in the project documents reflect a low energy building design. Any modifications to the systems described herein should be improvements on the sustainability and energy efficiency of the project, to the greatest extent possible. All design modifications that pertain to system selection, system energy efficiency and energy use, material selection and indoor air quality issues shall require the approval of Integral group.

1.3 CODES AND STANDARDS

A. All work and materials shall be in full accordance with the latest local rules and regulations, applicable sections of the California Code of Regulations, Title 24, State Fire Marshal, the Safety Orders of the Division of Industrial Safety, the California Electric Code and applicable State requirements. Nothing in these Plans and Specifications is to be construed to permit work not conforming to these requirements.

B. Wherever the Specifications call for or describe materials or construction of better quality or larger sizes than are required by the above rules and regulations, these Specifications shall govern. Should there be any direct conflict between the above rules and regulations and the specifications the rules shall govern.

C. Equipment shall have U.L. label listing.

1.4 DRAWINGS

A. Layout of the equipment and work is diagrammatic, unless specifically dimensioned. Drawings and details shall be checked for interferences before installing the work. Any interference noted between different drawings, and between drawings and actual field conditions shall be brought to the Engineer's attention for a decision. The right is reserved to make any reasonable change in location of equipment without involving additional expense to the City.

B. For purposes of clarity and legibility, drawings are diagrammatic to the extent that many offsets, bends, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Exact routing of piping and ductwork and locations of equipment shall be governed by structural conditions and obstructions. Contractor shall make use of all data in Contract Documents and field conditions.

C. In the event a major re-routing of a system appears necessary, Contractor shall prepare and submit for approval, Shop Drawings of the proposed rearrangement. Because of the diagrammatic nature and small scale of the Drawings, all necessary offsets, adjustments, and transitions required for the complete installation are not shown. Contractor shall carefully investigate the structural and finish conditions affecting all the Work and shall arrange such Work accordingly, furnishing such fittings, equipment, accessories, etc., as may be required to meet such conditions, at no increase in Contract Sum.

D. All dimensions and locations of mechanical equipment, doors, partitions, etc., are to be taken from the architectural plans but shall be verified at the site.

1.5 SUBMITTALS

A. See Section 01 33 00 - submittal procedures.

B. Submit shop drawings, a list of proposed material and equipment manufacturers and the names of Subcontractors.

C. Shop drawings shall be provided for all plumbing and mechanical systems for all floors of the building. Plumbing and mechanical shop drawings shall also be provided for the underslab systems (under the foundation slab).

D. Materials and methods with which the words "for approval" or "approved" are used, and materials and methods which differ from those specified, shall be submitted.

E. Prepare and submit shop drawings, sections, details and diagrams to minimum scale 1/4" = 1'-0". Pump rooms and mechanical rooms shall be 1/2" = 1'-0" minimum scale. Drawings shall be coordinated, dimensioned and indicate equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Include minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers, etc. Electronic submittal is encouraged.

F. Shop drawings shall be created and submitted on latest version of AutoCAD.

G. Submit manufacturer's specifications, data sheets, certified equipment drawings and installation instructions, including installation dimensions, clearances, weights, materials, finishes, color selection, accessories, acoustical characteristics, capacity and full load and part load performance curves; complete with electrical data, motor horse power, KW; motor efficiency, amperage, voltage phases and wiring diagrams. Identify the specific specification number, paragraph and equipment identification number per equipment schedule.

H. Certified Equipment Drawings (8-1/2" x 11" sheets) shall be indexed in accordance with Specification Section. Drawings to be submitted at a later date shall be marked with a page as a placeholder for insertion when submitted. The original submittal shall note which shop drawings will be submitted later. Marked-up catalogs are not acceptable and will be rejected. Electronic submittal is encouraged.

I. Electronic submittals in PDF format are required, submittal review comments will be provided in electronic format, with pertinent markups as needed. All submittals and equipment datasheets submitted to the engineer in PDF format shall be text searchable. Submittals shall be reproduced on both sides of each sheet of paper when paper submittals are required, to as great

an extent as is reasonable in order to reduce paper waste. At the discretion of the engineer, the submittals shall be provided in paper sets only.

J. All final approved submittals and equipment datasheets shall be provided, in PDF format, to the City as part of the as-built drawing set and shall be text searchable.

J. All submittals must indicate manufacturer qualifications showing company specializing in manufacturing the type of products specified, with minimum three years of documented experience.

1.6 COORDINATION DRAWINGS

A. Utilize the latest version of 3D AutoCAD, Navisworks, and/or Revit software for the coordination efforts. No proprietary software of any kind shall be used other than that indicated. Drawing paper size shall not be larger than FULL SIZED Contract documents, and in no case larger than 22” x 34”. Coordinate available space with ALL other trades involved.

B. These drawings are to show registers, grilles, diffusers, duct sizes, elevation of bottom of duct, pipe sizes, valves and accessories, elevation of bottom of pipe, all elevations of materials and/or systems throughout each floor inclusive of hanger components, seismic bracing if applicable, and any component of construction that impacts vertical and/or horizontal space. In addition, the locations of all valves, dampers, and other items requiring access for service and maintenance are to be shown. The drawings are to also show electrical, beams, architectural bracing, structural bracing, ceiling heights, access doors, walls, floor to floor dimensions, columns, doors and other major architectural and structural features as shown on the architectural and structural drawings. Where the routing of work differs from that indicated on the contract documents, such areas are to be indicated by highlighting.

C. Rerouting of any system or part thereof shall be submitted separately in order to obtain concurrence of the Architect/Engineer/City. Submitted rerouting must include fully documented proposed solutions with all trades coordinated. Contractor is fully responsible for coordination of systems included herein. Any effort by Architect/Engineer beyond answering contractor's questions will be at contractor's expense, including attending coordination meetings, review of interim plans, or review of incomplete questions (routing issues without suggested solutions).

D. The contractor and subcontractors are responsible to review and resolve any real or apparent interferences or conflicts as indicated by the coordination drawings produced by each trade.

E. After all conflicts or interferences are resolved, develop a final composite drawing showing the agreed upon routing, layout and juxtaposition of all duct work, conveyers, piping, major conduit, valves, panels, lighting fixtures and all other major mechanical and electrical installations. In the preparation of all the final Coordination Drawings, large scale details as well as cross and longitudinal sections are required to fully delineate all conditions.

F. Submit the Coordination Drawings (electronic submittal encouraged) to the design professional for review and comment, as indicated under “Shop Drawings” above.

G. No extra compensation will be paid for relocating any duct, pipe, conduit, or other material that has been installed without proper coordination between all trades involved. If any improperly coordinated work, or installed work that is not in accordance with the approved coordination

composites, or is specifically noted by the Architect/Engineer for a valid reason, necessitates additional work by the other trades, the costs of all such additional work is to be borne solely by the CONTRACTOR.

H. All changes in the scope of work due to revisions formally issued and approved are to be shown on both the individual subcontractor's Shop Drawings and the Coordination Drawings.

1.7 MATERIALS AND SUBSTITUTIONS

A. Comply with Section 01 25 00 - Substitution Procedure.

B. Shop drawings of proposed material and equipment that differ from the specified materials and equipment, shall be accompanied by drawings that define changes. These drawings shall show modifications of architectural, plumbing, electrical and mechanical work required by the proposed materials and equipment, such as relocation of flues, drains, revised electrical circuits, relocation of roof or wall penetrations, revised foundations, etc.

1.8 COORDINATION WITH OTHER WORK

A. Under the work in this Section become thoroughly familiar with the drawings for work in other Sections and adjust the work to conform with the conditions shown on these drawings to provide the best possible assembly of the combined work.

B. Obtain necessary information from the other trades regarding location of their work in order that the work in this Section may be placed in correct position.

C. The inclusion and proper location of supports, pads, sleepers, openings, anchorages, etc. provided by others is the responsibility of the Contractor under this Section. Cutting and/or boring shall be permitted under this Section only with the written approval of the Engineer.

D. It shall be the Contractor's responsibility to coordinate and have provided by other trades where not covered by the Contractor's scope of work, all electrical wiring and power to equipment, controls and devices, all plumbing and any other work from other trades as required to provide fully functioning HVAC systems per the contract documents.

1.9 MANUFACTURER'S DIRECTIONS

A. Manufacturer's directions shall be followed in cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the drawings and Specifications.

1.10 PROTECTION OF WORK

A. Until final acceptance of the work, protect materials from damage and provide adequate and proper storage facilities. Replace damaged or defective work, material, and equipment before requesting final acceptance.

1.11 WORKMANSHIP

A. Equipment and materials shall be installed in a neat and workmanlike manner. Materials and equipment not so installed shall, upon order of the Engineer, be removed and replaced in a satisfactory manner, without change in contract price.

1.12 CLOSING IN UNINSPECTED WORK

A. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested, and accepted by the Architect and the City's Engineer.

B. Any work enclosed or covered-up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair such materials as may be necessary to restore disturbed work to its original and proper condition at no extra cost to the City.

1.13 EQUIPMENT ANCHORING

A. Equipment shall be securely anchored to the building structure to prevent shifting or overturning during earthquakes.

1.14 DEFINITIONS

A. A.S.T.M. where referred to in this Specification, means the American Society for Testing Materials.

B. A.G.A. means the American Gas Association.

C. A.S.M.E. refers to the American Society of Mechanical Engineers.

D. A.S.H.R.A.E. refers to the American Society of Heating Refrigeration and Air Conditioning Engineers.

E. S.M.A.C.N.A. refers to the Sheet Metal and Air Conditioning Contractors National Association.

F. A.N.S.I. refers to the American National Standards Institute.

G. A.A.B.C. refers to the Associated Air Balance Council.

H. C.E.C. refers to the California Energy Commission.

1.15 PRELIMINARY OPERATION

A. Under this section, supervise and direct preliminary operation of systems should the City demand that any portion of the plant, apparatus, or equipment be operated previous to the final completion and acceptance of the work. Expenses will be paid by the City. Such preliminary operation or payment shall not be construed as an acceptance of the work.

1.16 CUTTING AND OPENINGS

A. Comply with Division 09 - Finishes.

1.17 "AS-BUILT" DRAWINGS

A. Comply with Section 01 78 39 - Project Record Documents.

1.18 FINAL INSPECTION

A. At the time of final inspection, a service representative shall be available to make final adjustments.

1.19 FINAL OPERATION

A. After acceptance of the installation, instruct the City's representative in operation and maintenance, for a period of three (3) working days at a time requested by the City during the first year of guarantee.

B. At the beginning of the instruction period, deliver to the City three (3) copies of a durable binder as described under "Operating Instructions". Refer to Section 01 78 39 for detailed requirements.

1.20 OPERATING INSTRUCTIONS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications. Refer to Section 01 78 39 for detailed requirements.

B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the GC for inclusion in the O&M manuals prior to the training of City personnel.

C. Provide six (6) complete sets of Operating Instructions. These instructions shall include brochures, diagrams, maintenance, and operating instructions and parts lists. See "Final Operation".

D. A summary of operating sequences (start-up, normal run, and shut-down), and control diagrams shall be provided in the main mechanical room.

E. The commissioning agent shall receive a copy of the O&M manuals for review.

1.21 TRAINING OF CITY PERSONNEL

A. The GC (General Contractor) shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:

1. Provide designated City personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, air conditioning units, air handling units, fans, boilers, terminal units, controls, water treatment systems, etc.
2. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
3. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
4. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
5. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
   a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
   b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
   c. Discussion of relevant health and safety issues and concerns.
   d. Discussion of warranties and guarantees.
   e. Common troubleshooting problems and solutions.
   f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
   g. Discussion of any peculiarities of equipment installation or operation.
   h. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.
   i. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate. A video record of the training session is suggested but not required.
8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
9. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

10. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

C. Controls Contractor. The controls contractor shall have the following training responsibilities:

1. The controls contractor shall provide designated City personnel training on the control system in this facility. The intent is to clearly and completely instruct the City on all the capabilities of the control system.
2. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays.
3. The trainings will be tailored to the needs and skill-level of the trainees.
4. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The City shall approve the instructor prior to scheduling the training.
5. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
7. Training sessions:
   a. Training I. Control System. The first training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
   b. Training II. Building Systems. The second session shall be held on-site and consist of actual hands-on training after the completion of system commissioning. The session shall include instruction on the following systems:
      1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
      2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
      3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
      4) Every screen shall be completely discussed, allowing time for questions.

5) Use of keypad or plug-in laptop computer at the zone level.
6) Use of remote access to the system via phone lines or networks.
7) Setting up and changing an air terminal unit controller.
8) Graphics generation
9) Point database entry and modifications
10) Understanding DDC field panel operating programming (when applicable)

D. TAB Contractor.The TAB contractor shall have the following training responsibilities:

1. TAB contractor shall meet with facility staff after completion of TAB and instruct them on the following:
   a. Go over the final TAB report, explaining the layout and meanings of each data type.
   b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
   c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
   d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
   e. Other salient information that may be useful for facility operations, relative to TAB.

1.22 WARRANTY

A. Comply with 01 77 00 section - Closeout procedure.

B. Equipment under this section of the specifications shall be guaranteed for a period of one year from date of acceptance against defective materials, design and workmanship.

C. Contractor shall leave entire installation in complete working order and free from defects in material, workmanship or finish.

D. The HVAC contractor, by accepting these specifications and by signing the Sub-contract, shall guarantee the following:

1. All equipment, material, and workmanship against defects in material and workmanship for a period of one (1) year from date of final acceptance by the City. The HVAC contractor shall furnish written guarantee to replace defective work and materials furnished under this Section, at no cost to the City, for this one (1) year period.

2. That equipment and material will produce the results specified.

E. The City reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.

F. Provide, at no cost to the City, one service mechanic for an 8-hour period after a period of 90 calendar days from date of acceptance of systems by Owner to repair, replace any latent deficiency.

END OF SECTION

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SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single phase electric motors.

B. Three phase electric motors.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (Reapproved 2008).

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers; 2004.

C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2011.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

E. Operation Data: Include instructions for safe operating procedures.

F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALITY ASSURANCE

A. Conform to NFPA 70.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 WARRANTY

A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Lincoln Motors: www.lincolnmotors.com.

B. A. O. Smith Electrical Products Company: www.aosmithmotors.com.

C. Reliance Electric/Rockwell Automation: www.reliance.com.

D. Baldor Electric Company

E. Siemens

F. US Motors

G. Toshiba

H. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:

1. Motors 1 HP: 208 volts, three phase, 60 Hz or per schdule; all motors called out as VFD equipped to be three phase.

B. Construction:

1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 40 degrees C environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.3 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.

2.4 **ELECTRICALLY COMMUTATED MOTORS**

A. Motor shall be brushless DC type specifically designed for fan applications with heavy duty ball bearings and electronic commutation. It shall contain internal circuitry that converts 115 volt single phase power into a DC signal. The motor shall be speed controllable down to 20% of full speed. Speed control is achieved through either a potentiometer dial mounted on the exterior of the motor housing, or a 0-10 volt control signal input through the pre wired controls wires. Motor shall be a minimum of 85% efficient at all speeds.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

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SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Equipment support bases.

B. Seismic restraints.

1.2 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2011.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2011.

C. SMACNA (SRM) - Seismic Duct Restraint Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

1.3 PERFORMANCE REQUIREMENTS

A. Equipment assemblies and equipment anchorages shall be capable of supporting combined gravity and lateral loads, and shall be positively anchored to the structure.

B. Design of equipment assemblies and equipment anchorages shall employ the following seismic design criteria:

1. Seismic Anchorage: Equipment shall be anchored or otherwise secured to the structure in conformance with section 13.6 of ASCE 7-05 (American Society of Civil Engineers) “Minimum Design Loads of Buildings and Other Structures” and the following parameters:
   a. ap = per table 13.6.1 of ASCE 7-05
   b. Rp = per table 13.6.1 of ASCE 7-05

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide schedule of vibration isolator type with location and load on each.

C. For equipment that is contractor supplied or is substituted for those that are specified, provide structural calculations for equipment anchorage to the structure, sealed and signed by a civil engineer registered in the State of California, demonstrating conformance with section 13.6 of ASCE 7-05 (American Society of Civil Engineers) “Minimum Design Loads of Buildings and Other Structures”.

D. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures.

E. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Kinetics Noise Control, Inc: www.kineticsnoise.com.

B. Mason Industries: www.mason-ind.com.

C. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

A. General:

1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.

2. Steel springs to function without undue stress or overloading.

2.3 EQUIPMENT SUPPORT BASES

A. Structural Bases:

1. Construction: Engineered, structural steel frames with welded brackets for side mounting of the isolators.

2. Frames: Square, rectangular or T-shaped.

3. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.

4. Applications: Adjustable motor slide rails for centrifugal fans.

B. Concrete Inertia Bases:

1. Construction: Engineered, steel forms, with integrated isolator brackets and anchor bolts, welded or tied reinforcing bars running both ways in a single layer.

2. Size: 6 inches minimum depth and sized to accommodate elbow supports.

3. Mass: Minimum of 1.5 times weight of isolated equipment.

4. Connecting Point: Reinforced to connect isolators and snubbers to base including template and fastening devices for equipment.

5. Concrete: Filled on site with minimum 3000 psi concrete.

2.4 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

A. Comply with:

1. ASHRAE Handbook - HVAC Applications
2. SMACNA - Seismic Duct Restraint Manual

B. Cable Restraints:

1. Wire Rope: Steel wire strand cables sized to resist seismic loads in all lateral directions.
2. Protective Thimbles: Eliminates potential for dynamic cable wear and strand breakage.
3. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
4. Connections:
   a. Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
   b. Internally brace clevis hanger bracket cross bolt to prevent deformation.
5. Vertical Suspension Rods: Attach required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Bases:

1. Set steel bases for one inch clearance between housekeeping pad and base.
2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
3. Adjust equipment level.

C. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

3.2 INSTALLATION - SEISMIC

A. Comply with:

1. ASHRAE Handbook - HVAC Applications
2. SMACNA - Seismic Duct Restraint Manual
3. 2010 California Building Code

B. Floor and Base-Mounted Equipment, Vibration Isolated Equipment and associated Vibration and Seismic Controls for Connections:

1. Provide flexible connections between equipment and interconnected piping.

2. Where concrete floor thickness is less than required for expansion anchor installation, install through bolt in lieu of expansion anchor.
3. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, install supplemental framing or blocking to transfer loads to structural elements.

C. Suspended Mechanical Equipment:

1. Provide flexible connections between equipment and interconnected piping.

D. Wall mounted Mechanical Equipment:

1. Install backing plates or blocking as required to deliver load to primary wall framing members.
2. Anchoring to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads is not permitted.

E. Piping:

1. Provide seismic bracing in accordance ASC 7.
2. Provide supports, braces, and anchors to resist gravity and seismic design forces.
3. Provide flexible connections between floor mounted equipment and suspended piping; between unbraced piping and restrained suspended items; as required for thermal movement; at building separations and seismic joints; and wherever relative differential movements could damage pipe in an earthquake.
4. Brace resiliently supported pipe with cable bracing or alternate means designed to prevent transmission of vibrations and noise to the structure.
5. Brace every run 5.0 feet or more in length with two transverse and one longitudinal bracing locations.
6. Pipes and Connections Constructed of Ductile Materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections):
   a. Provide transverse bracing at spacing not more than 40.0 feet on center.
   b. Provide longitudinal bracing at spacing not more than 80.0 feet on center.
7. Pipes and Connections Constructed of Non Ductile Materials (cast iron, no-hub, plastic or non-UL listed grooved coupling pipe):
   a. Provide transverse bracing at spacing not more than 20.0 feet on center.
   b. Provide longitudinal bracing at spacing not more than 40.0 feet on center.
8. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.

F. Ductwork:

1. Provide seismic bracing for ducts with cross sectional area greater than 6 sq ft (independent of duct contents).
2. Provide seismic bracing for all ducts containing hazardous materials.
3. Provide supports, braces, and anchors to resist gravity and seismic design forces.
4. Independently support in-line devices weighing more than 20 pounds.

5. Provide unbraced piping attached to braced in-line equipment with adequate flexibility to accommodate differential displacements.
6. Positively attach dampers, louvers, diffusers and similar appurtenances to ductwork with mechanical fasteners.

3.3 FIELD QUALITY CONTROL

A. Inspect isolated equipment after installation and submit report. Include static deflections.

B. Test isolator deflection.

C. Inspect minimum snubber clearances.

3.4 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

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SECTION 23 05 50
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Equipment installation requirements common to equipment sections.
7. Concrete bases.
8. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

   1. Finish: Polished chrome-plated.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

   2. Design Mix: 5000-psi, 28-day compressive strength.

   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

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

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

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are encouraged in mechanical rooms, along with diagonal placement and location of pump and equipment inlets and outlets, in order to minimize the number of 90 bends. Diagonal runs are discouraged in other areas, unless specifically indicated otherwise.

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

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

J. Install piping to allow application of insulation.

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

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Install steel pipe for sleeves smaller than 6 inches in diameter.

   2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Terminal Units: Tags.

B. Instrumentation: Tags.

C. Piping: Tags.

D. Pumps: Nameplates.

E. Small-sized Equipment: Tags.

F. Tanks: Nameplates.

G. Thermostats: Nameplates.

H. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
3. Seton Identification Products: www.seton.com.
4. Substitutions: See Section 01 25 00 – Substitution Procedure.
5. Letter Color: White.
6. Letter Height: 1/4 inch.
7. Background Color: Black.
8. Plastic: Conform to ASTM D709.

2.3 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Brady Corporation: www.bradycorp.com.
3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
4. Seton Identification Products: www.seton.com.
5. Substitutions: See Section 01 25 00 - Substitution Procedure.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.4 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradycorp.com.
2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
3. Seton Identification Products: www.seton.com.
4. Substitutions: See Section 01 25 00 - Substitution Procedure.

B. Color: Conform to ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

F. Color code as follows:

1. Heating, Cooling: Green with white letters.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

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SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Measuring electrical performance of HVAC equipment.

E. Setting quantitative performance of HVAC equipment.

F. Verifying that automatic control devices are functioning properly.

G. Vibration measurement of equipment operating conditions.

H. Reporting results of activities and procedures specified in this Section.

1.2 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.3 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to Engineer.
2. Submit 2 weeks prior to starting the testing, adjusting, and balancing work.
3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Engineer and other installers to sufficiently understand the design intent for each system.

4. Include at least the following in the plan:
   a. List of all air flow, water flow, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
   b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
   c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
   d. Final test report forms to be used.
   e. Detailed step-by-step procedures for TAB work for each system and issue, including:
      1) Diffuser proportioning.
      2) Total flow calculations.
      3) Rechecking.
      4) Diversity issues.
   f. Expected problems and solutions, etc.
   g. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
   h. Details of how TOTAL flow will be determined; for example:
      1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
      2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
   i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
   j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
   k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
   l. Method of checking building static and exhaust fan and/or relief damper capacity.
   m. Methods for making coil or other system plant capacity measurements, if specified.
   n. Time schedule for TAB work to be done in phases (by floor, etc.).
   o. Description of TAB work for areas to be built out later, if any.
   p. Time schedule for deferred or seasonal TAB work, if specified.
   q. False loading of systems to complete TAB work, if specified.
   r. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
   s. Interstitial cavity differential pressure measurements and calculations, if specified.
   t. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
   u. Procedures for formal progress reports, including scope and frequency.
   v. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Field Logs: Submit at least once a week to Commissioning Authority.

D. Progress Reports.

1. As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in

systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Submit to the Construction Manager within two weeks after completion of testing, adjusting, and balancing.
2. Revise TAB plan to reflect actual procedures and submit as part of final report.
3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
6. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing agent.
7. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
8. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
9. Include the following on the title page of each report:
   a. Name of Testing, Adjusting, and Balancing Agency.
   b. Address of Testing, Adjusting, and Balancing Agency.
   c. Telephone number of Testing, Adjusting, and Balancing Agency.
   d. Project name.
   e. Project location.
   f. Project Architect.
   g. Project Engineer.
   h. Project Contractor.
   i. Project altitude.
   j. Report date.
10. In addition to certified field report data, include the following:
    a. Pump curves.
    b. Fan curves.
    c. Manufacturers' test data.
    d. Field quality-control test reports prepared by system and equipment installers.
    e. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
11. Signature of testing, adjusting, and balancing Agent who certifies the report.
12. Summary of contents, including the following:
    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance
15. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
    a. Quantities of outside, supply, return, and exhaust airflows.
    b. Water and steam flow rates.
    c. Duct, outlet, and inlet sizes.
    d. Pipe and valve sizes and locations.
    e. Terminal units.
    f. Balancing stations.
16. Title 24 Acceptance Tests: Perform all functions and tests required by Title 24 acceptance tests. Identify and make any system adjustments to achieve acceptance testing objectives. Complete acceptance testing forms and submit to Engineer and General Contractor.

F. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC.

B. Certification of Testing, Adjusting, and Balancing Reports: Certify testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.

2. Certify that testing, adjusting, and balancing team complied with approved testing, adjusting, and balancing plan and procedures specified and referenced in this Specification.

C. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards or Testing, Adjusting and Balancing."

D. Instrumentation Type, Quantity and Accuracy: As described in AABC national standards.

E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.

3.2 PROJECT CONDITIONS

A. Full Owner Occupancy: The City will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the City during testing, adjusting, and balancing operations to minimize conflicts with the City's operations.

B. Partial Owner Occupancy: The City may occupy completed areas of the building before Substantial Completion. Cooperate with the City during testing, adjusting, and balancing operations to minimize conflicts with the City's operations.

3.3 COORDINATION

A. Coordinate efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. If another round of pressure testing of the raised floor assembly is required after the first testing, verify that all trades have completed their work to mitigate areas of leakage before commencing additional test.

3.4 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

3.5 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC MN-1, AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
   a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
   b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
   c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.6 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Examine the Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
3. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
4. Systems are started and operating in a safe and normal condition.
5. Temperature control systems are installed complete and operable.
6. Proper thermal overload protection is in place for electrical equipment.
7. Duct systems are clean of debris.
8. Fans are rotating correctly.
9. Fire and volume dampers are in place and open.
10. Examine equipment for installation and for properly operating safety interlocks and controls
11. Access doors are closed and duct end caps are in place.

12. Air outlets are installed and connected.
13. Duct system leakage is minimized.
14. Hydronic systems are flushed, filled, and vented.
15. Pumps are rotating correctly.
16. Proper strainer baskets are clean and in place.
17. Service and balance valves are open.
18. Examine equipment performance data, including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with design data and installed conditions.
19. Examine automatic temperature system components to verify the following:
    a. Dampers, valves, and other controlled devices operate by the intended controller.
    b. Dampers and valves are in the position indicated by the controller.
    c. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
    d. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
    e. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
    f. Sensors are located to sense only intended conditions.
    g. Sequence of operation for control modes is according to the Contract Documents.
    h. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
    i. Interlocked systems are operating.
    j. Changeover from heating to cooling mode occurs according to design values

B. Examine installed raised floor assembly prior to testing. Identify and key areas that are likely to cause excessive air leakage and report deficiencies discovered before and during performance of air leakage testing. Repeat examination prior to start of any additional pressure testing. Perform similar examination of mockup prior to start of pressure testing of mock-up.

C. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

D. Beginning of work means acceptance of existing conditions.

3.7 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
    1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

D. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so design conditions for system operations can be met

3.8 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

D. Raised floor air leakage: 0 to 8 percent of total air flow, and Category 1 leakage (not into conditioned space) 0 to 3 percent.

3.9 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the City.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.10 GENERAL PROCEDURES

A. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

B. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings

3.11 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

O. Once the first air leakage test has occurred for the raised floor system, if the resulting air leakage documented is greater than the allowable range, the TAB contractor shall perform one additional air leakage test in those zones that had failed to meet the air leakage requirement, after the subcontractors have mitigated the identified air leakage areas. This one additional test shall be included in the TAB contractor's scope of work. If additional tests are required beyond this, the TAB contractor shall perform any additional duct leakage tests at the expense of the subcontractor who bears responsibility for the mitigating the additional duct leakage in this area.

3.12 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

G. Hydronic system flows shall be balanced at the pump by setting the appropriate frequency on the Variable Frequency Drive. Under no circumstances shall it be acceptable to balance a pump or system flow by throttling or turning down an isolation valve at the pump. Hydronic system balancing shall occur with pump isolation valves at their full 100% open position.

H. Flow across control valves shall be measured by means of two sample ports (Pete's Plugs) located immediately adjacent to the inlet and outlet, respectively, of the control valve. These ports shall be used to obtain the pressure drop across the control valve at its full open position.

The control valve Cv shall then be used to calculate the flow rate through the valve. The manual shutoff valve shall be used to provide balance throttling only where necessary and required by the design, with the balanced position noted by a permanent mark spanning from the valve handle to stationary valve body.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

3.14 SCOPE

A. Test, adjust, and balance the following:

1. Plumbing Pumps
2. HVAC Pumps
3. Air Cooled Refrigerant Condensers
4. Unit Air Conditioners
5. Fans
6. Air Inlets and Outlets

3.15 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Model/Frame
2. HP/BHP
3. Phase, voltage, amperage; nameplate, actual, no load
4. RPM
5. Service factor
6. Starter size, rating, heater elements
7. Sheave Make/Size/Bore

B. Pumps:

1. Identification/number
2. Manufacturer
3. Size/model
4. Impeller

5. Service
6. Design flow rate, pressure drop, BHP
7. Actual flow rate, pressure drop, BHP
8. Discharge pressure
9. Suction pressure
10. Total operating head pressure
11. Shut off, discharge and suction pressures
12. Shut off, total head pressure

C. Air Cooled Condensers:
1. Identification/number
2. Location
3. Manufacturer
4. Model number
5. Serial number
6. Entering DB air temperature, design and actual
7. Leaving DB air temperature, design and actual
8. Number of compressors

D. Return Air/Outside Air:
1. Identification/location
2. Design air flow
3. Actual air flow
4. Design return air flow
5. Actual return air flow
6. Design outside air flow
7. Actual outside air flow
8. Return air temperature
9. Outside air temperature
10. Required mixed air temperature
11. Actual mixed air temperature
12. Design outside/return air ratio
13. Actual outside/return air ratio

E. Exhaust Fans:
1. Location
2. Manufacturer

3. Model number
4. Serial number
5. Air flow, specified and actual
6. Total static pressure (total external), specified and actual
7. Inlet pressure
8. Discharge pressure
9. Sheave Make/Size/Bore
10. Number of Belts/Make/Size
11. Fan RPM

END OF SECTION

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SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 23 21 14 - Hydronic Specialties

C. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2010.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007.

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007.

F. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2011.

G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2011.

H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2012.

I. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2012.

J. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2011be1.

K. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System); 2010.

L. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2012a.

M. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008.

N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.

O. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.6 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.

2.2 GLASS FIBER

A. Manufacturers:

1. Knauf Insulation: www.knaufusa.com.

2. Johns Manville Corporation: www.jm.com.
3. Owens Corning Corp: www.owenscorning.com.
4. Substitutions: See Section 01 25 00 Substitution Procedures.

B. Insulation: ASTM C547 and ASTM C 795; rigid molded, noncombustible.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C 795; semi-rigid, noncombustible, end grain adhered to jacket.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum service temperature: 650 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
1. Armacell International: www.armacell.com.
2. Substitutions: See Section 01 25 00 Substitution Procedures.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 3; use molded tubular material wherever possible.
1. Minimum Service Temperature: -40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

2.4 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

2.5 ACCESSORIES AND ATTACHMENTS:

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..

B. Bands: 3/4 inch wide aluminum.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

D. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

F. Apply insulation with the least number of joints practical.

G. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the least number of joints practical.

J. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

L. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

M. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

N. Exposed Piping: Locate insulation and cover seams in least visible locations.

O. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

P. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

Q. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

R. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

S. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

T. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

U. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.

V. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

W. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

END OF SECTION

SECTION 23 09 14
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Thermostats.

1.2 RELATED REQUIREMENTS

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

B. Section 23 21 14 - Hydronic Specialties.

C. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.

D. Section 26 27 26 - Wiring Devices: Elevation of exposed components.

1.3 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods for Testing Dampers for Rating; Air Movement and Control Association International, Inc.; 2007.

B. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

C. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; National Electrical Manufacturers Association; 2008.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association; 2009.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. See Section 01 33 00, for submittal procedures.

B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size,

flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

D. Design Data: Provide design data for sizing and selection of compressor.

E. Manufacturer's Instructions: Provide for all manufactured components.

F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.

G. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

H. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section I - Product Requirements, for additional provisions.

2. Extra Thermostats and Other Exposed Sensors: Two of each type.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Qualified Professional (QP) experienced in design of this Work.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years experience approved by manufacturer.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 WARRANTY

A. See Section I - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.2 THERMOSTATS

A. Electric Room Thermostats:

1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
2. Service: cooling and heating.
3. Covers: Locking with set point adjustment, with thermometer.
4. Product:
   a. Substitutions: See Section 01 25 00 - Substitution Procedure.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

A. General
   1. Install in accordance with manufacturer's instructions.
   2. Install sensors according to manufacturer's recommendations.
   3. Mount sensors rigidly and adequately for operating environment.
   4. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
   5. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.

B. Room Instrument Mounting. (where specified)
   1. Room instruments, including but not limited to wall mounted thermostats and sensors located in occupied spaces shall be mounted 135cm above the finished floor unless otherwise shown. Drawing notes take precedence to this height requirement.

END OF SECTION

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SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.

B. Radiant heating piping system.

1. Radiant in-slab piping system.
2. Pipe hangers and supports.
3. Unions, flanges, mechanical couplings, and dielectric connections.

C. Valves:

1. Butterfly valves.

1.2 RELATED REQUIREMENTS

A. Section 08 31 00 - Access Doors and Panels.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 23 05 53 - Identification for HVAC Piping and Equipment.

D. Section 23 07 19 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012 (ANSI B16.18).

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; 2001 (R2010).

C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2010.

D. ASME B31.9 - Building Services Piping; 2011 (ANSI/ASME B31.9).

E. ASTM B32 - Standard Specification for Solder Metal; 2008.

F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2005 (Reapproved 2011).

H. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2010.

I. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011.

J. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007.

K. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; 2011 and errata.

L. AWWA C606 - Grooved and Shouldered Joints; 2011 (ANSI/AWWA C606).

M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

N. Circuit setter balancing valves shall not be used unless indicated otherwise.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Provide pressure drop information for all valves, including flow and pressure drop curves.

C. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

D. Radiant In-slab System Product Data: Radiant heating piping specialties, including rated capacities and water flow and pressure drops of selected models.

E. Radiant In-slab System Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies and their attachments to the building structure.

F. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.
2. Indicate valve data and ratings.

G. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

H. Field quality-control test reports.

I. Project Record Documents: Record actual locations of valves.

J. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

L. Country of origin of material.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 5 years of experience.

C. Radiant installer shall have successfully completed three projects of similar size and system type in the past five years.

D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

E. The contractor performing the radiant system installation shall be a direct sub of the general contractor and not the sub of any other trade's installing contractor for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation. Replace caps on pipe ends after installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

E. Do not store pipe on ground or floor. Provide dunage for support during storage at shop, during delivery and at site.

1.7 COORDINATION

A. Coordinate pipe sleeve installations for foundation wall penetrations.

B. Coordinate piping installation with equipment supports.

C. Coordinate pipe fitting pressure classes with products specified in related Sections.

D. Radiant system:

1. Coordinate layout and installation of radiant heating piping and suspension system with building and structural components.
2. Coordinate size and location of access panels to allow access to manifolds concealed in ceilings, walls, and floors.
3. Coordinate thickening of slabs where required for adequate encasement of radiant heating piping components.
4. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Engineer.

1.8 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
4. Pipe elbows shall be long radius (1.5 diameter fittings).

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

2.2 HEATING WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
   a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   b. Braze: AWS A5.8/A5.8M BCuP copper/silver alloy.
2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.

2.3 **IN-SLAB RADIANT HEATING/COOLING SYSTEM**

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B) annealed.

1. Fittings: ASME B16.22, wrought copper. Pipe elbows shall be long radius (1.5 diameter fittings).
2. Joints: Solder, lead free, ASTM B32, HB alloy (95-5 tin-antimony), or tin and silver.

B. Manufacturers:

1. Uponor
2. Viego
3. Zern

4. Rehau

C. Tubing

1. Material: Crosslinked polyethylene (PEX)
2. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third-party agency.
3. Pressure Ratings:Standard Grade hydrostatic design and pressure ratings as issued by the Plastics Pipe Institute (PPI), a division of the Society of the Plastics Industry (SPI).
   a. 1) 200 F at 100 psi, 180 F at 125 psi, 140 F at 160 psi, 73 F at 200 psi
4. Minimum Bend Radius (Cold Bending): No less than six times the outside diameter. Use the PEX tubing manufacturer's bend supports if radius is less than stated.
5. Non-barrier tubing type
   a. PEX tubing that does not feature an oxygen diffusion barrier
6. Barrier Tubing Type: Aluminum tube laminated between two layers of cross-linked polyethylene.
   a. Aluminum tube laminated between two layers of PEX.
   b. Tubing with an oxygen diffusion barrier does not exceed an oxygen diffusion rate of 0.10 grams per cubic meter per day at 104 degrees F (40 degrees C) water temperature in accordance with German DIN 4726.
7. A oxygen diffusion barrier tubing is not required if one of the following dsign strategies is used:
   a. Isolate the ferrous materials in the boiler and other components within the primary side of the mechanical system with a heat exchanger
      1) use non-ferrous components within the secondary system side (e.g., pumps, expansion tanks, etc.).
   b. Use non-ferrous components within the entire fluid pathway

D. Manifolds

1. Use 2-inch valved copper manifolds offered by the respective PEX tubing manufactuer from Type L copper.
2. Use manifold mounting brackets offered by the respective PEX tubing manufactuer.
3. Manifolds must provdie individual flow control for each loop of the manifold through valve actuators available from the manifold supplier.
4. Manifolds must feature manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold.
5. Supply manifold with integral flow meters for each tubing loop.
6. Use manifolds with an isolation valve or a combination isolation and balancing valve on each outlet.
7. Install Pete's Ports on manifold piping on both return and supply lines, as well as on both sides of the control valve.
8. Use manifolds that support 5/8 inch or 3/4 inch PEX tubing.
9. Ensure manifold end cap offers tapping for 1/8 inch FNPT and 1/2 inch FNPT for vent and drain.

10. Each manifold location shall have the ability to vent air manually from the system.

E. Fittings

1. Use fittings offered by the PEX tubing manufacturer.
2. Fittings must comply with ASTM F877 and CAN/CSA B137.5 requirements.
3. Use Uponor QS20 compression fittings or Uponor ProPEX fittings as applicable.

F. Pressure Drop

1. Pressure drop through in-slab radiant tubing and manifold, including integrated flow meters and isolation valves, shall be no more than 10 feet of water column.

G. EXECUTION

1. Fasten the tubing to the flat mesh or reinforcing bar in accordance with drawings details.
2. Protect installed work from damage caused by subsequent construction activity on the site.
3. Install in-slab tubing at depth specified by mechanica drawings.
4. Where tubing exits the slab, use metal or plastic bend supports.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

C. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

D. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

H. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

I. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

J. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

K. Vertical Support: Steel riser clamp.

L. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

M. Floor Support for Hot P ipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

O. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

P. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

Q. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

R. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.5 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.
2. Mechanical Couplings: Comply with ASTM F1476.
3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections: Red brass dielectric nipple.

2.6 BUTTERFLY VALVES

A. Manufacturers:

1. Tyco Flow Control: www.tycoflowcontrol.com.
2. Hammond Valve: www.hammondvalve.com.
3. Crane Co.: www.cranevalve.com.

4. Milwaukee Valve Company: www.milwaukeevalve.com.
5. Victaulic Company: www.victaulic.com.
6. Substitutions: See Section 01 60 00 - Product Requirements.
7. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.

C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM enscapsulation, or Buna-N enscapsulation.

D. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

E. Disc: Aluminum bronze.

F. Operator: Infinite position lever handle with memory stop.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Pipe elbows shall be long radius (1.5 diameter fittings).

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Slope piping and arrange to drain at low points.

G. Pipe Hangers and Supports:

1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

2. Place hangers within 12 inches of each horizontal elbow.
3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Radiant PEX in-slab Piping Installation:

1. Install piping downstream from manifolds without joints.
2. Secure piping in concrete floors by attaching pipes to concrete reinforcement using plastic tie straps.
   a. 1.Install a sleeve of foam-type insulation around tubing and extending for a minimum of 3 inches on each side of the slab penetration to protect the tubing passing through expansion joints.
3. Install heat-emission plates on underside of wood subfloor with space between each plate for plate expansion.
4. Coordinate location of access doors on Drawings. Access panels are specified in Division 8 Section "Access Doors and Frames."
5. Install manifolds in accessible locations.

I. Hydronic Specialties:

1. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
2. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.

J. Fusion Welding of Polypropylene Joints

1. Install fittings and joints using socket-fusion, elecrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer's specifications and product standards.
2. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.
3. Prior to joining, the pipe and fittings shall be prepared in accordance with F 2389 and the manufacturer's specifications.
4. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

K. Polypropylene Installation

1. Fire stopping shall be provided to both be compatible with the Aquatherm Piping and meet the requirements of ASTM E 814 or ULC S115, "Fire Tests of Through-Penetration Firestops". Pipe insulations or fire resistive coating shall be removed where the pipe passes through a fire stop and, if required by the firestop manufacturer, for 3 inches beyond the firestop outside of the fire barrier.

2. When installed in systems with pumps in excess of 7.5 HP, piping shall be protected from excessive heat generated by operating the pump at shut-off conditions. Where the possibility exists that the pump will operate with no flow, the protection method shall be a temperature relief valve or comparable level of protection, set to a maximum temperature of 185°F.
3. If heat tracing is specified for the piping, it should be installed on the pipe interior or exterior, and it must be suitable for use with plastic piping and self-regulating to ensure the surface temperature of the pipe and fittings will not exceed 70°C (158°F).

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

B. Prepare hydronic piping and perform testing according to ASME B31.9. Prepare written report of testing.

3.4 RADIANT IN-SLAB SYSTEM FIELD QUALITY CONTROL

A. Test Preparation:

1. Temporarily restrain expansion joints so they are not damaged due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
2. Flush with clean water, and clean strainers.
3. Install relief valve set at a pressure no more than one-third higher than test pressure.

B. Tests:

1. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig.
2. After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
3. Pipe pressure shall maintain its test pressure for a period of no less than 24 hours before testing can be terminated as successful.
4. Prepare a written report of testing.

3.5 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.

4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

3.6 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION

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SECTION 23 21 14
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air vents.

B. Suction diffusers.

C. Relief valves.

1.2 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping.

1.3 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 AIR VENTS

A. Manufacturers:

1. ITT Bell & Gossett: www.bellgossett.com.
2. Taco, Inc: www.taco-hvac.com.
3. Substitutions: See Section 01 25 00 – Substitution Procedures.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

2.2 SUCTION DIFFUSERS

A. Suction diffuser shall not be used unless otherwise noted, or with the expressed written consent of the engineer.

2.3 RELIEF VALVES

A. Manufacturers:

1. ITT Bell & Gossett: www.bellgossett.com.
2. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.

C. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Strainers.

F. Flexible connections.

1.2 RELATED REQUIREMENTS

A. Section 23 07 19 - HVAC Piping Insulation.

B. Section 23 62 13 - Packaged Air-Cooled Refrigerant Compressor and Condenser Units.

1.3 REFERENCE STANDARDS

A. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010.

B. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2010.

C. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes; The American Society of Mechanical Engineers; 2011.

D. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers; 2010.

E. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2011 (ANSI/ASME B31.9).

F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2005 (Reapproved 2011).

H. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2008.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2010.

J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

K. UL 429 - Electrically Operated Valves; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.

D. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.

E. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

F. Submit welders certification of compliance with ASME (BPV IX).

G. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

H. Maintenance Data: Include instructions for operation, changing cartridges, assembly views, spare parts lists.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 PIPING

A. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.

1. Fittings: ASME B16.26 cast copper.
2. Joints: Flared.

B. Pipe Supports and Anchors:

1. Provide hangers and supports that comply with MSS SP-58.
   a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
5. Vertical Support: Steel riser clamp.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
8. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.2 REFRIGERANT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
2. DuPont Company; Fluorochemicals Div.
3. Elf Atochem North America, Inc.; Fluorocarbon Div.
4. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.
5. Or equal.

B. Refrigerant: R-410a only as defined in ASHRAE Std 34.

2.3 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.4 VALVES

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com.
2. Henry Technologies: www.henrytech.com.
3. Danfoss Flomatic: www.flomatic.com.
4. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Packed Angle Valves:

1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

D. Ball Valves:

1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.5 STRAINERS

A. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk.
2. Flexicraft Industries: www.flexicraft.com.
3. Penflex: www.penflex.com.
4. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.

3.3 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test to no leakage.

C. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.

D. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.

1. System shall maintain test pressure at the manifold gage throughout duration of test.
2. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
3. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
4. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.4 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter-dryer after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.

4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials.

B. Duct cleaning.

C. Hangers and Supports

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 09 91 00 - Painting: Weld priming, weather resistant, paint or coating.

C. Section 11 31 00 - Residential Appliances

D. Section 23 33 00 - Air Duct Accessories.

E. Section 23 37 00 - Air Outlets and Inlets.

F. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2009.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications; 2012.

D. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes; 2010.

E. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2012.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.

H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2012

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength; 2012a

J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.

L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.

M. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2012.

N. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.

O. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2012.

P. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2012.

Q. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.

R. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.

S. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association; 2011.

T. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

U. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

V. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

W. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication & Installation Guidelines; 2001.

X. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

Y. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.

Z. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

AA. Duct system has been design for low friction drop, both through straight duct and through fittings. Fitting type may be substituted only for fittings of equal to or lesser pressure drop, with written permission from engineer.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.7 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

C. Ductwork shall be transported to the site in enclosed vehicles or with ends capped with Visqueen or foam caps.

D. Do not store ductwork directly on ground or floor.

E. Ductwork stored or stacked on site shall be capped.

F. Installed duct shall be capped at the end of the day. Duct found uncapped shall be cleaned.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

1. Ducts shall have mill-phosphatized finish for surfaces exposed to view

B. Flexible Ducts:

1. UL Labeled, black polymer film supported by helically wound spring steel wire.
   a. Pressure Rating: 4 inches WG positive and 0.5 inches WG negative.
   b. Maximum Velocity: 4000 fpm.

c. Temperature Range: -20 degrees F to 175 degrees F.

C. Un-Galvanized Steel for Ducts: ASTM A 1008/A 1008M, Designation CS, cold-rolled commercial steel.

D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
2. VOC Content: Not more than 250 g/L, excluding water.
3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
4. For Use With Flexible Ducts: UL labeled.
5. Products:
   a. Carlisle HVAC Products; Hardcast Iron-Grip 601 Water Based Duct Sealant: www.carlislehvac.com.
   b. Substitutions: See Section 01 60 00 - Product Requirements.

E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

F. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
6. Other Types: As required.
7. Manufacturers:
   a. Powers Fasteners, Inc: www.powers.com.
   b. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MANUFACTURED DUCTWORK AND FITTINGS

A. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.

1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
2. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
3. Maximum Velocity: 4000 fpm.
4. Temperature Range: -10 degrees F to 160 degrees F.
5. Manufacturers:
   a. Hart & Cooley, Inc: www.hartandcooley.com.
   b. Substitutions: See Section 01 25 00 - Substitution Procedures.

B. Kitchen Cooking Hood Exhaust: Nominal 3 inches thick ceramic fiber insulation between 20 gage, 304 stainless steel liner and 24 gage, aluminized steel outer jacket.

1. Tested and UL listed for use with commercial cooking equipment in accordance with NFPA 96.

2. Certified for zero clearance to combustible material in accordance with:
   a. UL 2221 with a 2 hour rating.

3. Materials and construction of the modular sections and accessories to be in accordance with the terms of the following listings:
   a. UL 1978.
   b. UL 2221.

4. Manufacturers:
   a. AMPCO: www.ampcostacks.com.
   b. Selkirk: www.selkirkcommercial.com.
   c. Metalfab.
   d. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.3 HANGERS AND SUPPORTS

A. Verify all duct and hanger attachments with structural engineer.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Materials: Galvanized sheet steel or threaded steel rod.

D. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

E. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.

B. Install in accordance with manufacturer's instructions.

C. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

D. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

E. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

G. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

H. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

I. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

J. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

K. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

L. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

M. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

N. Flexible Ducts: Connect to metal ducts with adhesive.

O. Kitchen Hood Exhaust: Provide residue traps at base of vertical risers with provisions for clean out.

P. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

Q. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

R. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

S. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

T. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

U. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

V. Install ducts with fewest possible joints.

W. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

X. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

Y. Use double nuts and lock washers on threaded rod supports.

Z. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.

AA. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

AB. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.

AC. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

AD. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

AE. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

AF. Protect ductwork during construction against entry of foreign matter and construction dirt.

AG. Keep ductwork capped when work is complete for the day or when the certain main or trunk line is not being worked on or added to. The use of polyvinyl with ductape wrap is an adequate measure as long as it is secure with no openings or tears in the product.

AH. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

AI. Seal ducts before external insulation is applied.

3.2 HANGERS AND SUPPORTS

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.3 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Remove dirt and foreign matter from entire duct system and clean diffusers, registers and grilles before operating fans.

3.4 **DUCT AIR LEAKAGE TEST**

A. Risers and all supply and exhaust branch ducting shall be tested to within 5 feet of a diffuser collar or the point of connection to an exhaust device, respectively. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.

4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.5 SCHEDULES

Type	Material	Pressure Class	Air Leakage Requirements
Supply Risers/Mains	Galvanized	3" w.g.	
Exhaust Riser/Mains (Genera Exhaust)	Galvanized	3" w.g.	
Low pressure supply (heating systems)	Galvanized	1/2" w.g.	
Low pressure supply (cooling systems)	Galvanized	2" w.g.	
Supply (before terminals)	Galvanized	2" w.g.	
Return and relief	Galvanized	3" w.g.	
General Exhaust	Galvanized	1/2" w.g.	
Kitchen cooking hood exhaust	Galvanized	1/2" w.g.	
Outside air intake	Galvanized	1/2" w.g.	

END OF SECTION

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SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backdraft dampers - metal.

B. Duct access doors.

C. Flexible duct connections.

1.2 RELATED REQUIREMENTS

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

B. Section 23 31 00 - HVAC Ducts and Casings.

1.3 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.

B. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 BACKDRAFT DAMPERS - METAL

2.2 BACKDRAFT DAMPERS - FABRIC

A. Fabric Backdraft Dampers: Factory-fabricated, 18 gage, galvanized steel frame.

1. Blades: Neoprene coated fabric material.
2. Birdscreen: 1/2 inch nominal mesh of galvanized steel or aluminum.
3. Maximum Velocity: 1000 fpm (5 m/sec) face velocity.

2.3 DUCT ACCESS DOORS

2.4 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. Noninsulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

D. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
   a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 3 inches wide, 24 gage thick galvanized steel.

E. Maximum Installed Length: 14 inch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 23 31 00 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, turning vanes and elsewhere as indicated. Provide duct access doors t Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

E. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

END OF SECTION

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SECTION 23 34 16
CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Inline centrifugal fans.

B. Fan accessories.

1.2 RELATED REQUIREMENTS

A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.

1.3 REFERENCE STANDARDS

A. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 2007 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).

B. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2011.

C. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

1.4 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1. Motors shall be NEMA premium efficiency at a minimum.

C. Performance Base: Sea level conditions.

D. Temperature Limit: Maximum 300 degrees F.

E. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

1.5 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

1. Fan operating efficiency.
2. Motor ratings and electrical characteristics, plus motor and electrical accessories.
3. Material gages and finishes, including color charts.
4. Dampers, including housings, linkages, and operators

C. Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

1. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   a. Wiring Diagrams: Power, signal, and control wiring.
   b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

D. Manufacturer's Instructions: Include complete installation instructions.

E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.7 FIELD CONDITIONS

A. Permanent fans may not be used for ventilation during construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Panasonic

B. Broan

C. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 ACCESSORIES

A. Access Doors: Shaped to conform to scroll, with quick opening latches and gaskets.

2.3 CEILING MOUNTED EXHAUST FANS WITH INTEGRAL GRILLE

A. Fan shall be EnergyStar rated.

B. Fan motor shall be totally enclosed, four pole condenser type engineered to run continuously.

C. Fan shall be UL listed for installation in a tub/shower enclosure when used with GFCI branch circuit wiring.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install flexible connections between fan inlet and discharge ductwork; refer to Section 23 33 00. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Provide backdraft dampers on discharge of exhaust fans and as indicated; refer to Section 23 33 00.

D. Install units with clearances for service and maintenance.

END OF SECTION

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

C. Louvers.

1.2 RELATED REQUIREMENTS

A. Section 09 91 00 - Painting: Painting of ducts visible behind outlets and inlets.

1.3 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2012.

B. ASHRAE Std 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006.

C. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

1.4 SUBMITTALS

A. See Section 01 33 00 for submittal procedures.

B. Product Data: Provide data for equipment required for this project, including materials of construction, finish, accessories furnished and mounting details. Provide performance data including throw and drop, static-pressure drop, and noise ratings. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Titus: www.titus-hvac.com.

B. Ruskin: www.ruskin.com.

C. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, single deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

E. Damper Type: None.

2.3 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel frames and blades, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

E. Damper: None.

2.4 LOUVERS

A. Fabrication: 16 gage thick galvanized steel welded assembly, with factory prime coat finish.

B. Refer to mechanical schedules for requirements.

C. Color: To be selected by Architect from manufacturer's standard range.

D. Mounting: Furnish with interior flat flange for installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 91 00.

E. Install diffusers, registers, and grilles level and plumb.

F. Install diffusers, registers, and grilles to ducts to allow service and maintenance of dampers, air extractors, and fire dampers.

G. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

H. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

I. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 7 Section "Joint Sealants" for sealants applied during installation.

J. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

K. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

END OF SECTION

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SECTION 23 81 27
SMALL SPLIT-SYSTEM HEATING AND COOLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air-source heat pumps.

B. Air cooled condensing units.

C. Indoor ductless fan & coil units.

D. Controls.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Mounting pad for outdoor unit.

B. Section 22 10 05 - Plumbing Piping: Indoor coil condensate drain.

C. Section 23 31 00 - HVAC Ducts and Casings.

D. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats, time clocks.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; Air-Conditioning, Heating, and Refrigeration Institute; 2004.

C. ASHRAE Std 23.1 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010.

D. ASHRAE Std 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2007.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.

1.4 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in City s name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mitsubishi.

B. Aermec.

C. Substitutions: See Section 01 25 00 – Substitution Procedures.

2.2 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.

1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator.

2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.

1. Efficiency: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1 and scheduled data; seasonal efficiency to ASHRAE Std 103 and scheduled data.

2.3 INDOOR UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

   1. Construction and Ratings: In accordance with AHRI 210/240 and UL listed.

   2. Manufacturer: System manufacturer.

2.4 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

   1. Comply with AHRI 210.

   2. Refrigerant: R-410A.

   3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL listed.

B. Air Cooled Condenser: ARI 520; Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).

   1. Provide thermostatic expansion valves.

D. Operating Controls:

   1. Control by room thermostat to maintain room temperature setting.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 3. Coordinate anchor installation with concrete base.

D. Install in accordance with NFPA 90A and NFPA 90B.

END OF SECTION

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SECTION 260500

GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete the work shown on the drawings and/or specified in all Sections of Division 26 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete and fully operating facility. The work shall include but not be limited to the following:
   1. Furnish and install all required in-place equipment, conduits, conductors, cables and any miscellaneous materials for the satisfactory interconnection and operation of all associated electrical systems.

1.02 RELATED WORK

A. This Section provides the basic Electrical Requirements which supplement the General Requirements of Division 01 and apply to all Sections of Division 26.

1.03 STANDARDS AND CODES

A. All work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. American National Standards Institute (ANSI) Publications:
      a. C2-02 National Electrical Safety Code
   3. Code of Federal Regulations (CFR):
      a. 29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)
   4. Electronics Industries Association (EIA)
   5. Institute of Electrical and Electronics Engineers (IEEE)
   6. National Electrical Testing Association (NETA):
      a. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, Standard ATS
   7. National Electrical Manufacturers Association (NEMA)
   8. Occupational Safety and Health Act (OSHA) Standards
   9. State of California Public Utilities Commission:
      a. General Order 128 Rules for Construction of Underground Electric Supply and Communication Systems

B. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.

C. Underwriter Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, may be substituted for UL labeling and listing if acceptable to the Owner. Provide service entrance labels for all equipment required by the NEC to have such labels.

1.04 SUBMITTALS

A. As specified in Division 01. Submit to the Engineer shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system specified. Obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review.

B. Submittals are required for all items, regardless of whether they are furnished as specified or are substituted.

C. Information to be submitted includes manufacturer's name, trade name, equipment model number, nameplate data, equipment drawings including: size, layout dimensions and capacity, manufacturer's descriptive literature of cataloged products, diagrams, seismic calculations, test data, and performance and characteristic curves as applicable. Furnish project specification and paragraph reference, applicable Federal, Industry and Technical Society Publication References, and years of satisfactory service of each item required to establish contract compliance. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval.

D. If submittal information includes multiple products, items being submitted for approval shall be clearly identified and Items not to be used on the project shall be clearly marked out.

E. Organize submittals for equipment and items related to each specification section together as a package.

F. Submit submittal packages in digital form (PDF files or similar).
   1. Refer to specification section 01 33 00 for additional information.

G. Substitutions:
   1. Refer to specification section 01 25 00 for additional information.

H. Closeout Submittals:
   1. Refer to specification section 01 77 00 for additional information.
   2. Cost analysis: Submit final cost information including original bid and any change orders broken down by system, material and labor costs (as applicable):
      a. Power distribution
      b. Lighting and lighting controls
      c. Photovoltaic system
      d. Emergency generator system
   3. Operation and Maintenance Manuals: Furnish O & M Manuals for equipment where manuals are specified in the equipment specifications or are specified in Division 01. Electrical O & M Manuals shall include as a minimum:
      a. Copies of equipment supplied on the project.
      b. Instruction manuals including operation instructions and maintenance requirements/recommendations.
      c. List of suppliers for all equipment with addresses and telephone numbers.
      d. List of service support for all equipment with addresses and telephone numbers.
      e. Copies of all test reports required in Division 26 specification sections.
      f. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.
      g. Other closeout documentation and test results as required under other sections of the specifications.

h. Provide in a single transmittal.
i. Warranty for all work, including contractor's general warranty.
j. All warranties begin as per the Contract, Division 01 or final acceptance of the Work by the Owner, Architect, Engineer, and Authority Having Jurisdiction, which ever is later.
   i. Lamps and ballasts are to be covered as per specification 26 50 00.
   ii. Manufacturer's Warrantees and Guarantees that are longer than the base contract/specified amount are to be provided with the manuals.
   iii. The Contractor is responsible for all Warranty and Guarantee work whether or not the Manufacturer also Warrantees and Guarantees the product.

1.05 CONTRACT DOCUMENTS

A. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations.
   1. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.
   2. All drawings and divisions of these specifications shall be considered as whole. This contractor shall report any apparent discrepancies prior to submitting bids.
   3. Should there be a conflict or discrepancy between the drawings and specifications, or between different drawings sheets, or between different specification sections, the most expensive option shall be required, at the discretion of the Engineer.

B. Drawings:
   1. The Drawings shall govern the general layout of the completed construction:
      a. Locations of equipment, inserts, anchors, panels, pullboxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, lighting fixtures and ground connections are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
      b. The general arrangement and location of existing conduits, piping, apparatus, etc., is shown as existing on drawings or specified. The drawings and specifications are for the assistance and guidance of the contractor, exact locations, distances and elevations are governed by actual field conditions. Extreme accuracy of data given herein and on the drawings is not guaranteed. Minor changes may be necessary to accommodate work. The contractor is responsible for verifying existing conditions. Should it be necessary to deviate from the design due to interference with existing conditions or work in progress, claims for additional compensation shall be limited to those for work required by unforeseen conditions as determined by the Engineer.

1.06 COORDINATION

A. Coordinate the electrical work with the other trades, code authorities, utilities and the Engineer:
   1. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.
   2. Coordinate does not mean to only send a Request For Information. Coordinate implies that the contractor is to take the lead in bringing all of the necessary organizations together to coordinate the work and to provide for the associated costs.

B. Where connections must be made to existing installations, properly schedule all the required work, including the power shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the Owner's facilities:

1. Include costs for work during non-normal working hours and temporary facilities as may be required.
2. Include costs as necessary for sub-contractors as necessary to accomplish the specified work.

C. When two trades join together in an area, make certain that no electrical work is omitted. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.

D. Operations:
1. Perform all work in compliance with Division 01:
   a. Keep the number and duration of power shutdown periods to a minimum.
   b. Show all proposed shutdowns and their expected duration on the construction schedule.
      i. If the construction schedule is created and maintained by others, make sure that the associated information is incorporated.
      ii. Failure by the Contractor to properly schedule and plan for such activities is not a basis for additional compensation.
   c. Carry out shutdown only after the Engineer has favorably reviewed the schedule. Submit power/communications interruption schedule 15 days prior to date of interruption. Failure to provide schedule with adequate review time may result in rescheduling of the work at the Contractor's expense.

E. Construction Power:
1. See Division 01 Temporary Utilities.

F. Storage:
1. Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from sun, weather, condensation, dust, water, or construction operations.

G. Damaged Products:
1. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain approval from the Engineer before making repairs to damaged products.

H. Order material in such a timely manner and after approval of the same so as to insure that the approved material is available to be installed on site in a timely manner. Additional costs or substitutions necessitated because the Contractor failed to order material in a timely manner are not reimbursable. Costs associated with processing of paperwork by the owner and design consultants resultant of such failures to coordinate the work by the Contractor shall have such costs reimbursed by the Contractor.

1.07 LOCATIONS

A. General: Use equipment, materials and wiring methods suitable for the types of locations in which they are located.
1. Dry Locations:
   a. All those indoor areas which do not fall within the definition below for Wet Locations and which are not otherwise designated on the Drawings.
2. Wet Locations:
   a. All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.

1.08 SAFETY AND INDEMNITY

A. Lock out Requirements:
   1. Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147

B. The Contractor is solely and completely responsible for conditions of the job site including safety of all persons and properly during performance of the work. This requirement will apply continually and not be limited to normal working hours.
   1. No act, service, drawing review or construction review by the Owner, the Engineer or their Consultants is intended to include reviews of the adequacy of the Contractors safety measures in or near the construction site.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY

A. Material and Equipment: Provide materials and equipment that are new and are current products of manufacturers regularly engaged in the production of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period includes use of equipment and materials of similar size under similar circumstances. For uniformity, only one manufacturer will be accepted for each type of product.

B. Service Support: Submit a certified list of qualified permanent service organizations including their addresses and qualification for support of the equipment. These service organizations shall be convenient to the equipment installation and able to render service to the equipment on a regular and emergency basis during the warranty period of the contract.

C. Manufacturer's Recommendations: Where installation procedures are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendation shall be cause for rejection of the equipment or material.

2.02 NAMEPLATES

A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings, the model designation, and shop order number.

B. Additionally, identify each piece of equipment and related controls with a rigid laminated engraved plastic nameplate. Unless otherwise noted, nameplates shall be melamine plastic 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches unless otherwise noted. Where not otherwise specified, lettering shall be a minimum of 0.25 inch high normal block style. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscriptions are indicated on the Drawings, furnish

nameplates with appropriate inscriptions furnished by the Engineer upon prior request by the Contractor.

C. Each control device, including push buttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

2.03 FASTENERS

A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel.

2.04 FINISH REQUIREMENTS

A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.

B. In finished areas, paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ensure that all equipment and materials fit properly in their installation.

B. Perform any required work to correct improperly fit installation at no additional expense to the owner.

C. Equipment Installation:
1. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
2. In all rooms with concrete floors, install all floor mounted equipment on reinforced concrete pads as shown. Insure that pads are seismically secured to the building structure. The Contractor, suppliers, and fabricators shall take this requirement into consideration when designing, fabricating, and installing panels and other enclosures so that height above the floor of the operating handles of electrical devices meets the requirements of these Specifications and applicable codes.
3. Mount all metal panels which are mounted on or abutting concrete walls or any outside walls ¼ inch from the wall, and paint the back sides of the panels with Mobil Hi-Build Bituminous Coating 35-J-10, Kopper Bitumastic Super Tank Solution, or equal. Film thickness shall be 10 mils minimum.

D. Cutting, Drilling and Welding:
1. Provide the required cutting, drilling and welding that are required for the electrical construction work. Comply with Division 01 requirements.
2. Structural members shall not be cut or drilled, except after approval by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.

3. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel. Where welding is required, it shall be accomplished by tradesmen certified to do such work. Provide fire and other protection as appropriate.

3.02 FIELD TESTS

A. Test shall be in accordance with Acceptance Testing specifications issued by the National Electrical Testing Association (NETA).

B. Perform equipment field tests and adjustments. Properly calibrate, adjust and operationally check all circuits and components, and demonstrate as ready for service. Perform each operational check three times to ensure the circuit and components are working properly. Make additional calibration and adjustments if it is determined later that the initial adjustments are not satisfactory for proper performance. Perform equipment field test for equipment where equipment field tests are specified in the equipment Specifications. Give sufficient notice to the Engineer prior to any test so that the tests may be witnessed.

C. Provide instruments, other equipment, temporary facilities as may be necessary, and material required for the tests. These shall be of the type designed for the type of tests to be performed and shall be calibrated by a recognized testing laboratory within three months prior to testing.

D. Operational Tests: Operationally test all circuits to demonstrate that the circuits and equipment have been properly installed and adjusted and are ready for full-time service. Demonstrate the proper functioning of circuits in all modes of operation, including alarm conditions.

E. Re-testing will be required for all unsatisfactory tests after the equipment or system has been repaired. Re-test all related equipment and systems if required by the Engineer. Repair and re-test equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.

F. Perform calibration and adjustment on all equipment. Where the values for adjustment are not shown on the Drawings, obtain the proper values from the Engineer.

G. Maintain records of each test and submit five copies to the Engineer when testing is complete. All tests shall be witnessed by the Engineer. These records shall include:
   1. Name of equipment tested.
   2. Date of report.
   3. Date of test.
   4. Description of test setup.
   5. Identification and rating of test equipment.
   6. Test results and data.
   7. Name of person performing test.
   8. Owner or Engineer's initials.

H. Items requiring testing as a minimum:
   1. Ground field grid.
   2. Circuit Breakers.

3.03 PAINTING OF EQUIPMENT

A. Factory Applied: Electrical equipment shall have factory applied painting system which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical section.

B. Field Applied: Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.04 SIGNAGE

A. Nameplate Mounting:
   1. Provide number, location and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws or two rivets.

B. Warning Sign Mounting:
   1. Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.
   2. All enclosures of all types containing equipment or components functioning in excess of 600 volts AC shall have labels reading "Danger – Voltage In Excess OF 600 Volts" on enameled signs with 3" minimum lettering on all accessible sides of said equipment or components.
   3. All enclosures or assemblies containing equipment or components functioning with a nominal available current in excess of 1000 VA DC shall have labels reading "Danger – High DC Currents" on enameled signs with 3" minimum lettering on all accessible sides of said equipment or components.

3.05 "AS-BUILT" DRAWINGS
   1. Comply with Section 01 78 39 - Project Record Documents.

3.06 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
   1. Single line diagrams, wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment at each major piece of distribution equipment.
   2. Start up, proper adjustments, operating, lubrication and shutdown procedures.
   3. Safety precautions.
   4. The procedure in the event of equipment failure.
   5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

3.07 INSTRUCTION TO OWNER'S PERSONNEL

A. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or systems has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-

days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall maintain an attendance sheet from each session which contains the following information:
   1. Attendees with associated arrival and departure time.
   2. Topics covered.
   3. Information provided.
   4. Signatures of attendees taken at the completion of the session.

3.08 CLEAN UP

A. Thoroughly clean all soiled surfaces of installed equipment and materials.

B. Upon completion of electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Engineer.

END OF SECTION

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SECTION 260519

LOW VOLTAGE WIRE AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all wire and cable rated 600 volts or less, including splices and terminations, as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following Specification Section for work related to the work in this Section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 05 33 Electrical System Raceways and Fittings
   3. 26 05 32 Electrical System Junction and Pull Boxes
   4. 26 27 26 Wiring Devices

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes:
   1. American Society for Testing and Materials (ASTM):
      a. B3-01, Specification for Soft or Annealed Copper Wire
      b. B8-99, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
      c. B173-01a, Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
   2. Federal Standards (FED. STD.):
      a. 228, Methods of Testing Insulated Cable and Wire
   3. Federal Specifications (FS):
      a. A-A-59544, Cable and Wire, Electrical
      b. A-A-55809, Pressure Sensitive Electrical Plastic Insulation Tape
   4. National Electrical Manufacturers Association (NEMA):
      a. WC 70-1999/ICEA S-95-658-1999, Cross-Linked Thermosetting Polyethylene, Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
   5. National Fire Protection Association (NFPA), National Electrical Code (NEC) - Latest Revision
   6. California Electrical Code (CEC)
   7. Underwriters Laboratories (UL):
      a. 44-83 (R1988), Rubber-Insulated Wires and Cable
      b. 83-1983 (R1989), Thermoplastic-Insulated Wires and Cables
      c. 510-1986, Insulating Tape

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.
   1. Catalog Data: Provide manufacturer's descriptive literature.
   2. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 POWER CONDUCTORS

A. General: Conductors shall be copper, Class B stranded and of the sizes indicated. All conductors 120 volts and above shall be in raceway unless otherwise noted. Minimum power and control wire size shall be No. 12 AWG unless otherwise specified by the Engineer. All cable used on this Project shall be of the same type and conductor material.

B. Unless otherwise noted, conductors #6 and larger shall be XHHW insulation suitable for operation in wet or dry locations at temperatures not to exceed 75°C in wet locations and 90°C in dry locations. Conductors #8 and smaller shall be THHN in dry locations and THWN/THHN in wet locations. Control Cable shall be THHN.

C. Insulation Marking: All insulated conductors shall be identified with printing colored to contrast with the insulation color.

D. Color Coding: As specified in paragraph 3.03.

E. Special Wiring: Where special wiring is proposed by an equipment manufacturer, submit the special wiring requirements to the Engineer and, if approved, provide same. Special wire shall be the type required by the equipment manufacturer.

F. Other Wiring: Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and as approved by the Engineer.

G. Terminations:
   1. Cable Termination for Copper: Crimp style two hole NEMA spade terminals designed and rated for copper cable.
   2. Wire Terminations: Crimp on ring-tongue terminals, insulated sleeve, of proper size for the wire used.
   3. End Seals: Heat shrink plastic caps of proper size for the wire on which used.
   4. Manufacturer: T&B, Burndy or approved equal.

H. Manufacturer: BICC General Cable Inc., Southwire, or approved equal.

2.02 TAPE

A. Tape used for cable marking shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform to FS HH-I-595 and UL 510.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION

A. Clean Raceways: Clean all raceways prior to installation of cables as specified in Section 26 05 33 – Electrical System Raceways and Fittings.

B. Cable Pulling: Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be

permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.

C. Bending Radius: Cable bending radius shall be per applicable code. Install feeder cables in one continuous length.

D. Equipment Grounding Conductors: Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any conduit or any raceway.

E. Panelboard Wiring: In panels, bundle incoming wire and cables which are No. 6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.

F. Wiring at Hinges: For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing when the hinged member is moved.

G. All wiring and cable shall be supported from the structure above. All wiring over 100 volts shall be installed in conduit except as noted in Section 26 05 32.

3.02 CABLE TERMINATIONS AND SPLICES

A. Splices:
   1. All power cables shall be continuous below grade (i.e. no splices or terminations below grade).
   2. Use UL listed wirenuts for line voltage branch circuits in dry locations.

B. Terminations: Shall comply with the following:
   1. Make up and form cable and orient terminals to minimize cable strain and stress on device being terminated on.
   2. Burnish oxide from conductor prior to inserting in oxide breaking compound filled terminal.

3.03 CIRCUIT AND CONDUCTOR IDENTIFICATION

A. Color Coding: Provide color coding for all circuit conductors. Insulation color shall be white for neutrals and green for grounding conductors. An isolated ground conductor shall be identified with an orange tracer in the green body. Ungrounded conductor colors shall be as follows:

VOLTAGE	208/120V
Phase A	Black
Phase B	Red
Phase C	Blue

Neutral	White
Ground	Bare/Green

B. Color coding shall be in the conductor insulation for all conductors #10 AWG and smaller; for larger conductors, color shall be either in the insulation or in colored plastic tape applied at every location where the conductor is readily accessible.

C. Circuit Identification: All underground distribution and service circuits shall be provided with plastic identification tags in each secondary box and at each termination. Tags shall identify the source of the circuit and the item serviced by the circuit.

3.04 TESTING

A. The Contractor shall perform the following tests at his expense:
   1. Continuity Test of Wire: Test each wire for continuity and accuracy of the identifying tags at both ends and at all locations marked. Submit a report to the Engineer certifying the fact of the test and the accuracy of the marking.
   2. Insulation Resistance Tests: Perform insulation resistance tests on all wire and cable installed. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall be disconnected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading not less than 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.
   3. Phase Rotation: The contractor shall test and verify that the phase rotation of all new three-phase services, feeders and branch circuits matches the phase rotation of the existing circuits being replaced. A record shall be kept of each circuit tested and, on completion, given to the Engineer for review.

END OF SECTION

SECTION 260526

ELECTRICAL SYSTEM GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of furnishing, installing, connection and testing of all grounding systems as specified herein and as shown on the Drawings.

1.02 RELATED WORK

A. See the following specification sections for work related to work in this section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 05 19 Low Voltage Wire and Cables
   3. 26 24 16 Panelboards

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC):
      a. 250 Grounding
   2. American Society for Testing and Materials (ASTM) Publication:
      a. B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
      b. B228 Standard Specification for Concentric-Lay-Stranded Copper-Clad Steel Conductors
   3. Institute of Electrical and Electronics Engineers (IEEE):
      a. 81 Guide for Safety in AC Substation Grounding

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

1.05 QUALITY ASSURANCE

A. Each and every concealed connection must be inspected by the Owner's Representative before it is covered up by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

A. The grounding system shall consist of the grounding conductors, ground bus, ground fittings and clamps, and bonding conductors as shown on the Drawings.

2.02 SYSTEM COMPONENTS

A. Ground Rods: Ground rods shall be cone pointed copper clad Grade 40 HS steel rods conforming to ASTM B228. The welded copper encased steel rod shall have a conductivity of not less than 27% of pure copper. Rods shall be not less than 3/4-inch in diameter and ten feet long, unless otherwise indicated. Rods longer than ten feet shall be makeup of ten foot units joined together with threaded couplings. The manufacturer's trademark shall be stamped near the top.

B. Grounding Conductors:
   1. Interior grounding conductors shall match the feeder and branch circuit wiring, THHN/THWN below #6, XHHW #6 and above (refer to Section 26 05 19). All grounding conductors shall have green insulation.
   2. Exterior buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper. Sizes over No. 6 AWG shall be stranded conforming to ASTM B8.

C. Ground Connections: Exposed ground connections shall be high copper alloy bolted pressure types or exothermically welded type, as noted. Embedded or buried connections, taps, and splices shall be either exothermically welded type or approved compression types for connection of copper to copper or copper to steel, as required. Connections of grounding conductors to equipment ground buses and metal enclosures shall be of the binding post type with a 1/2-13NC stud. Each post shall accommodate cables from #4 AWG to #2/0 AWG.

D. Ground Rod Boxes: Boxes shall be nine-inch diameter precast concrete units. If box is in a location where vehicular traffic is present, cover shall be cast iron traffic cover. Otherwise, covers shall be precast concrete. Units shall be 12 inches deep. Covers shall be embossed with the wording "Ground Rod".

E. Ground Bus: 2” x 1/4” x 24” copper busbar. Provide isolation stand off bushings. Provide drilled and tapped 3/8” diameter holes in two offsetting rows 1” apart and 2” on center. Provide “ALCU” lugs and bronze bolts. Connect busbar to main grounding system and bond to metallic domestic cold water pipe with #8 ground conductor.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground all equipment for which a ground connection is required per CEC Article 250, even though not specifically shown on the Drawings.

B. Provide a ground rod box for each ground rod so as to permit ready access for the connection and/or removal of any pressure connectors to facilitate testing.

C. Where ground rods must be driven to depths over ten feet, increase rod diameter sufficiently to prevent the rod from bending or being damaged.

D. Effectively bond structural steel for buildings to the grounding system, "UFER" ground.

E. Install a ground rod in each primary handhole. Connect the ground conductor installed for each primary duct bank to the ground rod in each handhole. Bond metal conduits to handhole ground rod.

3.02 TESTING

A. Conduct ground resistance tests using a ground resistance tester with a scale reading of 5 ohms maximum.

B. Test methods shall conform to IEEE Standard 81 using the three electrode method. Conduct test only after a period of not less than 48 hours of dry weather.

C. Take resistance readings for each ground rod individually and for each system as a whole without benefit of chemical treatment or other artificial means. Ground resistance readings shall not exceed 5 ohms. If readings are not to the Contracting Officer's approval, provide lengthened or additional ground rods (maximum of two additional rods).

D. Furnish to the Owner's Representative a test report with recorded data of each ground rod location and each system.

END OF SECTION

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SECTION 26 05 32

JUNCTION AND PULL BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete all electrical installations shown on the drawings, included in these Specifications, or otherwise needed for a complete and fully operating facility. The work shall include but not be limited to the following:

B. Furnish and install all required material, supports and miscellaneous material for the satisfactory interconnection of all associated electrical systems.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 05 33 Electrical System Raceways and Fittings
   3. 26 05 19 Low Voltage Wire and Cables

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes:
   1. California Electrical Code (CEC)
   2. National Electrical Manufacturers Association (NEMA):
      a. Type 1 For indoor use primarily to provide a degree of protection against contact with the enclosed equipment
      b. Type 3R For outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation
      c. Type 4 For indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water
   3. Underwriters Laboratories (UL):
      a. 50 Enclosures for Electrical Equipment
      b. 514A Metallic Outlet Boxes

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

   1. Pull Boxes larger than 6"x 6" x 4".

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 OUTLET, JUNCTION, AND PULL BOXES

A. For boxes in dry interior locations use NEMA 1 box. For boxes in wet or exterior locations use NEMA 4 box. NEMA 3R is acceptable for exterior locations if installed per manufacturer's recommendations.

B. Standard Outlet Boxes, per UL 514A: Galvanized, one-piece die formed or drawn steel, knockout type of size and configuration best suited to the application indicated on the Drawings. Minimum box size shall be 4 inches square by 1-1/2 inches deep with mud rings as required.
   1. Manufacturer: RACO or approved equal.

C. Switch boxes, per UL 514A: Two inch wide by three inches long galvanized steel switch boxes shall be used only for the installation of single switches. Install multiple switches in standard gang boxes with raised device covers suitable for the application indicated.
   1. Manufacturer: RACO or approved equal.

D. Cast metal Outlet Boxes per UL 514A: Four inch round, galvanized cast iron alloy with threaded hubs and mounting lugs as required. Boxes shall be furnished with cast cover plates of the same material as the box and with neoprene cover gaskets.
   1. Manufacturer: Crouse-Hinds VXF series, Appleton JBX series or approved equal.

E. Conduit bodies per UL 514A: Cadmium plated, cast iron alloy. Conduit bodies with threaded conduit hubs and neoprene gasketed, cast iron covers. Bodies shall be used to facilitate pulling of controls or to make changes in conduit direction only. Splices are not permitted in conduit bodies.
   1. Manufacturer: Crouse-Hinds Form 8 Condulets, Appleton Form 35 Unilets, or approved equal.

F. Sheet Metal Boxes per UL 50: Use standard outlet or concrete ring boxes wherever possible; otherwise use a minimum 16 gauge galvanized sheet metal, NEMA 1 box sized to Code requirements with covers secured by cadmium plated machine screws located six inches on centers.
   1. Manufacturer: Circle AW Products, Hoffman Engineering Company or approved equal.

G. Cast Metal Boxes per UL 50: Use standard cast malleable iron outlet or device boxes wherever possible; otherwise use cadmium plated, cast malleable iron junction boxes with bolt-on, interchangeable conduit hub plates with neoprene gaskets.
   1. Manufacturer: Appleton RS series, Crouse-Hinds RS series, or approved equal.

H. Flush Mounted Pull boxes and Junction boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.01 OUTLET BOXES

A. General:
   1. All outlet boxes shall finish flush with building walls, ceilings and floors except in mechanical and electrical rooms above accessible ceiling or where exposed work is called for on the Drawings.
   2. Provide outlet boxes in sizes as code required for the number of conductors to be included in the box, but the minimum shall be as required in the previous section. Provide shallow

boxes were required to meet installation conditions. Box size shall meet requirements for installation of manufacturer's equipment.

3. Install raised device covers (plaster rings) on all switch and receptacle outlet boxes installed in masonry or stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
4. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
5. Exposed outlet boxes and boxes in damp or wet locations shall be cast metal with gasketed cast metal cover plates.

B. Box Layout:
1. Outlet boxes shall be installed at the locations and elevations shown on the drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
2. Locate switch outlet boxes on the latch side of doorways unless otherwise indicated.
3. Outlet boxes shall not be installed back to back nor shall through-wall boxes be permitted.
4. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.
5. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height with required location for equipment served.

C. Supports:
1. Outlet Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Fixture outlet boxes installed in suspended ceiling of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
3. Fixture outlet boxes installed in suspended ceilings with acoustical tiles or panels shall be supported directly from the structure above where pendant mounted lighting fixture are to be installed on the box.
4. Fixture Boxes above tile ceilings with exposed suspension systems shall be supported directly from the structure above.
5. Outlet and/or junction boxes shall not be supported by grid or fixture hanger wires at any locations.

3.02 JUNCTION AND PULL BOXES

A. General:
1. Install junction or pull boxes were required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not shown on the Drawings.
2. Unless specifically noted on the drawings, size junction and pull boxes to meet code requirements for number and size of conduits connected to box.
3. Locate pull boxes and junction boxes in concealed locations above removable ceilings or exposed in electrical rooms, utility rooms, or storage areas.
4. Install raised covers (plaster rings) on boxes in stud walls or in furred, suspended, or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
5. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
6. Exposed boxes and boxes in damp or wet locations shall be cast metal with gasketed cast metal cover plates.
7. Identify circuit numbers and panel on cover of junction box with clear adhesive backed label with permanent black letters.

B. Box Layouts:
   1. Boxes above hung ceilings with concealed suspension systems shall be located adjacent to openings for removable recessed lighting fixtures.

C. Supports:
   1. Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
   2. Boxes installed in suspended ceilings of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
   3. Boxes installed in suspended ceilings with acoustical tiles or panels shall be supported directly from the structure above.
   4. Boxes mounted above suspended acoustical tile ceilings with exposed suspension systems shall be supported directly from the structure above.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND FITTINGS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of furnishing and installing conduits, raceways and fittings for above grade installations, underground duct installations and inside buildings as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this section:
   1. 26 05 00 General Requirements for Electrical Systems

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC):
      a. 230.8 Raceway Seal
      b. 300.5(G) Raceway Seals
   2. American National Standards Institute (ANSI):
      a. C80.1 Specification for Zinc Coated Rigid Steel Conduit
      b. C80.3 Specification for Zinc Coated Electrical Metallic Tubing
   3. Federal Specifications (FS):
      a. A-A-55810 Flexible Metal Conduit
   4. National Electrical Manufacturers Association (NEMA):
      a. TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit (EPC 40 and EPC 80)
   5. Underwriters Laboratories (UL):
      a. 797 Electrical Metallic Tubing - Steel
      b. 360 Liquid-Tight Flexible Steel Electrical Conduit
      c. 514B Fittings for Cable and Conduit
      d. 6 Rigid Metal Conduit
      e. 651 Schedule 40 and 80 Rigid PVC Conduit
      f. 1479 Fire Tests of Through-Penetrations Firestops
      g. 1 Flexible Metal Conduit

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 CONDUITS, RACEWAYS

A. Galvanized Rigid Steel Conduit (GRS) shall be hot-dip galvanized after fabrication, conforming to ANSI C80.1 and UL 6.

B. Electrical Metallic Tubing (EMT) shall be steel, hot-dip galvanized after fabrication, conforming to ANSI C80.3 and UL 797. Uni-couple EMT is acceptable.

C. Flexible conduit: Flexible metal conduit (Greenfield) shall be galvanized steel or aluminum interlocked from a continuous metal strip and shall conform to UL 1 and FS A-A-55810.

D. Liquidtight flexible conduit: Liquidtight flexible metal conduit shall be liquid-tight (Sealtight) of galvanized steel interlocked from a continuous metal strip with an extruded polyvinyl chloride cover and shall conform to UL 360 and FS A-A-55810.

E. Rigid non-metallic conduit: Rigid non-metallic conduit for concrete encasement shall be Type EB, all others shall be PVC Schedule 40 (PVC-40 or NEMA TC2 Type EPC-40) conduit approved for underground use and for use with 90°C wires, and shall conform to UL 651.
   1. Conduit for use for utility feeders shall comply with utility requirements.

2.02 CONDUIT SUPPORTS

A. Channels:
   1. Supports for multiple conduits shall be cold rolled, carbon steel channels unless otherwise noted.
   2. All channels used in exterior, damp, wet or corrosive locations shall be hot dipped galvanized unless otherwise noted. Associated hardware shall have manufacturer's recommended compatible finish.
   3. Channels used in dry interior, non-corrosive environments shall be hot dipped galvanized or Dura-Green finished. Associated hardware shall have manufacturer's recommended compatible finish.
   4. Manufacturer: B-Line B series Strut Systems or approved equal.

B. Supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer.

C. Supports for individual EMT conduits shall be galvanized pressed steel single hole straps.

D. Hardware for supports shall be Kadee clamps and connectors as appropriate for the job conditions, or approved equal.

E. Clamp fasteners shall be by wedge anchors. Shot in anchors shall not be used.

F. Provide seismic calculations on individual conduit installations 2" and larger and on conduit racks with supports in excess of 12".

2.03 FITTINGS

A. Provide threaded-type couplings and connectors for galvanized rigid steel (GRS) conduits.
   1. Union couplings shall be Erickson type.
   2. Fittings shall be galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers.

3. Set-screw type and compression-type shall not be used.
4. Threadless couplings shall not be used.
5. Provide threaded couplings and raintight conduit ("Meyers") hubs for rigid steel conduit exposed to weather.
6. Locknuts and bushings shall not to be used in liquidtight applications

B. Provide steel set-screw type or compression-type couplings and connectors for electrical metallic tubing (EMT) conduits. Where set-screw fittings are utilized, the screws are to be "dimpled" and not pointed.

C. Diecast fittings or aluminum fittings shall not be used.

D. Fittings for Weathertight Flexible Metal conduit shall have neoprene gaskets.

E. Fittings for use with rigid non-metallic conduit shall be PVC and have solvent-weld-type conduit connections.

2.04 BUSHINGS

A. Bushings shall be the insulated type.

B. Bushings for rigid steel shall be insulated grounding type.

2.05 CONDUIT SEALANTS

A. Fire Retardant Types: Fire stop material shall be reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL 1479. Coordinate with requirements in other sections of the documents. Contractor shall obtain approval of the product and its application from the authority having jurisdiction and is responsible to insure that the application is appropriate for the actual installation.

B. Water Retardant Types: Link seals are to be used on all below building penetrations.

PART 3 - EXECUTION

3.01 CONDUIT, RACEWAY AND FITTING INSTALLATION

A. Installation shall comply with the CEC.

B. Provide a nylon pull cord in each empty raceway. Cord shall be ¼" in all raceways 1" and larger.

C. The minimum size raceway shall be 3/4-inch unless indicated otherwise noted.

D. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees regardless of direction. Back to back elbows in any direction without a straight section a minimum of ten times the diameter of the raceway are prohibited without specific approval in writing by the Engineer.

E. Treat cut steel surfaces or damaged ends with manufacturer's recommended corrosion-resistant coating. Application shall follow manufacturer's recommendation.

F. Coordinate minimum conduit bending radius with type and size of cable to be installed.

G. All exposed conduit and hardware shall be painted per spec section 26 05 00.

H. All conduit openings are to have bushings. If omitted, the conductors shall be removed and replaced after the bushings are installed.

3.02 LOCATION

A. Galvanized rigid steel conduit shall be used for:
   1. All above ground exterior work,
   2. Exposed interior work up to eight feet above finished floor including mechanical and electric rooms,
   3. Conduits embedded in concrete or grout unless otherwise noted,
   4. Conduits in corrosive atmospheres.

B. Electrical Metallic Tubing (EMT) shall be used for:
   1. Interior concealed work,
   2. Interior exposed conduit above eight feet as acceptable to the local authority having jurisdiction.

C. Flexible metal conduit (Greenfield) shall be used for:
   1. Interior work in short lengths (six foot maximum),
   2. Connection of recessed lighting fixtures, motors, transformers and any vibrating equipment, unless otherwise noted or where liquid tight flexible metal conduit is required.
   3. Flexible metal conduit shall be supported within twelve inches of each end where used for expansion purposes.

D. Liquidtight flexible metal conduit (Sealtight) shall be used wherever flexible conduit is required and moisture may be present including:
   1. All motors in mechanical equipment spaces,
   2. Vibrating equipment where moisture may be present,
   3. When making connections between two building structures.
   4. This requirement applies to all raceway including power and control raceway.
   5. Liquidtight flexible metal conduit is to be supported within twelve inches of each end where used for expansion purposes

E. Rigid non-metallic conduit (PVC) for all underground exterior work, unless otherwise noted. Associated vertical elbows shall be galvanized rigid steel.

3.03 ROUTING

A. Run all concealed conduits above ceilings and inside walls parallel to building lines, unless otherwise noted.

B. Run all exposed conduits parallel to building lines, unless otherwise noted.

C. Coordinate conduit locations with equipment, fixtures, and with structural and architectural elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows.

3.04 CONDUIT SUPPORTS

A. Properly support all conduits as required by the code. Wherever possible, run all conduits concealed except where otherwise shown on the drawings.

B. Provide "J" hangers on threaded rods or multiple conduits on trapezes consisting of channels supported by minimum 3/8" threaded rod from the structure above. Conduits shall not be supported from ceiling support wires or t-bar grids. Conduits shall not be supported from ductwork, water, fire sprinkler or HVAC lines.

C. Treat damaged channel finishes with manufacturer's recommended corrosion-resistant coating. Application shall follow manufacturer's recommendation.

D. Exposed Conduits:
   1. Support exposed conduits within three feet of any junction box, coupling, equipment, fixture or device and at intervals not exceeding code requirements.
   2. Wherever possible, group conduits together and support on common supports located away from walls. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps.
   3. Group together exposed conduits in horizontal runs and support on trapeze hangers unless otherwise noted. Arrange such conduits uniformly and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of rods or other suitable means from the structure above the ceiling.
   4. Support conduit risers in shafts with channels and straps.

3.05 MOISTURE SEALS

A. Provide in accordance with CEC paragraphs 230.8 and 300.5(G).

3.06 FLEXIBLE CONDUIT

A. Flexible metallic conduit shall have a maximum length of six feet unless otherwise noted.

B. Flexible metallic conduit shall not be considered as a ground conductor. Flexible metallic conduit shall be installed only in exposed or accessible locations.

C. Flexible metallic conduit used for lighting fixture whips may be a maximum of six feet. Fixture whips provided by light fixture manufacturers may be maximum of twelve feet in length.

3.07 UNDERGROUND RACEWAY

A. Conduits embedded in concrete floors on grade shall be installed between grids of reinforcing steel, or shall be encased below the floors, provided the concrete is thickened as shown on the Drawings. EMT shall not be embedded in concrete.

B. Slope all underground raceways to provide drainage. Slope conduit from equipment located inside a building to the pull box or manhole located outside the building.

C. All PVC conduits terminating into pull boxes and vaults shall be provided with bell fittings at ends.

D. PVC direct buried conduits shall be installed in soil, covered with sand under a warning tape and compacted soil. Minimum depth 18" below grade. All PVC conduit installed below grade shall

be provided with galvanized rigid steel elbows and risers. Rigid Steel shall be wrapped with 20 mil tape and extend minimum 12" above finished grade.

E. Where multiple conduits are run in parallel, install spacers on five-foot centers so as to maintain three-inch spacing between conduits.

F. PVC conduits installed under slabs shall be installed in soil, covered with sand under a vapor barrier and crushed rock. Minimum depth 6" below slab. All PVC conduit installed below slab shall be provided with galvanized rigid steel elbows and risers. Rigid steel shall be wrapped with 20 mil tape and extend minimum 12" above finished grade.

G. Where conduits penetrate structural members, obtain approval for the associated sleeves and windows from the structural consulting engineer and provide as required.

3.08 STORAGE OF PVC CONDUITS

A. Store rigid PVC conduit on a flat surface and shielded from the sun. PVC conduits 3" and larger shall be provided with 48" radius bends.

END OF SECTION

SECTION 26 05 44

IN GRADE PULL BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of providing all labor, supervision, tools, materials, and performing all work necessary to furnish and install pre-cast concrete pull boxes with necessary excavation.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 05 43 Electrical System Underground Ducts and Raceways

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. American Concrete Institute (ACI):
      a. 318 Building Code Requirements for Structural Concrete
   3. American Society for Testing and Materials (ASTM):
      a. A185 Steel Welded Wire Reinforcement for Concrete
      b. A615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
      c. C33 Concrete Aggregates
      d. C150 Portland Cement

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General Requirements:
   1. Concrete pull boxes for electrical power, controls and other communication circuits shall consist of pre-cast reinforced concrete boxes, extensions' bases, and covers as specified herein and as indicated on the Drawings. Pre-cast units shall be the product of a manufacturer regularly engaged in the manufacture of pre-cast vaults and pull boxes. Acceptable manufacturers are Christy, Utility Vault, Brooks, or approved equal.

B. Construction:
   1. Pre-cast concrete pull boxes for electrical power distribution and communication circuits with associated risers shall conform to ACI 318. Pull box tops in non-traffic areas shall conform to ACI 318. Pull boxes shall be the type noted on the Drawings and shall be constructed in accordance with the applicable details as shown. Walls shall consist of reinforced concrete. Walls shall be of monolithic concrete construction.

C. Covers:
   1. The word "ELECTRICAL" shall be cast in the top face of all electrical power cable boxes.

D. Concrete:
   1. Aggregates used in the concrete mix, either coarse or fine, excluding light weight aggregates, shall conform to ASTM C33. Aggregates shall be properly graded and free of deleterious substances to produce a homogeneous concrete mix when blended with cement.

E. Cement:
   1. The cement shall be Type II low alkali Portland cement and shall meet the requirement of ASTM C150.

F. Compressive Strength:
   1. Sufficient cement content shall be used per batch to produce a minimum compressive strength of 3,000 psi at 28 days.

G. Reinforcing Steel:
   1. Welded wire mesh for street lighting boxes shall conform to ASTM A 185.
   2. Reinforcing bars for primary and secondary electrical pullboxes, and communication pull boxes shall be intermediate grade billet steel conforming to ASTM A615.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pre-cast pull boxes shall be installed approximately where indicated on the Drawings. The exact location of each pull box shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. All cable boxes and secondary pull boxes shall be installed with a minimum of 6-inch thick crushed rock bedding.

B. Install junction or pull boxes were required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that not all boxes are necessarily shown on the Drawings.

C. Unless specifically noted as larger on the drawings, size junction and pull boxes to meet code requirements for number and size of conduits connected to box.

D. Paved areas:
   1. Pull boxes located in areas to be paved shall be installed such that the top of the cover shall be flush with the finished surface of the paving.

E. Unpaved Areas:

1. In unpaved areas, the top of pull box covers shall be approximately 2 inches above finished grade.

F. Traffic Areas:
1. In areas subject to vehicular traffic including roads, driveways, parking lots and other similar areas, provide traffic rated boxes and covers.

G. Trenching, Backfilling, and Compaction:
1. Trenching, backfilling and compaction shall be as specified in previous sections of the specification.

END OF SECTION

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SECTION 260800

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work included in this Section:
   1. Infrared testing.
   2. Equipment operational tests.
   3. Cable insulation test.
   4. Ground fault interrupter testing.
   5. Lighting controls installation.

B. General Scope:
   1. It is the intent of these tests to assure that all electrical equipment, both Contractor and Owner-supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
   2. The tests and inspections shall determine the suitability for energization.
   3. Schedule tests and give a minimum of two weeks advance notice to the Owner and Engineer.

C. Provide independent test lab to field calibrate and set trip units on all circuit breakers above 225 amps.

1.02 RELATED WORK

A. See the following Specification Sections for work related to the work in this Section.
   1. 26 05 00 General Requirements for Electrical Systems

1.03 TEST REPORT

A. The test report shall include the following:
   1. Summary of project.
   2. Description of equipment tested.
   3. Description of test.
   4. List of test equipment used in calibration and calibration date.
   5. Test results.
   6. Conclusions and recommendations.
   7. Appendix, including appropriate test forms.

B. The test report shall be bound and its contents certified.

C. Submit three copies of the completed report to the Engineer no later than fifteen days after completion of test unless directed otherwise.

1.04 FAILURE TO MEET TEST

A. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported directly to the Owner and Engineer.

B. Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory without additional cost to the Owner.

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 EQUIPMENT OPERATIONAL TEST

A. Check cleanliness of all interior and all parts. Remove any excess packing, shipping bolts, etc.

B. Tighten all points of connection with torque wrench to values recommended by the manufacturer.

C. Verify all proper operating conditions of all equipment mechanically and electrically.

D. If any equipment is found defective during operational check, it shall be replaced by the Contractor without cost to the Owner and tests repeated by the Contractor without cost to the Owner until satisfactory results are obtained.

3.02 CABLE INSULATION TEST

A. Under 600 Volts: Megger and record insulation resistances of all 600 volt insulated conductors size 1/0 AWG and larger using a 500 Volt megger for one minute. Make tests with circuits isolated from source and load. This test may be performed by the Contractor. One Megohm shall be the minimum acceptable value.

3.03 INFRARED TESTING

A. Contractor shall verify all bolted electrical connections by means of an "Infrared Meter". Connections that show as "loose" shall be re-torqued to manufacturer specifications.

3.04 LIGHTING CONTROLS

A. Manufacturer shall provide a factory authorized representative to provide a functional overview of the lighting control system prior to products being installed. Within ninety days of receipt of approved submittals, contractor shall contact manufacturer or local manufacturer's representative to schedule a pre-installation site visit to review the following:
   1. Discuss the functionality and integration of all products per the design requirements.
   2. Confirm the location of occupancy sensors and photocells as required.
   3. Confirm that the low voltage control wires meet the specification.
   4. Explain adjustment options and verify that the specified requirements for each device have been achieved.

END OF SECTION

SECTION 262416

PANELBOARD AND DISTRIBUTION PANELS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing panelboards and circuit breakers as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this Section:
1. 26 05 00 General Requirements for Electrical Systems
2. 26 05 19 Low Voltage Wire and Cables
3. 26 05 26 Electrical System Grounding
4. 26 28 16 Circuit Breakers

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
1. American National Standards Institute (ANSI):
   a. Z55.1-1967 (R1973), Gray Finishes for Industrial Apparatus and Equipment (Standard available from ANSI through archival library)
2. National Electrical Manufacturers Association (NEMA):
   a. PB 1-2006, General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less
   b. 250 - 2003, Enclosures for Electrical Equipment (1000 Volts Maximum)
   c. AB 1-2002, Molded Case Circuit Breakers, Molded Case Switches, and Circuit-Breakers Enclosures
3. Underwriters Laboratories (UL):
   a. 50 Enclosures for Electrical Equipment
   b. 67 Panelboards
   c. 869 Service Equipment

1.04 SUBMITTALS

A. Shop Drawings - As specified in Division 1 and Section 26 05 00. For each panelboard and distribution panel furnished under this Contract, submit manufacturer's name, catalog data, and the following information:
1. Panelboard / distribution panel type.
2. Cabinet dimension.
3. Gutter space.
4. Gauge of boxes and fronts.
5. Schedule for each panelboard indicating:
   a. Finish data.
   b. NEMA enclosure rating.
   c. Voltage rating.
   d. Breaker manufacturer, types, trip rating, and interrupting ratings.

e. Main bus and terminal connection sizes.
f. Location of line connections.

B. Single Submittal - A single complete submittal is required for all products covered by this Section.

C. Closeout Submittals: Submit operation and maintenance data for panelboards and circuit breakers including nameplate data, parts lists, factory and field test reports, recommended maintenance procedures and typewritten as-built panel schedules. Submit in accordance with Division 1.

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. General: Lighting and Receptacle Panelboards shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings or 42 circuits. All circuit breakers shall be quick-make, quick-break, thermal magnetic bolt-on type, with 1, 2 or 3 poles a shown, each with a single operating handle. Tandem or piggy-back breakers shall not be used.

B. Nameplates:
1. Each panelboard shall have a field mounted identifying nameplate giving the panel identification as shown on the Drawings. See specification section 26 05 00.
2. Each panelboard shall have a manufacturer's nameplate showing the voltage, bus rating, number of phases, frequency and number of wires.

C. Construction:
1. Panelboards shall be factory assembled.
2. Main circuit breakers shall be independently mounted from the branch circuit breakers. Back fed main breaker configurations are not acceptable.
3. Panelboards and enclosures shall conform to NEMA PB1 and 250, UL 50 and 67, and requirements of all relevant codes. Panelboards shall be suitable for use as service equipment in conformance with UL 869.
4. Panelboards shall be furnished with hinged trim construction where the front cover is hinged to the box. Panelboards shall have a front door with key latch and a typed directory card and holder. Panelboard circuits shall be arranged with odd numbers on the left and even numbers on the right. Provide weatherproof, NEMA type 3R enclosures for outdoor installation.

D. Factory Finish:
1. All non-painted steel parts shall be zinc plated.
2. All painted steel parts shall be cleaned and a zinc phosphate (outdoor equipment) or iron phosphate (indoor equipment) pre-treatment applied prior to paint application.
3. Paint Color shall be ANSI 61 (light gray) TGIC polyester powder, applied electrostatically through air unless otherwise noted. Following paint application, parts shall be baked to produce a hard durable finish. The average thickness of the paint film shall be 2.0 mils. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.
4. Adequacy of paint finish to inhibit the buildup of rust on ferrous metal materials shall be tested and evaluated per paragraphs 5.2.8.1-7 of ANSI C37.20.3-1987. Salt spray withstand tests in accordance with paragraph 5.2.8.4 shall be performed on a periodic basis

to provide conformance to this corrosion resistance standard of at least 2500 hours minimum (outdoor equipment) or 600 hours minimum (indoor equipment).

E. Busbars: Panelboard busbars shall be phase sequence type suitable for bolt-on circuit breakers. All busbars shall be copper, sized for a maximum current density of 1000A psi or shall be of sufficient cross sectional area to meet UL standard 891 temperature rise requirements.

F. Circuit Breakers: See specification section 26 28 16. Circuit breakers shall be the molded case type with trip and interrupting ratings as shown on the Drawings.

G. Manufacturer:
   1. 208Y/120V panelboards shall be Square D NQOD or equal by Siemens, GE or Cutler Hammer - unless otherwise noted.

2.02 DISTRIBUTION PANELS

A. General: Distribution panels shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings. All circuit breakers shall be quick-make, quick-break, thermal magnetic bolt-on type, with 1, 2 or 3 poles a shown, each with a single operating handle. Tandem or piggy-back breakers shall not be used.

B. Nameplates:
   1. Each distribution panel shall have a field mounted identifying nameplate giving the panel identification as shown on the Drawings. See specification section 26 05 00.
   2. Each distribution panel shall have a manufacturer's nameplate showing the voltage, bus rating, number of phases, frequency and number of wires.

C. Construction:
   1. Panelboards shall be factory assembled.
   2. Main circuit breakers shall be independently mounted from the branch circuit breakers. Back fed main breaker configurations are not acceptable.
   3. Finish of door and trim shall be ANSI 49 or 61, in accordance with ANSI Z55.1. Box shall be hot-dip galvanized, field finished to match the front.
   4. Distribution panels and enclosures shall conform to NEMA PB1 and 250, UL 50 and 67, and requirements of all relevant codes. Distribution panels shall be suitable for use as service equipment in conformance with UL 869.
   5. Distribution panels shall be furnished with hinged trim construction where the front cover is hinged to the box. Distribution panels shall have a front door with key latch and a typed directory card and permanently attached holder. Adhesive backed holders are not acceptable. Distribution panels circuits shall be arranged with odd numbers on the left and even numbers on the right. Provide weatherproof, NEMA type 3R enclosures for outdoor installation.

D. Busbars: Distribution panels busbars shall be phase sequence type suitable for bolt-on circuit breakers. All busbars shall be copper, sized for a maximum current density of 1000A psi or shall be of sufficient cross sectional area to meet UL standard 891 temperature rise requirements.

E. Circuit Breakers: See specification section 26 28 16. Circuit breakers shall be the molded case type with trip and interrupting ratings as shown on the Drawings.

F. Manufacturer - Unless otherwise noted:
   1. 208Y/120V distribution panels up to 600 amps shall be Square D I-line or equal by Siemens, GE or Cutler Hammer - unless otherwise noted.
   2. 208Y/120V distribution panels from 800 to 1200 amps shall be Square D I-line or equal by Siemens, GE or Cutler Hammer - unless otherwise noted.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Panelboards and Distribution Panels shall be installed where indicated on the Drawings, and in accordance with the manufacturer's instructions.

3.02 MOUNTING

A. Panelboards and Distribution Panels shall be mounted with the top of the box 6'-6" above the floor. Panelboards and Distribution Panels shall be plumb within 1/8-inch. The highest breaker operating handle shall not be higher than 72 inches above the floor.

3.03 FIELD TESTS

A. Insulation Resistance Tests: Perform insulation resistance tests on circuits to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall not be connected. Test the insulation with a 500Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.

B. Grounding: Grounding shall conform to Section 26 05 26.

C. Continuity: Panelboard and Distribution Panel circuits shall be tested for continuity prior to energizing. Continuity tests shall be conducted using a dc device with a bell or buzzer.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of:
   1. Furnishing, installing, and connecting all duplex receptacles complete with wall plates and/or covers, as shown on the Drawings.
   2. Furnishing, installing and connecting all single pole and three-way switches complete with wall plates and or handle operators, as shown on the Drawings.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 05 19 Low Voltage Wire and Cable
   3. 26 05 32 Junction and Pull Boxes for Electrical Systems
   4. 26 05 33 Raceways and Fittings for Electrical Systems

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. Federal Specifications (FS):
      a. W-C-596 Series General Specifications for Electrical Plugs and Receptacles
      b. W-S-896F General Specifications for Flush Mounted Toggle and Lock Switches
   3. National Electrical Manufacturers Association (NEMA) Publication:
      a. WD1 General Purpose Wiring Devices
   4. Underwriters Laboratories (UL) Standards:
      a. 20 General-Use Snap Switches
      b. 498 Attachment Plugs and Receptacles
      c. 514A Electrical Metallic Outlet Boxes
      d. 514B Fittings for Cable and Conduit
      e. 943 Ground-Fault Circuit-Interrupters

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Catalog Data: Provide manufacturers descriptive literature properly marked to identify the items to be supplied.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 RECEPTACLES

A. General - Receptacles shall be heavy duty, high abuse, grounding type conforming to NEMA WD1 and UL 498 Standards.

B. Duplex Receptacles:
   1. Receptacles shall be specification grade, rated 20 ampere, two-pole, 3-wire, 120 volt, NEMA 5-20 configuration, back and side wired, self-grounding with screw terminals. Color shall be ivory unless otherwise noted. Receptacles shall be heavy duty, industrial or hospital grade.
   2. Devices shall have a nylon composition face with a nylon or melamine body. Units shall comply with Federal Specification W-C-596 and meet UL 498 test requirements.
   3. Manufacturer: Hubbell #HBL5362 Series, Leviton #5362 Series, Pass & Seymour PSL5352.

C. GFCI Receptacles:
   1. Device shall be rated 20 ampere, 2-pole, 3-wire, 120 volt, conforming to NEMA 5-20R configuration. Face shall be nylon composition. Unit shall have an LED type red indicator light, test and reset push buttons. Color shall be ivory unless otherwise noted. Receptacles shall be heavy duty, industrial or hospital grade.
   2. GFCI component shall meet UL 943 Class A standards with a tripping time of 1/40 second at 5 milliamperes current unbalance. Operating range shall extend from -31°F to 158°F. Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.
   3. Manufacturer: Hubbell #GF5362 Series, Leviton #6898 Series or Pass & Seymour 2094-SI.

2.02 SWITCHES

A. General purpose light switches shall be rated 20 amperes to 120 or 277 volts ac only. Units shall be flush mounted, self-grounding, quiet operating toggle devices. Color shall be ivory unless otherwise noted. Receptacles shall be heavy duty, industrial or hospital grade.

B. Units shall conform to Federal Specifications W-S-896, UL 20 and NEMA WD1.

C. Manufacturer: Hubbell, Leviton or Pass & Seymour.

2.03 PLATES

A. General - Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform to NEMA WD1, UL 514, and FS W-P-455A. Plates on finished walls shall be non-metallic or stainless steel. Plates on unfinished walls and on fittings shall be of zinc plated steel or case metal and shall have rounded corners and beveled edges.

B. Non-Metallic: Plates shall be plain with beveled edges and shall be nylon or reinforced fiberglass.

C. Stainless Steel: Plates shall be .040 inches thick with beveled edges and shall be manufactured from No. 430 alloy having a brushed or satin finish.

D. Cast Metal: Plates shall be cast or malleable iron covers with gaskets so as to be moisture resistant or weatherproof.

E. Blank Plates: Cover plates for future telephone outlets shall match adjacent device wall plates in appearance. All openings shall be closed.

F. Plates on surface mounted boxes shall be of a type designed specifically for surface mounting.

G. Manufacturer: Hubbell, Leviton, Pass & Seymour.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES

A. Interior Locations: In finished walls, install each device in a flush mounted box with washers as required to bring the device mounting strap level with the surface of the finished wall. On unfinished walls, surface mount boxes level and plumb.

B. Mounting Heights: Measure locations of wall outlets from the finished floor to the center of the outlet box. Adjust boxes so that the front edge of the box shall not be farther back from the finished wall plane than 1/4-inch. Adjust boxes so that they do not project beyond the finished wall. Unless otherwise noted, height above finished floor shall be as follows:
   1. Receptacles 18 Inches from floor to middle of box
   2. Toggle Switches 46 Inches from floor to middle of box

C. Receptacles:
   1. Ground each receptacle using a grounding conductor, not a yoke or screw contact.
   2. Install receptacles with connections spliced to the branch circuit wiring in such a way that removal of the receptacle will not disrupt neutral continuity and branch circuit power will not be lost to other receptacles in the same circuit.

3.02 INSTALLATION OF WALL PLATES

A. General - Plates shall match the style of the device and shall be plumb within 1/16-inch of the vertical or horizontal.

B. Interior Locations, Finished Walls: Install non-metallic plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Oversized plates or sectional plates are not acceptable and shall not be used. If wall finish will not accommodate proper mounting of the plate, the situation shall be brought to the attention of the architect and the wall finish replaced appropriately.

C. Interior Locations, Unfinished Walls: Install stainless steel or cast metal cover plates.

D. Exterior Locations: Install cast metal plates with gaskets on wiring devices in such a manner as to provide a rain tight weatherproof installation. Cover type shall match box type.

E. Future Locations: Install blanking cover plates on all unused outlets.

F. Provide clear ¼ inch wide label with black, typed 11 point lettering on all receptacle faceplates showing panelboard name and circuit number supplying receptacle, unless otherwise noted.

G. All wall plates shall have the panel and circuit number of the associated device marked on the inside of the plate in indelible marker so that the designation cannot be wiped off.

3.03 COORDINATION OF FINISHES AND LOCATIONS

A. Check shop drawings of other trades for conflicts from such items as cabinetry, bulletin boards, etc and bring any such conflict to the architect's attention

B. Confirm all elevations with the appropriate shop drawings and the architectural elevations and if there are conflicts, refer the same to the Engineer for resolution.

C. Confirm all finishes with the architect.

3.04 TESTS

A. Receptacles:
   1. Test receptacles for blade and ground plug tension prior to installation. Do not install any receptacle having less than 16 oz. individual blade retention.
   2. After installation of receptacles, energize circuits and test each receptacle to detect lack of ground continuity, reversed polarity, and open neutral condition.

END OF SECTION

SECTION 262816

CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing circuit breakers as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following Specification Sections for work related to the work in this Section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 24 16 Panelboards and Distribution Panels

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. International Organization for Standardization (ISO):
      a. 9001 Quality Management Systems
   3. American National Standards Institute (ANSI):
      a. Z55.1-1967 (R1973), Gray Finishes for Industrial Apparatus and Equipment (Standard available from ANSI through archival library)
   4. National Electrical Manufacturers Association (NEMA):
      a. Type 1 For indoor use primarily to provide a degree of protection against contact with the enclosed equipment
      b. Type 3R For outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation
      c. Type 4 For indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water
      d. 250 Enclosures for Electrical Equipment (1000 Volt Maximum)
      e. AB-1 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
   5. Federal Specifications (FS):
      a. W-C-375 Series, Circuit Breakers, Molded Case, Branch Circuit and Service, Series Trip
   6. Underwriters Laboratories (UL):
      a. 50 Enclosures for Electrical Equipment
      b. 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
      c. 508 Industrial Control Equipment
      d. 869 Service Equipment
      e. 1053 Ground Fault Sensing and Relaying Equipment
      f. 1066 Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
   7. International Electrotechnical Commission (IEC):
      a. 60947 Low Voltage Switchgear and Control Gear – Part 2: Circuit Breakers
      b. 61000-4 Series Electromagnetic Compatibility

1.04 SUBMITTALS

A. Shop Drawings - Submittals shall be in accordance with Division 1 and section 26 05 00. For each circuit breaker furnished under this Contract, submit manufacturer's name, catalog data, and the following information:
   1. Terminal connection sizes.
   2. Cabinet dimensions.
   3. Finish data.
   4. Voltage rating.
   5. Breaker manufacturer, types, trip ratings and interrupting ratings.

B. Single Submittal - A single complete submittal is required for all products covered by this Section.

C. Closeout Submittals: Submit in accordance with Division 1 and Section 260500, operation and maintenance data for circuit breakers including nameplate data, parts lists, manufacturer's circuit breaker time current coordination curves, factory and field test reports and recommended maintenance procedures.

1.05 WARRANTY

A. Provide 1 year manufacturer’s warranty from date of owner acceptance.

1.06 QUALIFICATIONS

A. Manufacturer shall have a minimum of 20 years experience in the manufacture of circuit breakers.

B. Manufacturer shall be registered to ISO 9001, including in-house engineering for product design activities.

PART 2 - PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER

A. Molded case circuit breakers shall be 80 percent rated unless otherwise noted. molded case breaker with an over center toggle-type mechanism, providing quick-make, quick-break action. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Circuit breakers shall have variable magnetic trip elements, which are set by a single adjustment to assure uniform tripping characteristics in each pole.

B. Breakers shall be bolt-on type.

C. Breakers shall be calibrated for operation in an ambient temperature of 40°C.

D. Each circuit breaker shall have trip indication by handle position and shall be trip-free. Two and three pole breakers shall be common trip.

E. The circuit breakers shall be constructed to accommodate the supply connection at either end of the circuit breaker. Circuit breaker shall be suitable for mounting and operation in any position.

F. Breakers shall be UL listed and meet NEMA AB1 and Federal Specifications W-C-375.

G. Circuit breakers shall have removable lugs. Lugs shall be UL listed for copper and aluminum conductors. Breakers shall be UL listed for installation of mechanical screw type lugs.

H. Circuit breakers serving HACR rated loads shall be HACR type. Circuit breakers serving other motor loads shall be motor rated.

I. Breakers shall be rated as shown on Drawings.

J. Where shown on Drawings, provide circuit breakers with electronic trip unit with adjustable protection settings.
   1. Circuit breaker trip system shall be a MICROLOGIC electronic trip unit with true RMS sensing.
   2. Current transformers shall be used to ensure accurate measurements from low current up to high currents.
   3. Electronic trip unit shall be fitted with thermal imaging.
   4. The following monitoring functions shall be integral parts of electronic trip units:
      a. A test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.
      b. Provide LED for load indication at 105 percent.
      c. Provide LED for load indication at 90 percent of load for applications 600A and smaller
      d. Provide LED for visual verification of protection circuit functionality for applications 600A or smaller.
      e. Provide optional LED for trip indication for applications above 600A.
   5. MICROLOGIC trip unit functions shall consist of adjustable protection settings with the capability to be set and read locally by rotating a switch.
   6. Long-time pickup shall allow for adjustment to nine long-time pickup settings. This adjustment must be at least from 0.4 to 1 times the sensor plug (In), with finer adjustments available for more precise settings to match the application.
   7. Manufacturer: Square D - PowerPact H-Frame, J-Frame, L-Frame, P-Frame and R-Frame (15 amperes to 3000 amperes).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Circuit breakers shall be installed where indicated on the Drawings, and in accordance with the manufacturer's instructions.

3.02 MOUNTING

A. The highest breaker operating handle shall not be higher than 72 inches above the floor.

END OF SECTION

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SECTION 26 28 17

DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing disconnect switches as shown on the Drawings and as described herein.

B. Switches shall be of the type approved, indicated and specified herein.

1.02 RELATED WORK

A. See the following Specification Sections for work related to the work in this Section:
   1. 26 05 00 General Requirements for Electrical Systems

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. Underwriters Laboratories (UL):
      a. 98 - Enclosed and Dead Front Switches
   2. National Electrical Manufacturers Association (NEMA):
      a. Type 1 For indoor use primarily to provide a degree of protection against contact with the enclosed equipment
      b. Type 3R For outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation
      c. Type 4 For indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water
      d. 250 - Enclosures for Electrical Equipment (1000 Volt Maximum)
      e. KS 1 - Enclosed Switches

1.04 SERVICE ENTRANCE

A. Switches identified for use as service equipment are to be labeled for this application.

1.05 SUBMITTALS

A. Shop Drawings - Submittals shall be in accordance with Division 1. For each disconnect switch furnished under this Contract, submit manufacturer's name, catalog data, and the following information:
   1. Terminal connection sizes.
   2. Cabinet dimensions.
   3. Finish data.
   4. Voltage rating.
   5. Manufacturer, types, equipment rating for voltage, horsepower, amperage and fault current.

B. Single Submittal - A single complete submittal is required for all products covered by this Section.

C. Closeout Submittals: Submit in accordance with Division 1 and Section 26 05 00, operation and maintenance data for disconnect switches including nameplate data, parts lists, fuse manufacturer's time current coordination curves, factory and field test reports and recommended maintenance procedures.

PART 2 - PRODUCTS

2.01 ENCLOSURE

A. Provide NEMA Type 1 disconnect switches in dry interior locations and NEMA Type 4 disconnect switches in wet locations unless otherwise noted. NEMA Type 3R is acceptable for exterior locations if installed per manufacturer's recommendations.

2.02 SWITCH INTERIOR

A. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.

B. Lugs shall be front removable and UL Listed for 75º C conductors (30 -1200 ampere), aluminum or copper conductors for Type 1 or 3R, and copper conductors only for Type 4.

C. 30 through 100 ampere switches shall be equipped with field installed fuse pullers for Type 1 or Type 3R and factory installed fuse pullers for Type 4.

D. Switches required for Type 4 stainless steel applications shall have all copper current carrying parts.

E. All current carrying parts shall be plated to resist corrosion.

F. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.

G. Switches shall have provisions for a field installable electrical interlock.

2.03 SWITCH MECHANISM

A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.

B. The operating handle shall be an integral part of the box, not the cover.

C. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.

D. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle position.

E. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover

interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.04 SWITCH ENCLOSURES

A. Switch covers shall be attached with welded pin-type hinges for Type 1 or 4 stainless steel, and top hinged, attached with removable screws and securable in the open position for Type 3R.

B. Factory finish for NEMA Type 1 or 3R enclosures:
   1. All non-painted steel parts shall be zinc plated.
   2. All painted steel parts shall be cleaned and a zinc phosphate (outdoor equipment) or iron phosphate (indoor equipment) pre-treatment applied prior to paint application
   3. Paint Color shall be ANSI 61 (light gray) TGIC polyester powder, applied electrostatically through air. Following paint application, parts shall be baked to produce a hard durable finish. The average thickness of the paint film shall be 2.0 mils. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.
   4. Adequacy of paint finish to inhibit the buildup of rust on ferrous metal materials shall be tested and evaluated per paragraphs 5.2.8.1-7 of ANSI C37.20.3-1987. Salt spray withstand tests in accordance with paragraph 5.2.8.4 shall be performed on a periodic basis to provide conformance to this corrosion resistance standard of at least 2500 hours minimum (outdoor equipment) or 600 hours minimum (indoor equipment).

C. The enclosure shall be brush finished on type 304 stainless steel for Type 4-stainless steel.

D. The enclosure shall have ON and OFF markings stamped into the cover.

E. The operating handle shall be provided with a dual colored, red/black position indication.

F. All switches shall have provisions to accept up to three 3/8 in hasp padlocks to lock the operating handle in the OFF position.

G. Tangential knockouts shall be provided to facilitate ease of conduit entry for Type 1 and 3R switches rated 30-200A. Type 4 stainless steel enclosure shall contain no knockouts. Supply watertight hubs as required.

H. Enclosures for Type 3R switches through 200 ampere shall have provisions for interchangeable bolt-on hubs in the top endwall. Hubs shall be Square D B-Type hubs sized as indicated on the plans.

I. Cover sealing means for switches rated through 200 amperes shall be quick release trunk latches for Type 4 stainless steel.

J. Type 4 stainless steel enclosures shall be dual rated as Type 3R to facilitate their use in outdoor applications.

K. Cover viewing window will be incorporated on 30-200A NEMA 4 stainless steel, two or three pole switches.

2.05 SWITCH RATINGS

A. Switches shall be horsepower rated for AC and/or DC as indicated on the plans.

B. The UL listed short circuit current rating of the switches shall be:

1. 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere).
2. 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).
3. 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

C. Provide short circuit current rating matching available short circuit current.

2.06 MANUFACTURER

A. Disconnect switches shall be heavy duty type, manufactured by Square D Company or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Disconnect switches shall be installed where indicated on the Drawings, and in accordance with the manufacturer's instructions.

3.02 MOUNTING

A. The highest disconnect switches operating handle shall not be higher than 72 inches above the floor.

END OF SECTION

SECTION 26 31 00

PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing photovoltaic panels, wiring, inverters and controls as shown on the Drawings and as described herein. The system shall include all required components for a fully operational, grid tied system, to convert sunlight into AC electrical power whether or not specified herein. System shall comply with all utility company requirements for grid tied systems.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this Section:
   1. 26 05 00 General Electrical Requirements
   2. 26 05 19 Low Voltage Wire and Cable
   3. 26 28 17 Disconnect Switches
   4. 26 05 26 Grounding

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. Institute of Electrical and Electronics Engineers (IEEE):
      a. 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
      b. 929 Recommended Practice for Utility Interface of Residential and Intermediate Photovoltaic (PV) Systems
   3. National Electrical Manufacturers Association (NEMA):
      a. Type 3R - For outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation.
   4. Underwriters Laboratory (UL):
      a. 1741 Inverters, Converters, and Controllers for Use in Independent Power Systems

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Shop Drawings: As specified in Division 1. Submit manufacturer's descriptive literature and a shop drawing indicating all required components for a fully functioning system.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

D. Closeout Submittals: Submit operation and maintenance manuals for photovoltaic system. Include list of all components and contact information for a local factory authorized maintenance company. Submit in accordance with Division 1.

1.05 WARRANTY

A. Manufacturer shall warrant photovoltaic solar cells against defects in workmanship and material for a period of 20 years.

B. Photovoltaic module shall be provided with a 25 year limited product warranty.

C. Photovoltaic inverter shall be provided with a 10 year warranty against defects in workmanship and material with extend option to extend to 20 years.

D. Manufacturer shall provide monitoring service, feature upgrades, and warrant monitoring system against defects in workmanship and material for a period of 5 years.

E. Manufacturer shall warrant combiner box, isolation transformer, and DC fused disconnect switch against defects in workmanship and material for a period of 1 year.

1.06 QUALIFICATIONS

A. The contractor shall have at least 3 years experience successfully installing 3 phase, grid tied, photovoltaic systems of similar type and design and be a California licensed Electrical Contractor or shall have a contractual agreement with a subcontractor having such qualifications to do the work.

B. Prior to commencement of installation, submit data for review including: A list of five projects completed by installing contractor with photovoltaic module manufacturer, photovoltaic inverter manufacturer, and monitoring system manufacturer, system capacity (kW - DC) and owner reference for each project with contact information.

PART 2 - PRODUCTS

2.01 MONO-CRYSTALLINE SILICON MODULE

A. General: Photovoltaic Modules shall be polycrystalline type solar cells with minimum 20.1% conversion efficiency. Modules shall be 61.39 inches by 41.18 inches and 1.81 inches thick; and weigh 41 pounds.

B. Solar cells shall be encapsulated between a tempered glass cover and an EVA pottant with back sheet installed into an anodized aluminum frame.

C. Each module shall be rated 327 W at nominal operating voltage of 55 V, and shall be rated at 54.7 VDC maximum power voltage, 64.9 VDC open circuit voltage, 5.98 A DC maximum power current, and 6.46 A DC maximum short circuit current at Standard Test Conditions (STC).

D. Manufacturer: Sunpower SPR-327E-WHT or reviewed and approved equal.

2.02 PHOTOVOLTAIC INVERTER 1 PHASE

A. General: Provide a utility interactive, single phase, pulse width modulating, true sine-wave inverter to convert DC power from the photovoltaic solar cells to AC power. Inverter shall have peak efficiency of 97% and CEC weighted efficiency of 95.5%.

B. Output shall be 208 VAC, 60 Hz, 1 phase. Maximum AC output power shall be 6000 W, and maximum AC output current shall be 29 A. AC voltage range shall be between 183 and 229 V. AC frequency range shall be between 59.3 and 60.5 Hz.

C. Maximum DC input power at STC shall be 7200 W, maximum DC voltage shall be 600 V, with peak power tracking voltage of 250 to 600 VDC and maximum DC input current shall be 25 A, with a ripple current of less than 5% of rated current. Start voltage shall be 250 V.

D. Inverter shall provide over- and under-voltage and frequency protection shutting down inverter in compliance with UL 1741, and anti-islanding protection to prevent feedback of power onto the grid during a utility outage. Unit shall also provide over temperature protection, short circuit protection, over current protection and DC ground fault protection.

E. Inverter shall operate within an ambient temperature range of between -13°F and 113°F.

F. Inverter shall include integral DC disconnect switch and integral combiner for 6 fused series strings. Enclosure shall be cast aluminum, NEMA 3R type. Electronics enclosure shall be sealed and inverter shall include controlled forced ventilation and regulated fan cooling.

G. Unit shall sense power reductions at night and set the unit to night mode when losses exceed power input. Unit shall consume 1.5 W in night mode and less than 7 W in standby mode.

H. Unit shall automatically turn on when power increases above losses (night/day operation). Unit shall track power and compensate for cloud cover.

I. Provide RS485 interface.

J. Manufacturer: SunPower SPR-6000m or reviewed and approved equal

2.03 COMBINER BOX

A. General: Provide interface enclosure for paralleling multiple photovoltaic cell circuits (see single line diagram for number of circuits). Enclosures shall be NEMA 4 rated and suitable for the intended purpose. Protect each circuit with an individual touch safe fuse.

B. Manufacturer: SolarBos CCS Compact Solutions Combiner Box.

2.04 PERFORMANCE METER

A. The system shall include a California Energy Commission approved performance meter, per utility company requirements.

2.05 MONITORING SYSTEM

A. The system shall include all materials and labor required to provide a complete photovoltaic monitoring system, including California Energy Commission approved performance meter, data loggers, current transducers, environmental sensors, etc., to display the benefits of the of the PV installation.

B. The system shall be a remote, real-time, web-based, solar electric monitoring system capable of recording and transmitting real time and historical solar performance data. Solar electric performance data will be collected locally from the system, and then transmitted via the Internet

to a centralized database. Data shall be accessible from any device with a web browser, including PCs.

C. System shall display at a minimum:
   1. Instantaneous AC voltage, current and power
   2. Instantaneous DC voltage, current and power
   3. Building Instantaneous AC voltage, and power
   4. Cumulative AC and DC energy generation
   5. Cumulative building energy
   6. Sun Irradiance
   7. Wind Speed and direction
   8. Ambient temperature and cell temperature

D. Provide a display to help promote solar electric energy to the community. The display shall provide real-time information including a web-connected PC. The display shall be interactive, lighted, and suitable for use by all ages. Coordinate exact location with the architect. Display shall as a minimum include a 15" inch LCD display.

E. In addition to monitoring data, the system shall provide fault notification, track net building energy usage, and provide well-designed real time displays that are useful for educational purposes.

F. Manufacturer: Tigo Energy or California Solar Incentive (CSI) approved agency.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all components in accordance with the manufacturer's instructions.

B. Contractor shall be certified by the manufacturer to field install photovoltaic modules and inverters.

3.02 FIELD TESTS

A. Complete testing of the installed system shall be performed by a factory certified representatives prior to system start up. All required modifications shall be made and system signed off.

B. Grounding: Grounding shall conform to Section 26 05 26.

3.03 UTILITY INTERCONNECT

A. Contractor shall coordinate with the utility company to provide all grid intertie requirements and process all required paper work per utility company requirements. See specification Section 26 05 00

B. The photovoltaic contractor shall provide, submit and process all California Solar Initiative (CSI) and Federal Rebate and Tax Credit applications and documentation and render the full rebate or tax credit amounts to the owner. In addition, the photovoltaic contractor shall provide and install all CSI required Net Meters and photovoltaic system meters and a 2-year minimum

contract for photovoltaic system off-site monitoring, data collection and reporting to PG&E. Monitoring company shall be Tigo Energy or approved agency.

END OF SECTION

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SECTION 26 31 00.10

PHOTOVOLTAIC ENERGY MAXIMIZER AND SECURITY SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing photovoltaic energy maximizer system, as shown on the Drawings and as described herein, to maximize the AC electrical power conversion efficiency of a photovoltaic inverter and total net annual energy production of a photovoltaic system, provide the ability to deactivate the DC output of the system adjacent to each photovoltaic module for safety purposes and provide a theft detection system able to send an alarm to the client and the client's designated security company if a photovoltaic module is disconnected from the system.

B. Each system shall include all required components including all cabling, module maximizer, wireless gateways, management units and software to maximize the AC output of a photovoltaic array. The contractor shall provide all components required for a fully operational system whether or not specified herein. System shall comply with all utility company requirements for grid tied photovoltaic systems.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this Section:
   1. 26 05 00 General Electrical Requirements
   2. 26 31 00 Photovoltaic System
   3. 26 05 26 Grounding

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. Equipment shall be Underwriter Laboratories (UL) listed.

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Shop Drawings: As specified in Division 1. Submit manufacturer's descriptive literature and a shop drawing indicating all required components for a fully functioning system.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

D. Closeout Submittals: Submit operation and maintenance manuals for photovoltaic system. Include list of all components and contact information for a local factory authorized maintenance company. Submit in accordance with Division 1.

1.05 WARRANTY

A. Manufacturer shall warrant the system against defects in material or workmanship for a period of 10 years and photovoltaic module output of not less than 80% of the photovoltaic panel's published minimum peak power rating for a period of 20 years if determined by the manufacturer to be due to defects in the material or workmanship of the system.

1.06 QUALIFICATIONS

A. The contractor shall have at least 3 years experience successfully installing 3 phase, grid tied, photovoltaic systems of similar size, type and design and be a California licensed Electrical Contractor or shall have a contractual agreement with a subcontractor having such qualifications to do the work.

B. Prior to commencement of installation, submit data for review including: A list of five projects completed by installing contractor with photovoltaic module manufacturer, photovoltaic inverter manufacturer, and monitoring system manufacturer, system capacity (kW - DC) and owner reference for each project with contact information.

PART 2 - PRODUCTS

2.01 MODULE MAXIMIZER (MM)

A. Provide one Module Maximizer (MM) per photovoltaic module. MM shall be designed to be mounted on the underside of the Photovoltaic Module frame. MM shall be rated NEMA 3R. Unit shall be provided with properly sized leads to connect the unit to its associated photovoltaic module and the next unit in the string with a minimum of extra wiring. Match unit with photovoltaic module properties per manufacturer's recommendation.

B. Operating Characteristics

Input Data	MM-ES50	MM-ES75	MM-ES110	MM-ES170
Maximum Power	300W	350W	300W	300W
Max Input DC Voltage (Voc)	52V	75V	110V	170V
Vmp range	16-48V	30-65V	30-89V	30-140V
Maximum cont. current (Imp)	9.5A	6.5A	4.7A	2.6A
Maximum input current (Isc)	10A	7.5A	5A	3A

Output Data (DC)	MM-ES50	MM-ES75	MM-ES110	MM-ES170
Maximum Output Power	300W	350W	300W	300W
Maximum cont. current (Imp)	9.5A	6.5A	4.7A	2.6A
Nominal Voltage/range	variable	variable	variable	variable

Mechanical Data	
Operating temperature range	-30°C to +70°C
Cooling	Natural convection
Enclosure rating	NEMA 3R, IP-65

C. MM shall use impedance matching technology to actively manage power output. Unit shall communicate operational data, performance data and control commands wirelessly with the Management Unit via a Wireless Gateway.

D. MM shall provide constant sensing of photovoltaic module presence for theft detection purposes. The central controller shall send a periodic signal to each module and receive an acknowledgement. Module shall also be capable of shutting down an arc fault in the system.

E. MM shall allow disconnection the associated photovoltaic module from the system for safety purposes via a manual master control at the Management Unit, or automatically if the Management Unit detects malfunctions at the photovoltaic module.

F. Manufacturer: Tigo Energy – MM-ES series or approved equal.

2.02 WIRELESS GATEWAY (WG)

A. Provide one Wireless Gateway (WG) per maximum 72 MM's. WG's shall wirelessly communicate with the MM's and support communication between the Maximizer Management Unit (MMU) and the associated MM's.

B. WG's shall be daisy chained together back to the head end MMU using RS-485 cables. WG's should be placed per manufacturer's recommendations close to the center of the modules they are monitoring.
   1. WG's shall be located maximum 40 feet from the associated MM's.

C. Maximum distance between MMU and first WG and between WG's shall not exceed manufacturer's recommendations. Maximum total distance between MMU and last WG shall not exceed 4000 feet.

D. Final WG in a daisy chain shall be terminated. Coordinate with manufacturer for requirements.

E. Manufacturer: Tigo Energy – Wireless Gateway or approved equal.

2.03 MAXIMIZER MANAGEMENT UNIT (MMU)

A. The MMU shall communicate with each PV module in the system, provide management and control functions for the MM, and serve as a gateway to the Data Center.

B. Provide one MMU per maximum 5 WG's and 360 MM's/Photovoltaic Modules. MMU shall be located adjacent to the Photovoltaic System Inverter. MMU shall be rated NEMA 3. MMU shall be provided with a lead to connect an RS-485 cable to its associated WG's. MMU shall collect data from the MM on one second intervals and provide revenue grade accuracy.

C. The MMU has a manual user interface and LCD display for onsite programming.

D. The MMU shall be pre-configured with CAT-5 Ethernet access. Units shall offer optional wi-fi or cellular communication modules.

E. The MMU shall include a manual emergency shutdown button located on the front of the MMU. The system shall enable each module to be electrically removed from the high voltage DC cabling limiting the voltage exposure to the open-circuit voltage (Voc) of a single module.

F. The MMU shall be provided with software to allow secure remote access to the MMU through any internet-enabled computer. Software shall have individual views available for system owners, installers, and emergency services personnel. Views shall include simple, easy-to-understand graphics to allow for quick analysis of the real-time output and historical

performance of each system, and the ability to view and remedy system faults, error codes or issue alerts.

1. MMU software shall allow remote shutdown of the array from the MM to the inverter, for routine maintenance or emergency reasons.
2. Software shall be capable of detecting arc faults on a module and sending a shut down signal to the MM. Software shall also be capable of detecting thermal over-stress from hot-spots and malfunctioning bypass diodes and automatically alert the system operator to the problem and pinpoint the specific module having the issue.
3. Software shall be capable of detecting temporary over voltage due to cold, clear conditions outside the normal operating range and "clipping" the input voltage to prevent inverter shutdown and keep the system running as efficiently as possible.
4. System shall be customizable to provide a user friendly, internet accessible graphical display including photographs of the installation, schematic diagram and historic and real time production.

G. MMU shall be capable of sending an alert, make a phone call or e-mail a local operator if more than 2 modules in the string do not acknowledge the controller.

H. Manufacturer: Tigo Energy – Maximizer Management Unit or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all components in accordance with the manufacturer's instructions. Contractor shall be certified by the manufacturer to field install photovoltaic modules and inverters.

B. Provide 120V duplex power outlet adjacent to the MMU for system power. Provide a data connection for Internet access.

1. For outdoor MMU installations, provide weatherproof housing for AC power adapter and data connection.

3.02 FIELD TESTS

A. Complete testing of the installed system shall be performed by a factory certified representatives prior to system start up. All required modifications shall be made and system signed off.

3.03 UTILITY INTERCONNECT

A. Contractor shall coordinate with the utility company to provide all grid intertie requirements per utility company requirements.

END OF SECTION

SECTION 265000

LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of providing a lighting system complete, including fixtures, lamps, bracing, hangers, reflectors, glassware, lenses, poles, bases, auxiliary equipment, ballasts and sockets.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 05 19 Low Voltage Wire and Cable
   3. 26 05 32 Junction and Pull Boxes for Electrical Systems
   4. 26 05 33 Raceways and Fittings for Electrical Systems

1.03 STANDARDS AND CODES

A. All work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. Certified Ballast Manufacturers (CBM)
   3. Underwriters Laboratories (UL) Standard:
      a. 935 Standard for Fluorescent-Lamp Ballasts
      b. 1594 Luminaires

1.04 SUBMITTALS

A. As specified in Division 1 and Section 26 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature including data, photometric curves for each fixture configuration proposed.

C. Submit shop drawings showing proposed methods for mounting lighting fixtures.

D. Seismic Requirements, submit:
   1. Sketch or description of the anchorage system.

E. Submit Operation and Maintenance Data per Division 1.

1.05 WARRANTY

A. Lamps that fail within the first year after final acceptance shall be replaced by the Contractor subject to the applicable provisions of the General Provisions.

B. Ballasts that fail within three years after final acceptance shall be replaced by the Contractor subject to the applicable provisions of the General Provisions.

C. Contractor shall be responsible for providing material and labor to replace failed lamps and ballasts. This responsibility shall not be transferred to the distributor, supplier or manufacturer of the equipment.

PART 2 - PRODUCTS

2.01 FIXTURES

A. Fixtures shall be of the types, wattages, and voltages shown on the Drawings and comply with UL 1598.

B. Substitutions will not be considered unless the photometric distribution curve indicates the proposed fixture is equal to or exceeds the specified luminaire.

C. Luminaire wire and the current carrying capacity thereof shall be in accordance with the CEC.

D. Luminaires and lighting equipment shall be delivered to the project site complete, with suspension accessories, aircraft cable, stems, canopies, hickeys, castings, sockets, holders, ballasts, diffusers, frames, supports, braces, and related items.

2.02 BALLASTS

A. Ballasts shall be shall be suitable for lamps specified, high power factor and of the types shown on the drawings. Ballasts shall bear the UL label.
   1. Electronic ballasts shall be high frequency by Advance, Osram/Sylvania, or approved equal.
   2. All fluorescent ballasts shall be UL 935 listed and program start type to increase lamp life unless otherwise noted.
      a. Fluorescent dimming ballasts shall be by Advance or Lutron unless otherwise specified.

B. All ballasts for fixtures installed outdoors shall provide reliable starting of lamps at 0°F at 90% of the nominal line voltage.

C. Ballasts producing excessive noise (above 36 dB) or vibration will be rejected and shall be replaced at no expense to the Owner.

2.03 LAMPS

A. Lamps shall be new at the time of acceptance and shall be Phillips or approved equal by General Electric, Osram/Sylvania unless otherwise noted.

B. Fluorescent lamps shall have a color temperature of 3500 degrees Kelvin, unless noted otherwise on the drawings. Other lamps shall be as noted on the drawings.

C. Where available from the approved manufacturer(s), lamps shall be California TTLC (total threshold limit concentration) compliant.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. All fixtures and luminaires shall be clean and lamps shall be operable at the time of acceptance.
   2. Install luminaires in accordance with manufacturer's instructions, complete with lamps, ready for operation as indicated.
   3. Align, mount, and level the luminaires uniformly.
   4. Avoid interference with and provide clearance for equipment. Where an indicated position conflicts with equipment locations, change the location of the luminaire by the minimum distance necessary.
   5. Wear protective hand covering to prevent fingerprints on lamps, reflectors and other sensitive lighting fixture parts.
   6. Keep protective coverings provided by the manufacturer in place until beneficial occupancy. If covers are removed prematurely and contamination of critical surfaces occurs, the associated surfaces are to be replaced by the Contractor at no cost to the owner.

B. Exterior Fixtures:
   1. Exterior flood fixtures:
      a. Provide photometrics for the specific installation showing the overall area, maintained foot-candles, specific pole or other mounting locations, mounting height, variables used for calculating maintained foot-candles, and specific aiming targets.
      b. Locate the aiming targets and aim each individual fixture directly at the target. Include overtime as necessary.
      c. Confirm the anticipated foot-candles with a light meter with calibration documentation not more than ninety days old. Include overtime as necessary.
      d. Provide safety cables on fixtures.
   2. Poles:
      a. Provide seismic calculations as necessary to validate the pole bases.
      b. Grout bases after the poles have been aligned.
      c. Provide grounding stud.
      d. Provide hand hole near the bottom and as appropriate at other locations.
      e. Support cables and conductors rising within the poles in accordance with the applicable code sections.
      f. Provide anchor bolt covers.

C. Mounting and Supports:
   1. Mounting heights shall be as shown on the Drawings. Unless otherwise shown, mounting height shall be measured to the centerline of the outlet box for wall-mounted fixtures and to the bottom of the fixture for all other types. Coordinate with the architectural details and advise Engineer of any conflicts encountered
   2. Luminaire supports shall be anchored to structural members.
   3. Luminaire mounting shall comply with UBC seismic zone 4 requirements.
   4. Refer to fixture mounting details on drawings for installation requirements.
   5. Pendant Fixture Mounting: Provide flexible fixture hangers unless otherwise noted on Drawings: Crouse-Hinds, type ARB, Appleton, type JBX-CS, or approved equal.
   6. Provide seismic bracing on pendant fixtures as necessary to insure that pendant and other mount fixtures do not impact walls, beams, ductwork, pipes, other fixtures or obstructions within 45 degrees of normal mounting angle.
   7. Provide seismic calculations on mounting unless exception is provided in writing from the Engineer.
   8. All pendant fixtures are to have a dedicated safety cable.
   9. Fixtures in excess of 25 pounds are not to be supported from the box but are to be supported directly by the structure.

10. If and as appropriate, provide fixture studs, fixture “hickies”, etc to provide a complete and safe installation. Include the installation of these components in the “box fill calculations”.

3.02 LAMPS

A. Lamps that are used for any purpose prior to acceptance by the owner, are to be replaced with new lamps before acceptance:
   1. As an alternative and subject to acceptance by the owner, Contractor may offer to provide a quantity of replacement lamps to the Owner equal to the total quantity of lamps on the project

END OF SECTION

SECTION 26 51 01

DIGITAL LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of providing but is not limited to the following: digital lighting control system consisting of room controller with inputs from digital occupancy sensors, photocells and manual switches. All devices shall be fully compatible.

B. See the following specification sections for work related to the work of this section:
   1. 26 05 00 General Requirements for Electrical Systems
   2. 26 50 00 Lighting

1.02 SUBMITTALS

A. In accordance with Section 16010.

B. Shop Drawings:
   1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
   2. Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:
   1. Indicates where sensor is proposed to be installed.
   2. Prove that the sensor is suitable for the proposed application.

E. Submit Operation and Maintenance Data per Division 1.

1.03 STANDARDS AND CODES:

A. California Electrical Code (CEC):
   1. Article 725, Class 2 remote control systems.

B. Underwriters Laboratories (UL) Standard:
   1. UL 916 Energy Management Equipment

C. The lighting control system shall also be listed or approved by all national, state and local energy codes to include but not limited to California Title 24 requirements.

1.04 QUALIFICATIONS OF MANUFACTURER

A. Manufacturer shall be regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Manufacturer shall be ISO 9001 certified.

B. Substitutions shall forward a letter of compliance indicating qualifications, including a brief list of installations, prior to bidding in accordance with Section 01 25 00.

1.05 WARRANTY

A. Entire system shall carry a warranty as noted in the General Provisions. Equipment shall be warranted for 5 years.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control and Automation system as defined under this section covers the following equipment:
   1. Digital Room Controllers – Self configuring, digitally addressable one, two or three relays controllers with 0-10v control for ballasts (if applicable) and single relay application specific plug load controllers.
   2. Digital Occupancy Sensors – Self configuring, digitally addressable and calibrated occupancy sensors with LCD screens and two way active Infra-Red (IR) communications.
   3. Digital Switches – Self configuring, digitally addressable push button switches, dimmers, and scene switches with two way active Infra-Red (IR) communications.
   4. Digital Photosensors – Single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
   5. Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.
   6. Configuration Tools – Handheld remote for room configuration provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send and receive of room variables and store of occupancy sensor settings. Computer software also customizes room settings.
   7. Digital Lighting Management (DLM) local network – Free topology, plug in wiring system (Cat 5e) for power and data to room devices.

2.02 ROOM CONTROLLERS

A. Room Controllers automatically bind the room loads to the connected devices in the space without any tools or configuration requirements. Room Controllers shall be provided to match the room lighting load and control requirements and sequences. The controllers will be simple to install and will not have screw type connections, dip switches, potentiometers or require special mounting or configuration. The control units will include the following features:
   1. Automatic room configuration to the most energy efficient sequence of operation based upon the devices in the room.
   2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an Off-the-Shelf unit without requiring any configuration or setup.
   3. Device Status LED's to indicate:
      a. Data transmission
      b. Device has power
      c. Status for each load

d. Configuration status
4. Quick installation features including:
   a. Standard junction box mounting (inside or outside)
   b. Quick low voltage connections using standard RJ-45 patch cable
5. Plenum rated
6. Manual override and LED indication for each load
7. Universal voltage (120/230/277 VAC, 50-60 Hz)
8. Zero cross circuitry for each load.

B. On/Off Room Controllers shall include:
1. One or two relay configuration
2. Efficient 150 mA switching power supply
3. Three RJ-45 DLM local network ports
4. Manufacturer: The Watt Stopper LMRC-101, LMRC-102,

C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
2. One, two or three relay configuration
3. Efficient 250 mA switching power supply
4. Four RJ-45 DLM local network ports.
5. One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
6. Optional Network Bridge for BACnet MS/TP communications (LMRC-3xx).
7. The following dimming attributes may be changed or selected using a wireless configuration tool:
   a. Establish preset level for each load from 0-100%
   b. Set high and low trim for each load
   c. Set lamp burn in time for each load up to 100 hours
8. Manufacturer: The Watt Stopper LMRC-211, LRMC-212, LRMC-213, LMRC-311, LMRC-312, LMRC-313 or approved equal.

2.03 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Wall or ceiling mounted (to suit installation) passive infrared, ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square footage coverage requirements for each area controlled, utilizing Room Controller modules and accessories which suits the lighting and electrical system parameters.

B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
1. Digital calibration and LCD entry for the following variables:
   a. Sensitivity 0-100% in 10% increments
   b. Time Delay – Fixed (1-30 minutes in 1 minute increments), and automatic
   c. Test mode – Five second time delay
   d. PIR, Ultrasonic or Dual Technology activation and/or re-activation.
   e. Walk-through mode
   f. Load parameters including auto/manual ON, blink warning, and daylight enable/disable.
2. One or two RJ-45 digital connections for DLM local network.
3. Two-way infrared communications port to allow remote programming through hand held commissioning tool.
4. Device Status LED's including:

a. PIR Detection
b. Ultrasonic detection
c. Configuration mode
d. Load binding

5. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
6. Manual override of controlled loads.

C. Units will provide for digital calibration and commissioning and will not have any dip switches or potentiometers for field settings

D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required

E. Manufacturer: The Watt Stopper LMPX, LMDX, LMPC, LMUC, LMDC or approved equal.

2.04 SINGLE / DUAL RELAY WALL SWITCH VACANCY SENSORS

A. Passive infrared sensing technology- Type PW: Manual ON, Automatic OFF Wall switch type passive infrared occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Watt Stopper PW-100, PW-200 PW-103, PW-203 or approved equal.

B. Ultrasonic sensing technology- Type UW: Manual ON, Automatic OFF Wall switch type ultrasonic occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Watt Stopper UW-100, UW-200 or approved equal.

C. Dual-tech (utilizing both passive infrared and ultrasonic) sensing technology- Type DW: Manual ON, Automatic OFF Wall switch type dual technology, passive Infrared and ultrasonic occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Watt Stopper DW-100, DW-200, DW-103, DW-203 or approved equal.

2.05 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration (as indicated in drawings); available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:
1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
2. Removable buttons for field replacement with engraved buttors and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
3. Red configuration LED on each switch that blinks to indicate data transmission.
4. Blue Load/Scene Status LED on each switch button with the following characteristics:
a. Bi-level LED
b. Dim locator level indicates power to switch
c. Bright status level indicates that load or scene is active
5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

B. Two RJ-45 ports for connection to DLM local network.

C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.

D. The following switch attributes may be changed or selected using a wireless configuration tool:
   1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
   2. Individual button function may be configured to Toggle, On only or Off only.
   3. Individual scenes may be locked to prevent unauthorized change.
   4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
   5. Ramp rate may be adjusted for each dimmer switch.
   6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.

E. Manufacturer: The Watt Stopper LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101 or approved equal.

2.06 DIGITAL PHOTOSENSORS

A. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.

B. Digital photosensors include the following features:
   1. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
   2. Sensor light level range shall be from 1-10,000 footcandles (fc).
   3. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
   4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling after they turn off.
   5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
   6. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
   7. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
   8. Red configuration LED that blinks to indicate data transmission.
   9. Blue status LED indicates test mode, override mode and load binding.
   10. Recessed switch to turn controlled load(s) ON and OFF.

11. One RJ-45 port for connection to DLM local network.
12. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.

C. Closed loop digital photosensors include the following additional features:
1. An internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from bright sources outside of this cone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes setpoints following self-calibration.
4. A sliding setpoint control algorithm for dimming daylight harvesting with a "Day Setpoint" and the "Night Setpoint" to prevent the lights from cycling.
5. Manufacturer: The Watt Stopper LMLS-400.

D. Open loop digital photosensors include the following additional features:
1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
3. A proportional control algorithm for dimming daylight harvesting with a "Setpoint" to be maintained during operation.
4. Manufacturer: The Watt Stopper LMLS-500 or approved equal.

2.07 ROOM NETWORK

A. The DLM local network is a free topology lighting control network and protocol designed to control a small area of a building. Digital room devices connect to the network using RJ-45 patch cords which provide both data and power to room devices. Features of the DLM local network include:
1. Automatic configuration and binding of sensors, switches and lighting loads to the most energy efficient sequence of operation based upon the device attached.
2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
3. Push and Learn configuration that can change the automatic binding process and load parameters by using only the digital devices in the room.
4. Two way infrared communications that allow load parameters, sensor configuration and binding operations to be configured through a hand held configuration tool up to 30 feet from any device

PART 3 - EXECUTION

3.01 INSTALLATION

A. Proper judgment shall be exercised in executing the installation to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of architectural, mechanical, lighting or structural components.

B. Identification:
1. Control Module Panels shall have nameplates in accordance with Section 16010.

C. System Installation:

1. Before installation coordinate exact placement of photocells with manufacturer's factory authorized technician.
2. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and placement of photocell and all related equipment to ensure a trouble-free daylighting control system.

3.02 SYSTEM STARTUP:

A. Manufacturer shall provide a factory authorized technician for commissioning to confirm proper installation and operation of all system components. Technician shall program system as scheduled on the drawings. If no schedule is provided obtain desired schedule form engineer prior to commissioning.

3.03 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.

C. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.04 TRAINING

A. Manufacturer shall provide factory authorized application engineer to train Owner personnel in the operation and programming of the lighting control system. Provide a minimum of two (4) hours of training to Owner representatives.

B. System Installation and Operation Manual shall be provided to the owner, including list of recommended spare parts.

END OF SECTION

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SECTION 270500

GENERAL REQUIREMENTS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all required labor, supervision, materials and equipment (except equipment furnished by the Owner to be installed by the Contractor) to satisfactorily complete the work shown on the drawings and/or specified in all Sections of Division 27 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete and fully operating facility. The work shall include but not be limited to the following:
   1. Furnish and install all required in-place equipment, conduits, conductors, cables and any miscellaneous materials for the satisfactory interconnection and operation of all associated communication systems.

1.02 RELATED WORK

A. This Section provides the basic Communication Requirements which supplement the General Requirements of Division 1 and apply to all Sections of Division 27.

1.03 STANDARDS AND CODES

A. All work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. American National Standards Institute (ANSI) Publications:
      a. C2-02 National Electrical Safety Code
   3. Code of Federal Regulations (CFR):
      a. 29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)
   4. Electronics Industries Association (EIA)
   5. Building Industry Consultants Society International (BICSI)
   6. Institute of Electrical and Electronics Engineers (IEEE)
   7. National Electrical Testing Association (NETA):
      a. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, Standard ATS
   8. National Electrical Manufacturers Association (NEMA)
   9. Occupational Safety and Health Act (OSHA) Standards
   10. State of California Public Utilities Commission:
      a. General Order 128 Rules for Construction of Underground Electric Supply and Communication Systems

B. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.

C. Underwriter Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, may be substituted for UL labeling and listing

if acceptable to the Owner. Provide service entrance labels for all equipment required by the NEC to have such labels.

1.04 SUBMITTALS

A. As specified in Division 1. Submit to the Engineer shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system specified. Obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review.

B. Submittals are required for all items, regardless of whether they are furnished as specified or are substituted.

C. Information to be submitted includes manufacturer's name, trade name, equipment model number, nameplate data, equipment drawings including: size, layout dimensions and capacity, manufacturer's descriptive literature of cataloged products, diagrams, test data, and performance and characteristic curves as applicable. Furnish project specification and paragraph reference, applicable Federal, Industry and Technical Society Publication References, and years of satisfactory service of each item required to establish contract compliance. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval.

D. If submittal information includes multiple products, items being submitted for approval shall be clearly identified and Items not to be used on the project shall be clearly marked out.

E. Organize submittals for equipment and items related to each specification section together as a package.

F. Submit submittal packages in digital form (PDF files or simimlar).
   1. Refer to specification section 01 33 00 for additional information.

G. Substitutions:
   1. Refer to specification section 01 25 00 for additional information.

H. Closeout Submittals:
   1. Cost analysis: Submit final cost information including original bid and any change orders broken down by system, material and labor costs (as applicable):
      a. Public Address System
      b. Telecom System
      c. Data System
      d. Audio/Visual System
   2. Operation and Maintenance Manuals. Furnish O & M Manuals for equipment where manuals are specified in the equipment specifications or are specified in Division 1. Electrical O & M Manuals shall include as a minimum:
      a. Copies of equipment supplied on the project.
      b. Instruction manuals including operation instructions and maintenance requirements/recommendations.
      c. List of suppliers for all equipment with addresses and telephone numbers.
      d. List of service support for all equipment with addresses and telephone numbers.
      e. Copies of all test reports required in Division 27 specification sections.
      f. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.

g. Other closeout documentation and test results as required under other sections of the specifications.
h. Provide in a single transmittal.
i. Warranty for all work, including contractor's general warranty.
j. All warranties begin as per the Contract, Division 1 or final acceptance of the Work by the Owner, Architect, Engineer, and Authority Having Jurisdiction, which ever is later:
   i. Manufacturer's Warrantees and Guarantees that are longer than the base contract/specified amount are to be provided with the manuals.
   ii. The Contractor is responsible for all Warranty and Guarantee work whether or not the Manufacturer also Warrantees and Guarantees the product.

1.05 CONTRACT DOCUMENTS

A. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations:
   1. Should there be a need to deviate from the Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.
   2. All drawings and divisions of these specifications shall be considered as whole. This contractor shall report any apparent discrepancies prior to submitting bids.
   3. Should there be a conflict or discrepancy between the drawings and specifications, the most expensive option shall be required, at the discretion of the Engineer.

B. Drawings:
   1. The Drawings shall govern the general layout of the completed construction:
      a. Locations of equipment, inserts, anchors, panels, pullboxes, manholes, conduits, stub-ups, fittings, outlets, racks, devices and ground connections are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
      b. The general arrangement and location of existing conduits, piping, apparatus, etc., is shown as existing on drawings or specified. The drawings and specifications are for the assistance and guidance of the contractor, exact locations, distances and elevations are governed by actual field conditions. Extreme accuracy of data given herein and on the drawings is not guaranteed. Minor changes may be necessary to accommodate work. The contractor is responsible for verifying existing conditions. Should it be necessary to deviate from the design due to interference with existing conditions or work in progress, claims for additional compensation shall be limited to those for work required by unforeseen conditions as determined by the Engineer.

1.06 COORDINATION

A. Coordinate the communications work with the other trades, code authorities, utilities and the Engineer:
   1. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.
   2. Coordinate does not mean to only send a Request For Information. Coordinate implies that the contractor is to take the lead in bringing all of the necessary organizations together to coordinate the work and to provide for the associated costs.

B. Where connections must be made to existing installations, properly schedule all the required work, including the power or communication system shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the Owner's facilities:

1. Include costs for work during non-normal working hours and temporary facilities as may be required.
2. Include costs as necessary for sub-contractors to accomplish the specified work.

C. When two trades join together in an area, make certain that no communications work is omitted. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.

D. Operations:
1. Perform all work in compliance with Division 1:
   a. Keep the number and duration of power shutdown periods to a minimum.
   b. Show all proposed shutdowns and their expected duration on the construction schedule:
      i. If the construction schedule is created and maintained by others, make sure that the associated information is incorporated.
      ii. Failure by the Contractor to properly schedule and plan for such activities is not a basis for additional compensation.
   c. Carry out shutdown only after the Engineer has favorably reviewed the schedule. Submit power/communications interruption schedule 15 days prior to date of interruption. Failure to provide schedule with adequate review time may result in rescheduling of the work at the Contractor's expense.

E. Construction telephone:
1. See Division 1 Temporary Utilities.

F. Storage:
1. Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from sun, weather, condensation, dust, water, or construction operations.

G. Damaged Products:
1. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain approval from the Engineer before making repairs to damaged products.

H. Order material in such a timely manner and after approval of the same so as to insure that the approved material is available to be installed on site in a timely manner. Additional costs or substitutions necessitated because the Contractor failed to order material in a timely manner are not reimbursable. Costs associated with processing of paperwork by the owner and design consultants resultant of such failures to coordinate the work by the Contractor shall have such costs reimbursed by the Contractor.

1.07 LOCATIONS

A. General:
1. Use equipment, materials and wiring methods suitable for the types of locations in which they are located:
   a. Dry Locations:
      i. All those indoor areas which do not fall within the definition below for Wet Locations and which are not otherwise designated on the Drawings.
   b. Wet Locations:
      i. All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.

1.08 SAFETY AND INDEMNITY

A. The Contractor is solely and completely responsible for conditions of the job site including safety of all persons and properly during performance of the work. This requirement will apply continually and not be limited to normal working hours:
   1. No act, service, drawing review or construction review by the Owner, the Engineer or their Consultants is intended to include reviews of the adequacy of the Contractors safety measures in or near the construction site.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY

A. Material and Equipment:
   1. Provide materials and equipment that are new and are current products of manufacturers regularly engaged in the production of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period includes use of equipment and materials of similar size under similar circumstances. For uniformity, only one manufacturer will be accepted for each type of product.

B. Service Support:
   1. Submit a certified list of qualified permanent service organizations including their addresses and qualification for support of the equipment. These service organizations shall be convenient to the equipment installation and able to render service to the equipment on a regular and emergency basis during the warranty period of the contract.

C. Manufacturer's Recommendations:
   1. Where installation procedures are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendation shall be cause for rejection of the equipment or material.

2.02 NAMEPLATES

A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings, the model designation, and shop order number.

B. Additionally, identify each piece of equipment and related controls with a rigid laminated engraved plastic nameplate. Unless otherwise noted, nameplates shall be melamine plastic 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches unless otherwise noted. Where not otherwise specified, lettering shall be a minimum of 0.25 inch high normal block style. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscriptions are indicated on the Drawings, furnish nameplates with appropriate inscriptions furnished by the Engineer upon prior request by the Contractor.

2.03 FASTENERS

A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel.

2.04 FINISH REQUIREMENTS

A. Equipment:
   1. Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish which as been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.

B. In finished areas, paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ensure that all equipment and materials fit properly in their installation.

B. Perform any required work to correct improperly fit installation at no additional expense to the owner.

C. Equipment Installation:
   1. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
   2. Mount all metal panels or cabinets which are mounted on or abutting concrete walls or any outside walls ¼ inch from the wall, and paint the back sides of the panels with Mobil Hi-Build Bituminous Coating 35-J-10, Kopper Bitumastic Super Tank Solution, or equal. Film thickness shall be 10 mils minimum.

D. Cutting, Drilling and Welding:
   1. Provide the required cutting, drilling welding that is required for the electrical construction work. Comply with Division 1 requirements.
   2. Structural members shall not be cut or drilled, except after approval by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.
   3. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel. Where welding is required, it shall be accomplished by tradesmen certified to do such work. Provide fire and other protection as appropriate.

3.02 FIELD TESTS

A. Test shall be in accordance with Acceptance Testing recommendations issued by the NIA/TIA for telecommunications equipment and the manufacturers recommendations for equipment other than telephone or data systems.

B. Perform equipment field tests and adjustments. Properly calibrate, adjust and operationally check all components, and demonstrate as ready for service. Make additional calibration and adjustments if it is determined later that the initial adjustments are not satisfactory for proper performance. Perform equipment field test for equipment where equipment field tests are specified in the equipment Specifications. Give sufficient notice to the Engineer prior to any test so that the tests may be witnessed.

C. Provide instruments, other equipment, temporary facilities as may be necessary, and material required for the tests. These shall be of the type designed for the type of tests to be performed and shall be calibrated by a recognized testing laboratory within three months prior to testing.

D. Operational Tests: Operationally test all drops to demonstrate that the circuits and equipment have been properly installed and adjusted and are ready for full-time service. Demonstrate the proper functioning of drops in all modes of operation.

E. Re-testing will be required for all unsatisfactory tests after the equipment or system has been repaired. Re-test all related equipment and systems if required by the Engineer. Repair and re-test equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.

F. Perform calibration and adjustment on all equipment. Where the values for adjustment are not shown on the Drawings, obtain the proper values from the Engineer.

G. Maintain records of each test and submit five copies to the Engineer when testing is complete. All tests shall be witnessed by the Engineer. These records shall include:
   1. Name of equipment tested.
   2. Date of report.
   3. Date of test.
   4. Description of test setup.
   5. Identification and rating of test equipment.
   6. Test results and data.
   7. Name of person performing test.
   8. Owner or Engineer's initials.

H. Items requiring testing as a minimum:
   1. Data system.
   2. Telephone system.
   3. Intercom/PA system.
   4. Audio/Visual system.

3.03 PAINTING OF EQUIPMENT

A. Factory Applied: Communication equipment shall have factory applied painting system which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical section.

B. Field Applied: Paint communication equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.04 SIGNAGE

A. Nameplate Mounting:
   1. Provide number, location and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws or two rivets.

3.05 "AS-BUILT" DRAWINGS

   1. Comply with Section 01 78 39 - Project Record Documents.

3.06 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
   1. Single line diagrams, wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
   2. Start up, proper adjustments, operating and shutdown procedures.
   3. Safety precautions.
   4. The procedure in the event of equipment failure.
   5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

3.07 INSTRUCTION TO OWNER'S PERSONNEL

A. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or systems has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall maintain an attendance sheet from each session which contains the following information:
   1. Attendees with associated arrival and departure time.
   2. Topics covered.
   3. Information provided.
   4. Signatures of attendees taken at the completion of the session.

3.08 CLEAN UP

A. Thoroughly clean all soiled surfaces of installed equipment and materials.

B. Upon completion of electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Engineer.

END OF SECTION

SECTION 270526

COMMUNICATION SYSTEM GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of furnishing, installing, connection and testing of all grounding systems as specified herein and as shown on the Drawings.

1.02 RELATED WORK

A. See the following specification sections for work related to work in this section:
   1. 27 05 00 General Requirements for Communication Systems
   2. 27 10 00 Wire and Cables for Communication Systems
   3. 27 20 00 Data Communications
   4. 27 30 00 Voice Communications

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC):
      a. 250 Grounding
   2. American Society for Testing and Materials (ASTM) Publication:
      a. B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
      b. B228 Standard Specification for Concentric-Lay-Stranded Copper-Clad Steel Conductors
   3. Institute of Electrical and Electronics Engineers (IEEE):
      a. 81 Guide for Safety in AC Substation Grounding
   4. EIA/TIA Standards

1.04 SUBMITTALS

A. As specified in Division 1 and Section 27 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

1.05 QUALITY ASSURANCE

A. Each and every concealed connection must be inspected by the Owner's Representative before it is covered up by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

A. The grounding system shall consist of the grounding conductors, ground bus, ground fittings and clamps, and bonding conductors as shown on the Drawings.

2.02 SYSTEM COMPONENTS

A. Ground Rods: Ground rods shall be cone pointed copper clad Grade 40 HS steel rods conforming to ASTM B228. The welded copper encased steel rod shall have a conductivity of not less than 27% of pure copper. Rods shall be not less than 3/4-inch in diameter and ten feet long, unless otherwise indicated. Rods longer than ten feet shall be make up of ten foot units joined together with threaded couplings. The manufacturer's trademark shall be stamped near the top.

B. Grounding Conductors:
   1. Interior grounding conductors shall match the feeder and branch circuit wiring, THHN/THWN below #6, XHHW #6 and above (refer to Section 26 05 19). All grounding conductors shall have green insulation.
   2. Exterior buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper. Sizes over No. 6 AWG shall be stranded conforming to ASTM B8.

C. Ground Connections: Exposed ground connections shall be high copper alloy bolted pressure types or exothermically welded type, as noted. Embedded or buried connections, taps, and splices shall be either exothermically welded type or approved compression types for connection of copper to copper or copper to steel, as required. Connections of grounding conductors to equipment ground buses and metal enclosures shall be of the binding post type with a 1/2-13NC stud. Each post shall accommodate cables from #4 AWG to #2/0 AWG.

D. Ground Rod Boxes: Boxes shall be nine-inch diameter precast concrete units. If box is in a location where vehicular traffic is present, cover shall be cast iron traffic cover. Otherwise, covers shall be precast concrete. Units shall be 12 inches deep. Covers shall be embossed with the wording "Ground Rod".

E. Ground Bus: 2” x 1/4” x 24” copper busbar. Provide isolation stand off bushings. Provide drilled and tapped 3/8” diameter holes in two offsetting rows 1” apart and 2” on center. Provide “ALCU” lugs and bronze bolts. Connect busbar to main grounding system and bond to metallic domestic cold water pipe with #8 ground conductor.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground all equipment for which a ground connection is required per CEC Article 250, even though not specifically shown on the Drawings.

B. Provide a ground rod box for each ground rod so as to permit ready access for the connection and/or removal of any pressure connectors to facilitate testing.

C. Where ground rods must be driven to depths over ten feet, increase rod diameter sufficiently to prevent the rod from bending or being damaged.

D. Make connections of grounding conductors to equipment ground buses and enclosures using binding post type connectors.

E. Effectively bond structural steel for buildings to the grounding system, "UFER" ground.

F. Install a ground rod in each primary handhole. Connect the ground conductor installed for each primary duct bank to the ground rod in each handhole. Bond metal conduits to handhole ground rod.

3.02 TESTING

A. Conduct ground resistance tests using a ground resistance tester with a scale reading of 5 ohms maximum.

B. Test methods shall conform to IEEE Standard 81 using the three electrode method. Conduct test only after a period of not less than 48 hours of dry weather.

C. Take resistance readings for each ground rod individually and for each system as a whole without benefit of chemical treatment or other artificial means. Ground resistance readings shall not exceed 5 ohms. If readings are not to the Contracting Officer's approval, provide lengthened or additional ground rods (maximum of two additional rods).

D. Furnish to the Owner's Representative a test report with recorded data of each ground rod location and each system.

END OF SECTION

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SECTION 270528.32

JUNCTION AND PULL BOXES FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete all electrical installations shown on the drawings, included in these Specifications, or otherwise needed for a complete and fully operating facility. The work shall include but not be limited to the following:

B. Furnish and install all required material, supports and miscellaneous material for the satisfactory interconnection of all associated electrical systems.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 27 05 00 General Requirements for Communication Systems
   2. 27 05 28.33 Communication System Raceways and Fittings
   3. 27 10 00 Communication System Wire and Cables

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes:
   1. California Electrical Code (CEC)
   2. National Electrical Manufacturers Association (NEMA):
      a. Type 1 For indoor use primarily to provide a degree of protection against contact with the enclosed equipment
      b. Type 3R For outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation
      c. Type 4 For indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water
   3. Underwriters Laboratories (UL):
      a. 50 Enclosures for Electrical Equipment
      b. 514A Metallic Outlet Boxes

1.04 SUBMITTALS

A. As specified in Division 1 and Section 27 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.
   1. Pull boxes larger than 6"x 6" x 4".

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 OUTLET, JUNCTION, AND PULL BOXES

A. For boxes in dry interior locations use NEMA 1 box. For boxes in wet or exterior locations use NEMA 4 box. NEMA 3R is acceptable for exterior locations if installed per manufacturer's recommendations.

B. Standard Outlet Boxes, per UL 514A: Galvanized, one-piece die formed or drawn steel, knockout type of size and configuration best suited to the application indicated on the Drawings. Minimum box size shall be 4 inches square by 1-1/2 inches deep with mud rings as required.
   1. Manufacturer: RACO or approved equal.

C. Switch boxes, per UL 514A: Two inch wide by three inches long galvanized steel switch boxes shall be used only for the installation of single switches. Install multiple switches in standard gang boxes with raised device covers suitable for the application indicated.
   1. Manufacturer: RACO or approved equal.

D. Cast metal Outlet Boxes per UL 514A: Four inch round, galvanized cast iron alloy with threaded hubs and mounting lugs as required. Boxes shall be furnished with cast cover plates of the same material as the box and with neoprene cover gaskets.
   1. Manufacturer: Crouse-Hinds VXF series, Appleton JBX series or approved equal.

E. Conduit bodies per UL 514A: Cadmium plated, cast iron alloy. Conduit bodies with threaded conduit hubs and neoprene gasketed, cast iron covers. Bodies shall be used to facilitate pulling of controls or to make changes in conduit direction only. Splices are not permitted in conduit bodies.
   1. Manufacturer: Crouse-Hinds Form 8 Condulets, Appleton Form 35 Unilets, or approved equal.

F. Sheet Metal Boxes per UL 50: Use standard outlet or concrete ring boxes wherever possible; otherwise use a minimum 16 gauge galvanized sheet metal, NEMA 1 box sized to Code requirements with covers secured by cadmium plated machine screws located six inches on centers.
   1. Manufacturer: Circle AW Products, Hoffman Engineering Company or approved equal.

G. Cast Metal Boxes per UL 50: Use standard cast malleable iron outlet or device boxes wherever possible; otherwise use cadmium plated, cast malleable iron junction boxes with bolt-on, interchangeable conduit hub plates with neoprene gaskets.
   1. Manufacturer: Appleton RS series, Crouse-Hinds RS series, or approved equal.

H. Flush Mounted Pull boxes and Junction boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.01 OUTLET BOXES

A. General:
   1. All outlet boxes shall finish flush with building walls, ceilings and floors except in mechanical and electrical rooms above accessible ceiling or where exposed work is called for on the Drawings.

2. Provide outlet boxes in sizes as code required for the number of conductors to be included in the box, but the minimum shall be as required in the previous section. Provide shallow boxes where required to meet installation conditions. Box size shall meet requirements for installation of manufacturer's equipment.
3. Install raised device covers (plaster rings) on all switch and receptacle outlet boxes installed in masonry or stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
4. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
5. Exposed outlet boxes and boxes in damp or wet locations shall be cast metal with gasketed cast metal cover plates.

B. Box Layout:
1. Outlet boxes shall be installed at the locations and elevations shown on the drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
2. Locate switch outlet boxes on the latch side of doorways unless otherwise indicated.
3. Outlet boxes shall not be installed back to back nor shall through-wall boxes be permitted.
4. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.
5. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height with required location for equipment served.

C. Supports:
1. Outlet Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Fixture outlet boxes installed in suspended ceiling of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
3. Fixture outlet boxes installed in suspended ceilings with acoustical tiles or panels shall be supported directly from the structure above where pendant mounted lighting fixture are to be installed on the box.
4. Fixture Boxes above tile ceilings with exposed suspension systems shall be supported directly from the structure above.
5. Outlet and/or junction boxes shall not be supported by grid or fixture hanger wires at any locations.

3.02 JUNCTION AND PULL BOXES

A. General:
1. Install junction or pull boxes were required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not shown on the Drawings.
2. Unless specifically noted on the drawings, size junction and pull boxes to meet code requirements for number and size of conduits connected to box.
3. Locate pull boxes and junction boxes in concealed locations above removable ceilings or exposed in electrical rooms, utility rooms, or storage areas.
4. Install raised covers (plaster rings) on boxes in stud walls or in furred, suspended, or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
5. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
6. Exposed boxes and boxes in damp or wet locations shall be cast metal with gasketed cast metal cover plates.

7. Identify circuit numbers and panel on cover of junction box with clear adhesive backed label with permanent black letters.

B. Box Layouts:
   1. Boxes above hung ceilings with concealed suspension systems shall be located adjacent to openings for removable recessed lighting fixtures.

C. Supports:
   1. Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
   2. Boxes installed in suspended ceilings of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
   3. Boxes installed in suspended ceilings with acoustical tiles or panels shall be supported directly from the structure above.
   4. Boxes mounted above suspended acoustical tile ceilings with exposed suspension systems shall be supported directly from the structure above.

END OF SECTION

SECTION 270528.33

RACEWAYS AND FITTINGS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of furnishing and installing conduits, raceways and fittings for above grade installations, underground duct installations and inside buildings as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this section:
   1. 27 05 00 General Requirements for Communication Systems

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC):
      a. 230.8 Raceway Seal
      b. 300.5(G) Raceway Seals
   2. American National Standards Institute (ANSI):
      a. C80.1 Specification for Zinc Coated Rigid Steel Conduit
      b. C80.3 Specification for Zinc Coated Electrical Metallic Tubing
   3. Electronics Industry Alliance (EIA)
   4. Federal Specifications (FS):
      a. A-A-55810 Flexible Metal Conduit
   5. National Electrical Manufacturers Association (NEMA):
      a. TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit (EPC 40 and EPC 80)
   6. Telecommunications Industry Association (TIA)
   7. Underwriters Laboratories (UL):
      a. 797 Electrical Metallic Tubing - Steel
      b. 360 Liquid-Tight Flexible Steel Electrical Conduit
      c. 514B Fittings for Cable and Conduit
      d. 6 Rigid Metal Conduit
      e. 651 Schedule 40 and 80 Rigid PVC Conduit
      f. 1479 Fire Tests of Through-Penetrations Firestops
      g. 1 Flexible Metal Conduit

1.04 SUBMITTALS

A. As specified in Division 01 and Section 27 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 CONDUITS, RACEWAYS

A. Galvanized Rigid Steel Conduit (GRS) shall be hot-dip galvanized after fabrication, conforming to ANSI C80.1 and UL 6.

B. Electrical Metallic Tubing (EMT) shall be steel, hot-dip galvanized after fabrication, conforming to ANSI C80.3 and UL 797. Uni-couple EMT is acceptable.

C. Flexible conduit: Flexible metal conduit (Greenfield) shall be galvanized steel or aluminum interlocked from a continuous metal strip and shall conform to UL 1 and FS A-A-55810.

D. Liquidtight flexible conduit: Liquidtight flexible metal conduit shall be liquid-tight (Sealtight) of galvanized steel interlocked from a continuous metal strip with an extruded polyvinyl chloride cover and shall conform to UL 360 and FS A-A-55810.

E. Rigid non-metallic conduit: Rigid non-metallic conduit for concrete encasement shall be Type EB, all others shall be PVC Schedule 40 (PVC-40 or NEMA TC2 Type EPC-40) conduit approved for underground use and for use with 90°C wires, and shall conform to UL 651.
   1. Conduit for use for utility feeders shall comply with utility requirements.

2.02 CONDUIT SUPPORTS

A. Channels:
   1. Supports for multiple conduits shall be cold rolled, carbon steel channels unless otherwise noted.
   2. All channels used in exterior, damp, wet or corrosive locations shall be hot dipped galvanized unless otherwise noted. Associated hardware shall have manufacturer's recommended compatible finish.
   3. Channels used in dry interior, non-corrosive environments shall be hot dipped galvanized or Dura-Green finished. Associated hardware shall have manufacturer's recommended compatible finish.
   4. Manufacturer: B-Line B series Strut Systems or approved equal.

B. Supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer.

C. Supports for individual EMT conduits shall be galvanized pressed steel single hole straps.

D. Hardware for supports shall be Kadee clamps and connectors as appropriate for the job conditions, or approved equal.

E. Clamp fasteners shall be by wedge anchors. Shot in anchors shall not be used.

F. Provide seismic calculations on individual conduit installations 2" and larger and on conduit racks with supports in excess of 12".

2.03 FITTINGS

A. Provide threaded-type couplings and connectors for galvanized rigid steel (GRS) conduits.
   1. Union couplings shall be Erickson type.

2. Fittings shall be galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers.
3. Set-screw type and compression-type shall not be used.
4. Threadless couplings shall not be used.
5. Provide threaded couplings and raintight conduit ("Meyers") hubs for rigid steel conduit exposed to weather.
6. Locknuts and bushings shall not to be used in liquidtight applications

B. Provide steel set-screw type or compression-type couplings and connectors for electrical metallic tubing (EMT) conduits. Where set-screw fittings are utilized, the screws are to be "dimpled" and not pointed.

C. Diecast fittings or aluminum fittings shall not be used.

D. Fittings for Liquidtight Flexible Metal conduit shall have neoprene gaskets.

E. Fittings for use with rigid non-metallic conduit shall be PVC and have solvent-weld-type conduit connections.

2.04 BUSHINGS

A. Bushings shall be the insulated type.

B. Bushings for rigid steel shall be insulated grounding type.

2.05 CONDUIT SEALANTS

A. Fire Retardant Types: Fire stop material shall be reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL 1479. Coordinate with requirements in other sections of the documents. Contractor shall obtain approval of the product and its application from the authority having jurisdiction and is responsible to insure that the application is appropriate for the actual installation.

B. Water Retardant Types: Link seals are to be used on all below building penetrations.

PART 3 - EXECUTION

3.01 CONDUIT, RACEWAY AND FITTING INSTALLATION

A. Installation shall comply with the CEC.

B. Provide a nylon pull cord in each empty raceway. Cord shall be ¼" in all raceways 1" and larger.

C. The minimum size raceway shall be one inch unless indicated otherwise noted.

D. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees regardless of direction. Back to back elbows in any direction without a straight section a minimum of ten times the diameter of the raceway are prohibited without specific approval in writing by the Engineer.

E. Treat cut steel surfaces or damaged ends with manufacturer's recommended corrosion-resistant coating. Application shall follow manufacturer's recommendation.

F. Coordinate minimum conduit bending radius with type and size of cable to be installed. Conduits for voice / data / video installations are to also confirm to EIA / TIA standards. If a conflict is identified, the more stringent requirement shall prevail.

G. All exposed conduit and hardware shall be painted per spec section 270500.

H. All conduit openings are to have bushings. If omitted, the conductors shall be removed and replaced after the bushings are installed.

3.02 LOCATION

A. Galvanized rigid steel conduit shall be used for:
   1. All above ground exterior work,
   2. Exposed interior work up to eight feet above finished floor including mechanical and electric rooms,
   3. Conduits embedded in concrete or grout unless otherwise noted,
   4. Conduits in corrosive atmospheres.

B. Electrical Metallic Tubing (EMT) shall be used for:
   1. Interior concealed work,
   2. Interior exposed conduit above eight feet as acceptable to the local authority having jurisdiction.

C. Flexible metal conduit (Greenfield) shall be used for:
   1. Interior work in short lengths (six foot maximum),
   2. Connection of any vibrating equipment, unless otherwise noted or where liquid tight flexible metal conduit is required.
   3. Flexible metal conduit shall be supported within twelve inches of each end where used for expansion purposes.

D. Liquidtight flexible metal conduit (Sealtight) shall be used wherever flexible conduit is required and moisture may be present including:
   1. Vibrating equipment where moisture may be present,
   2. When making connections between two building structures.
   3. Liquidtight flexible metal conduit is to be supported within twelve inches of each end where used for expansion purposes

E. Rigid non-metallic conduit (PVC) for all underground exterior work, unless otherwise noted. Associated vertical elbows shall be galvanized rigid steel.

3.03 ROUTING

A. Run all concealed conduits above ceilings and inside walls parallel to building lines, unless otherwise noted.

B. Run all exposed conduits parallel to building lines, unless otherwise noted.

C. Coordinate conduit locations with equipment, fixtures, and with structural and architectural elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows.

3.04 CONDUIT SUPPORTS

A. Properly support all conduits as required by the code. Wherever possible, run all conduits concealed except where otherwise shown on the drawings.

B. Provide "J" hangers on threaded rods or multiple conduits on trapezes consisting of channels supported by minimum 3/8" threaded rod from the structure above. Conduits shall not be supported from ceiling support wires or t-bar grids. Conduits shall not be supported from ductwork, water, fire sprinkler or HVAC lines.

C. Treat damaged channel finishes with manufacturer's recommended corrosion-resistant coating. Application shall follow manufacturer's recommendation.

D. Exposed Conduits:
   1. Support exposed conduits within three feet of any junction box, coupling, equipment, fixture or device and at intervals not exceeding code requirements.
   2. Wherever possible, group conduits together and support on common supports located away from walls. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps.
   3. Group together exposed conduits in horizontal runs and support on trapeze hangers unless otherwise noted. Arrange such conduits uniformly and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of rods or other suitable means from the structure above the ceiling.
   4. Support conduit risers in shafts with channels and straps.

3.05 MOISTURE SEALS

A. Provide in accordance with CEC paragraphs 230.8 and 300.5(G).

3.06 FLEXIBLE CONDUIT

A. Flexible metallic conduit shall have a maximum length of six feet unless otherwise noted.

B. Flexible metallic conduit shall not be considered as a ground conductor. Flexible metallic conduit shall be installed only in exposed or accessible locations.

3.07 UNDERGROUND RACEWAY

A. Conduits embedded in concrete floors on grade shall be installed between grids of reinforcing steel, or shall be encased below the floors, provided the concrete is thickened as shown on the Drawings. EMT shall not be embedded in concrete.

B. Slope all underground raceways to provide drainage. Slope conduit from equipment located inside a building to the pull box or manhole located outside the building.

C. All PVC conduits terminating into pull boxes and vaults shall be provided with bell fittings at ends.

D. PVC direct buried conduits shall be installed in soil, covered with sand under a warning tape and compacted soil. Minimum depth 18" below grade. All PVC conduit installed below grade shall be provided with galvanized rigid steel elbows and risers. Rigid Steel shall be wrapped with 20 mil tape and extend minimum 12" above finished grade.

E. Where multiple conduits are run in parallel, install spacers on five-foot centers so as to maintain three-inch spacing between conduits.

F. PVC conduits installed under slabs shall be installed in soil, covered with sand under a vapor barrier and crushed rock. Minimum depth 6" below slab. All PVC conduit installed below slab shall be provided with galvanized rigid steel elbows and risers. Rigid steel shall be wrapped with 20 mil tape and extend minimum 12" above finished grade.

G. Where conduits penetrate structural members, obtain approval for the associated sleeves and windows from the structural consulting engineer and provide as required.

3.08 STORAGE OF PVC CONDUITS

A. Store rigid PVC conduit on a flat surface and shielded from the sun. PVC conduits 3" and larger shall be provided with 48" radius bends. If utilized for voice / data / video conductors, radiuses shall conform to TIA / EIA standards.

END OF SECTION

SECTION 270543

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of furnishing and installing raceways, raceway spacers, reinforcing steel, anchors and encasing material with necessary excavation for underground ducts.

B. Encasement - Encasement shall be sand or concrete, at the Contractor's option, for all other raceways.

C. Where required - All raceways for medium voltage cable and all other raceways, where run underground and in excavation shall be installed in compliance with the requirements of this Section. Conduits run underground without encasement shall be as indicated in the Drawings.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 27 05 00 General Requirements for Communication Systems
   2. 27 05 28.33 Communication System Raceways and Fittings

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC):
      a. 300.50 Underground Installations
      b. 352 Rigid Nonmetallic Conduit
   2. State of California Public Utilities Commission:
      a. General Order 128 Rules of Construction of Underground Electric Supply and Communication Systems

1.04 SUBMITTALS

A. As specified in Division 1 and Section 27 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. As specified in Section 27 05 28.33 Communication System Raceways and Fittings.

B. Spacers:
   1. Molded plastic as furnished by the raceway manufacturer, to cradle and position the raceways in the excavation for placing the encasement.
   2. Shape to accurately fit the raceway, provide the correct raceway spacing, to interlock in place and stack.

PART 3 - EXECUTION

3.01 EXCAVATION

A. As specified in Divisions 31 and 33 and as required for the work shown on the Drawings.

3.02 RACEWAY

A. Install cable supports at maximum 5 foot intervals along ductbank.

B. Install raceways per code and utility requirements. Refer to CEC Table 300.5 for minimum burial depth requirements and install per CEC 300.50.

C. Provide minimum 12 inch separation between raceways for high voltage (over 100 volts) and low voltage (under 100 volts) systems.

D. Provide minimum 12 inch separation between electrical conduit and other utilities.

3.03 SAND ENCASEMENT

A. As specified in Divisions 31 and 33.

3.04 BACKFILL

A. As specified in Divisions 31 and 33.

END OF SECTION

SECTION 270544

IN GRADE PULL BOXES FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of providing all labor, supervision, tools, materials, and performing all work necessary to furnish and install pre-cast concrete pull boxes with necessary excavation.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 27 05 00 General Requirements for Communication Systems
   2. 27 05 43 Underground Ducts and Raceways for Communication Systems

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. American Concrete Institute (ACI):
      a. 318 Building Code Requirements for Structural Concrete
   3. American Society for Testing and Materials (ASTM):
      a. A185 Steel Welded Wire Reinforcement for Concrete
      b. A615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
      c. C33 Concrete Aggregates
      d. C150 Portland Cement

1.04 SUBMITTALS

A. As specified in Division 1 and Section 27 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General Requirements:
   1. Concrete pull boxes for electrical power, controls and other communication circuits shall consist of pre-cast reinforced concrete boxes, extensions' bases, and covers as specified herein and as indicated on the Drawings. Pre-cast units shall be the product of a manufacturer regularly engaged in the manufacture of pre-cast vaults and pull boxes. Acceptable manufacturers are Christy, Utility Vault, Brooks, or approved equal.

B. Construction:
   1. Pre-cast concrete pull boxes for electrical power distribution and communication circuits with associated risers shall conform to ACI 318. Pull box tops in non-traffic areas shall conform to ACI 318. Pull boxes shall be the type noted on the Drawings and shall be constructed in accordance with the applicable details as shown. Walls shall consist of reinforced concrete. Walls shall be of monolithic concrete construction.

C. Covers:
   1. The word "SIGNAL" shall be cast in the top face of all telecom, intercom, CATV, data, EMS, security and/or clock cable boxes.

D. Concrete:
   1. Aggregates used in the concrete mix, either coarse or fine, excluding light weight aggregates, shall conform to ASTM C33. Aggregates shall be properly graded and free of deleterious substances to produce a homogeneous concrete mix when blended with cement.

E. Cement:
   1. The cement shall be Type II low alkali Portland cement and shall meet the requirement of ASTM C150.

F. Compressive Strength:
   1. Sufficient cement content shall be used per batch to produce a minimum compressive strength of 3,000 psi at 28 days.

G. Reinforcing Steel:
   1. Welded wire mesh for street lighting boxes shall conform to ASTM A 185.
   2. Reinforcing bars for primary and secondary electrical pull boxes, and communication pull boxes shall be intermediate grade billet steel conforming to ASTM A615.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pre-cast pull boxes shall be installed approximately where indicated on the Drawings. The exact location of each pull box shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. All cable boxes and secondary pull boxes shall be installed with a minimum of 6-inch thick crushed rock bedding.

B. Install junction or pull boxes where required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that not all boxes are necessarily shown on the Drawings.

C. Unless specifically noted as larger on the drawings, size junction and pull boxes to meet code requirements for number and size of conduits connected to box.

D. Paved areas:
   1. Pull boxes located in areas to be paved shall be installed such that the top of the cover shall be flush with the finished surface of the paving.

E. Unpaved Areas:

1. In unpaved areas, the top of pull box covers shall be approximately 2 inches above finished grade.

F. Traffic Areas:
   1. In areas subject to vehicular traffic including roads, driveways, parking lots and other similar areas, provide traffic rated boxes and covers.

G. Trenching, Backfilling, and Compaction:
   1. Trenching, backfilling and compaction shall be as specified in previous sections of the specification.

END OF SECTION

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SECTION 271000

WIRE AND CABLES FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all wire and cable rated 600 volts or less, including splices and terminations, as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following Specification Section for work related to the work in this Section:
   1. 27 05 00 General Requirements for Communication Systems
   2. 27 05 28.33 Raceways and Fittings for Communication Systems
   3. 27 05 28.32 Junction and Pull Boxes for Communication Systems

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes:
   1. American Society for Testing and Materials (ASTM):
      a. B3-01, Specification for Soft or Annealed Copper Wire
      b. B8-99, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
      c. B173-01a, Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
   2. Federal Standards (FED. STD.):
      a. 228, Methods of Testing Insulated Cable and Wire
   3. Federal Specifications (FS):
      a. A-A-59544, Cable and Wire, Electrical
      b. A-A-55809, Pressure Sensitive Electrical Plastic Insulation Tape
   4. National Electrical Manufacturers Association (NEMA):
      a. WC 70-1999/ICEA S-95-658-1999, Cross-Linked Thermosetting Polyethylene, Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
   5. National Fire Protection Association (NFPA), National Electrical Code (NEC) - Latest Revision
   6. California Electrical Code (CEC)
   7. Underwriters Laboratories (UL):
      a. 44-83 (R1988), Rubber-Insulated Wires and Cable
      b. 83-1983 (R1989), Thermoplastic-Insulated Wires and Cables
      c. 510-1986, Insulating Tape

1.04 SUBMITTALS

A. As specified in Division 1 and Section 27 05 00.
   1. Catalog Data: Provide manufacturer's descriptive literature.
   2. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. General: Conductors shall be copper, Class B stranded and of the sizes indicated. All conductors 120 volts and above shall be in raceway unless otherwise noted. Minimum power and control wire size shall be No. 12 AWG unless otherwise specified by the Owner's Representative. All cable used on this Project shall be of the same type and conductor material.

B. Unless otherwise noted, conductors #6 and larger shall be XHHW insulation suitable for operation in wet or dry locations at temperatures not to exceed 75°C in wet locations and 90°C in dry locations. Conductors #8 and smaller shall be THHN in dry locations and THWN/THHN in wet locations. Control Cable shall be THHN.

C. Insulation Marking: All insulated conductors shall be identified with printing colored to contrast with the insulation color.

D. Color Coding: As specified in paragraph 3.03.

E. Special Wiring: Where special wiring is proposed by an equipment manufacturer, submit the special wiring requirements to the Owner's Representative and, if approved, provide same. Special wire shall be the type required by the equipment manufacturer.

F. Other Wiring: Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and as approved by the Owner's Representative.

G. Terminations:
   1. Cable Termination for Copper: Crimp style two hole NEMA spade terminals designed and rated for copper cable.
   2. Wire Terminations: Crimp on ring-tongue terminals, insulated sleeve, of proper size for the wire used.
   3. End Seals: Heat shrink plastic caps of proper size for the wire on which used.
   4. Manufacturer: T&B, Burndy or approved equal.

H. Manufacturer: BICC General Cable Inc., Southwire, or approved equal.

2.02 ANALOG CLOCK

A. Cable shall be 3 conductor #12. Verify exact quantity of conductors with specific clock system:
   1. Conductor for all exterior, underground or wet locations shall be THWN conductors.
   2. Cable for all interior plenum locations shall be plenum rated cable. Manufacturer: West Penn 25238 or approved equal.
   3. Cable for all interior non-plenum locations shall be riser rated cable. Manufacturer: West Penn 238 or approved equal.
   4. Verify additional 120V, 20A circuit wiring for required for power.

2.03 DIGITAL CLOCK

A. Cable shall be (1) #18 shielded twisted pair. Verify exact quantity with specific clock system:

1. Cable for all exterior, underground or wet locations shall be outdoor rated with water-blocked construction, sunlight and moisture resistance jacket. Manufacturer: West Penn AQ293 or approved equal.
2. Cable for all interior plenum locations shall be plenum rated cable. Manufacturer: West Penn 25238 or approved equal.
3. Cable for all interior non-plenum locations shall be riser rated cable. Manufacturer: West Penn 238 or approved equal.
4. Verify additional 120V, 20A circuit wiring for required for power.

2.04 SPEAKER (PA SYSTEM)/INTERCOM

A. Speaker Trunk Cable. Cable refers to MDF to IDF and IDF to IDF wiring topology:
   1. Cable shall be twisted pair. Refer to drawings for cable quantity.
      a. Cable for all exterior, underground or wet locations shall be outdoor rated with water-blocked construction, sunlight and moisture resistance jacket. Cable shall be 25 pair #19 shielded twisted pair. Manufacturer: Superior Essex Sealpic FSF or approved equal.
      b. Cable for all interior plenum locations shall be plenum rated. Cable shall be 6 pair #22 shielded twisted pair. Manufacturer: West Penn D25432 or approved equal.
      c. Cable for all interior non-plenum locations shall be riser rated cable. Cable shall be 19 pair #22 shielded twisted pair. Manufacturer: West Penn 436 or approved equal.

B. Speaker Drop Cable. Cable refers to MDF, IDF or STC to speaker device wiring topology:
   1. Cable shall be 4 pair #19 combination shielded twisted pair with unshielded pair. Refer to drawings for cable quantity.
      a. Manufacturer: West Penn 25359B or approved equal.

2.05 TELEPHONE AND DATA CABLE

A. Telephone and Data Station Drop Cable:
   1. Four pair UTP 24 AWG Solid Copper rated Category 6 capable of transmitting analog and digital voice data rates up to 622 Mbps. Cable shall meet and exceed TIA/EIA-568-B Category 6 Specifications, meet IEEE 802.5 16 Mbps, meet IEEE 802.3 10 Mbps CSMA/CD and meet IEEE 802.3 10Base-T and 1000Base-T standards. Refer to drawings to cable quantities.
      a. Conductor Identification: Conductors shall be pigmented "White/Blue; White/Orange; White/Green & White/Brown."
      b. Cable for all exterior, underground or wet locations shall be outdoor rated with water-blocked construction, sunlight and moisture resistance jacket. Superior Essex Category 6 OSP series or approved equal.
      c. Cable for all interior plenum locations. Cable shall have Fluorinated Ethylene-Propylene insulation with flame retardant PVC Jacket. Manufacturer: Superior Essex Category 6 plenum rated cable series or approved equal.
      d. Cable for all interior non-plenum locations. Cable shall have Polyolefin insulation with flame retardant PVC Jacket. Superior Essex Category 6 riser rated cable series or approved equal.

B. Telephone Trunk Cable. Cable refers to MDF to IDF, IDF to IDF, and IDF to STC wiring topology:
   1. UTP/24 AWG Solid Copper rated "Category 3." Capable of transmitting analog and digital voice data rates up to 10 Mbps. Cable shall meet and exceed Category 3 Specifications, meet IEEE 802.5 4 Mbps Token Ring, meet IEEE 802.3 10 Mbps

CSMA/CD and exceed IEEE 802.3 10Base-T standards. Refer to drawings for quantities of high pair count cable.

a. Conductor Identification: Conductors shall be pigmented "White/Blue; White/Orange; White/Green & White/Brown."
b. Cable for all exterior, underground or wet locations shall be outdoor rated with water-blocked construction, sunlight and moisture resistance jacket. Manufacturer: Superior Essex MegaPIC Category 5 (25) pair OSP series or approved equal.
c. Cable for all interior plenum locations. Cable shall have Fluorinated Ethylene-Propylene insulation with flame retardant PVC Jacket. Manufacturer: Superior Essex Category 3 (25) pair CMP plenum rated cable series or approved equal.
d. Cable for all interior plenum locations. Cable shall have Polyolefin insulation with flame retardant PVC Jacket. Manufacturer: Superior Essex Category 3 (25) pair CMR riser rated cable series or approved equal.

C. Data Trunk Cable:

1. Fiber optic cable. Meets and or exceeds Bellcore GR-20-CORE and RUS specifications. The following chart is a specification chart with minimal requirements for the cable:

Fiber Optic Cable	multimode
Optical Specs	62.5/125
Wavelength (nm)	850/1300
Max Attenuation (dB/KM)	3.5/1.0
Min Bandwidth (MHzkm)	220/600
Gigabit Ethernet Min Distance	300/550
Color	orange

a. Cable for all exterior, underground or wet locations shall be outdoor and riser rated with water blocking strength members for strength and surrounded with a fire resistance jacket. Optical fibers placed inside a single gel filled tube with fiber bundle. Manufacturer: Superior Essex loose tube indoor/outdoor riser fiber – OFNR or approved equal cable.
b. Cable for all interior plenum locations shall be plenum rated cable. Cable shall include dielectric yarns that are applied for additional strength and a flame resistant outer jacket. Manufacturer: Superior Essex Distribution Multiple Unit - OFNP Fiber or approved equal cable.
c. Cable for all interior non-plenum locations shall be riser rated cable. Cable shall include dielectric yarns that are applied for additional strength and a flame resistant outer jacket. Manufacturer: Superior Essex Distribution Single Unit - OFNR Fiber or approved equal cable.

2.06 CATV/MATV TELEVISION CABLE

A. Trunk Cable. Cable refers to MDF to IDF, IDF to IDF, and IDF to STC wiring topology:

1. Coaxial distribution cable shall be 14 AWG, gas injected foam polyethylene insulated, bonded bifoil plus 60% aluminum braid shielded, RG-11 type. Nom. dB/100ft shall be 3.40 or better. Refer to drawings and CATV section for cable quantities:

a. Cable for all exterior, underground or wet locations shall be outdoor buried rated with polyethylene insulated jacket with flooding compound. Manufacturer: Superior Essex Coax Series 11 Quad Buried Drop Cable.
b. Cable for all interior plenum locations shall be. Manufacturer: Superior Essex Coax Series 11 Quad Buried Drop Cable.

2. Coaxial distribution cable for interior non-plenum locations. Cable shall be 14 AWG, gas injected foam polyethylene insulated, bonded bifoil plus 61% aluminum braid shielded, RG-11/U.
   a. Manufacturer: West Penn 1100 or approved equal.
3. Coaxial distribution cable for interior air plenum locations. Cable shall be 14 AWG, foam FEP insulated, 100% bifoil plus 65% aluminum braid shielded, RG-11/U.
   a. Manufacturer: West Penn 25821 or approved equal.

B. Station Drop Cable:
1. Coaxial cable for all exterior or underground locations. Cable shall be 18 AWG, 75°C, gas injected foam polyethylene insulated, flooded, 100% bifoil plus 65% aluminum braid shielded, RG-6/U, outdoor burial rated.
   a. Manufacturer: West Penn AQC841 or approved equal.
2. Coaxial cable for interior non-plenum locations. Cable shall be 18 AWG, 75°C, foam polyethylene insulated, 100% bifoil plus 65% aluminum braid shielded, RG-6/U type.
   a. Manufacturer: West Penn 841 or approved equal.
3. Coaxial cable for interior air plenum locations. Cable shall be 18 AWG, 75°C, foam FEP insulated, 100% bifoil plus 90% aluminum braid shielded, RG-6/U.
   a. Manufacturer: West Penn 25841 or approved equal.

2.07 TAPE

A. Tape used for cable marking shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform to FS HH-I-595 and UL 510.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION

A. Clean Raceways: Clean all raceways prior to installation of cables as specified in Section 27 05 28.33 – Communication System Raceways and Fittings.

B. Cable Pulling: Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.

C. Bending Radius: Cable bending radius shall be per applicable code. Install feeder cables in one continuous length.

D. Equipment Grounding Conductors: Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any conduit or any raceway.

E. Wiring at Hinges: For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing when the hinged member is moved.

F. All wiring and cable shall be supported from the structure above. All wiring over 100 volts shall be installed in conduit except as noted in Section 27 05 28.32. All wiring below 100 volts shall be installed in J hooks a maximum 48 inches on center unless otherwise noted.

G. Low Voltage Cables:
1. All cables provided inside buildings shall be plenum rated.
2. All cables provide outside buildings shall be outdoor rated, gel filled cables.
3. All low voltage wires and cables concealed in walls shall be run in EMT conduit from flush outlet boxes to above accessible ceilings. Provide conduit where cables penetrate floors and fire walls above ceilings. Where low voltage cables run parallel to line voltage (over 120 volts), they shall be installed a minimum of 12 inches apart.
4. Contractor installing Category 6 cables shall be manufacturer certified to pull and install such cables.
5. Maximum horizontal cabling distance for Category 6 cables shall not exceed 295 feet per EIA/TIA 568B Standards. Contractor shall notify engineer prior to commencement of work of any cabling exceeding the 295 foot maximum distance.
6. Do not bend Category 6 station cables to a radius of less than eight (8) times the cable diameter.
7. All cables shall be provided with plastic identification tags in each end, identify the source of the cables and the destination of the cables.

H. Fiber Optic Backbone Cables:
1. Splices in the Fiber Optic backbone cables and UTP station cables are NOT permitted. There are no exceptions unless during the installation period unless the contractor finds a problem with the means and method of construction. The contractor shall be responsible to obtain Owner's permission in writing for any splices prior to the splice being installed.
2. Contractor shall place all Fiber Optic backbone cabling in accordance with these specifications, and as indicated on the Drawings. Place Fiber Optic backbone cabling between the Main Distribution Frame (MDF) and the Intermediate Distribution Frames (IDF's) unless otherwise noted.
3. Contractor installing fiber optic cables shall be manufacturer certified to pull and install such cables.
4. Note that the Fiber Optic cable used for underground portions of the backbone (if applicable) must be suitable for underground use.
5. Fiber Optic Bending Radius: Indoor rated fiber optic cable shall have minimum bending radius of 3.9 inches and outdoor rated fiber optic cable shall have minimum bending radius of 6 inches.
6. All cables shall be provided with plastic identification tags in each end, identify the source of the cables and the destination of the cables.

3.02 CABLE TERMINATIONS AND SPLICES

A. Splices:
1. All power, fire alarm, telephone and data, and CATV MATV television cables shall be continuous below grade (i.e. no splices or terminations below grade).
2. Use UL listed wirenuts for line voltage branch circuits in dry locations.

B. Terminations: Shall comply with the following:
1. Make up and form cable and orient terminals to minimize cable strain and stress on device being terminated on.
2. Burnish oxide from conductor prior to inserting in oxide breaking compound filled terminal.

3.03 Field Tests:

1. Refer to individual system specification sections for testing requirements.

END OF SECTION

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SECTION 272000

DATA COMMUNICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing components for the data communication systems. Provide racks, cabinets, pathways, boxes, cabling, terminations, patch cords, patch panels, jacks and testing as required.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this Section:
   1. 27 05 00 General Requirements for Communication Systems
   2. 27 10 00 Communication System Wire and Cables
   3. 27 05 26 Communication System Grounding

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. American National Standards Institute (ANSI) Standards:
      a. ANSI X3T9.5 Fast Ethernet 100Base-T LAN: Defines standard for 100 Mb/s LAN based on either Fiber Optic cable or Unshielded Twisted Pair (UTP)
   2. Telecommunications Industry Association / Electronic Industries Alliance (TIA/EIA) Standards:
      a. TIA/EIA 455 Reference Guide for Fiberoptic Testing Procedures
      b. TIA/EIA 472 General Specifications for Fiberoptic Cables
      c. TIA/EIA 492 Generic Specification for Optical Waveguide Fibers
      d. TIA/EIA 568B Commercial Building Telecommunications Cable Standard
      e. TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces
      f. TIA/EIA 598 Fiber Optic Cable Color Coding
      g. TIA/EIA 606 Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings
      h. TIA/EIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications
   3. Institute of Electrical and Electronics Engineers, Inc. (IEEE) Standards:
      a. IEEE 802.3 Ethernet 10Base-T LAN: Defines media and distance requirements for 10Mb/s LAN (issued in October 1990)
      b. IEEE 802.3z Gigabit Ethernet 1000Base SX and LX LAN: Defines media and distance requirements for 1000Mb/s LAN
   4. Underwriters Laboratories (UL) Standards:
      a. UL 910 Test method of Fire and Smoke Characteristics of Electrical and Optical Cables Used in Air Handling Spaces
      b. UL 1666 Standard Flame test for Flame Propagation Height of Electrical and Optical Cable Installed Vertically in Shafts

1.04 QUALIFICATIONS

A. The telecommunications contractor shall have at least five years experience providing similar work, and shall provide a minimum of five references for similar projects completed with the last five years.

B. The telecommunications installer(s) shall be certified category 5e and fiber optic cable installer(s) and shall provide proof of certification.

1.05 SUBMITTALS

A. Shop Drawings - In accordance with Section 27 05 00.

B. Submit the following items:
   1. Manufacturer's Catalog Data: Manufacturer's original catalog cuts and original description of data of all material and equipment with sufficient information provided so that the exact function of each device is known.
   2. Description of conductors to be used with a statement that all wire shall be in conduit.
   3. Floor plan of the point to point connections.
   4. Diagram of the wiring circuitry.
   5. Riser diagram.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

D. Closeout Submittals: Submit operation and maintenance data for all components of the telecommunications equipment specified herein. Submit certified test results. Submit in accordance with Division 1.

1.06 WARRANTY

A. Manufacturer shall provide a one year warranty for all system components.

PART 2 - PRODUCTS

2.01 FIBER OPTIC TERMINATION PANEL (PATCH PANEL)

A. Minimum performance specifications: Suitable for use with specified Fiber Optic cables. Must meet requirements of TIA/EIA T586B.

B. Provide Zirconia Ceramic sleeve, SC - type ports.

C. Panels shall be wall mounted with minimum capacity for 12 fiber connections.
   1. Manufacturer: Leviton 5W120-00N, 5F100-9ZT or approved equal.

D. Provide cable management ring in the back of the panels or other means of securing cables being terminated. Ensure wire management maintains recommended bend radius, and has storage for up to 2 meters of excess cable per coupling.

E. Store 2 meters of excess cable in purpose designed cable storage.

2.02 FIBER OPTIC TERMINATION PANEL (PATCH PANEL)

A. Minimum performance specifications: Suitable for use with specified Fiber Optic cables. Must meet requirements of TIA/EIA T586B.

B. Provide Zirconia Ceramic sleeve, SC - type ports.

C. Panels for MDF's shall be mountable in a standard 19-inch equipment rack. Provide minimum 20% spare connection capacity.
   1. Manufacturer: Leviton 5RXXX series or approved equal.

D. Panels for IDF's shall be mountable in a standard 19-inch equipment rack with minimum capacity for 36 fiber connections. Provide minimum 20% spare connection capacity or minimum 12 ports whichever is larger.
   1. Manufacturer: Leviton 5R430-00N or approved equal.

E. Provide cable management retaining brackets on the back of the panels or other means of securing cables being terminated. Cable tie down bars, support and strain relief and other wire management devices to be placed between each patch panel. Ensure wire management maintains recommended bend radius, and has storage for up to 2 meters of excess cable per coupling.

F. Store 2 meters of excess cable in purpose designed cable storage.

2.03 FIBER OPTIC PATCH CORDS

A. Minimum performance specifications: Suitable for use with specified Fiber Optic cables. Must meet requirements of TIA/EIA T586B.3.

B. Fiber optic cable specifications:
   1. Connector style: SC-SC.
   2. Density: Duplex.
   3. Cable listing: OFNR
   4. Length: 3 meters

Fiber Optic Cable	multimode 62.5/125
Wavelength (nm)	850/1300
Max Attenuation (dB/KM)	3.5/1.0
Min Bandwidth (MHzkm)	220/600
Gigabit Ethernet Min Distance	300/550
Color	orange

C. Cable lettering must be legible and shall contain the following information:
   1. Manufactures name.
   2. Fiber size.
   3. Fiber Grade.
   4. UL Listing.
   5. Manufacturer's Trade Mark.
   6. Sequential foot markings, in two-foot increments.

D. Fiber optic connectors:
   1. Zirconia Ceramic tipped, SC - type plug, suitable for use with specified Fiber Optic cable. Maximum insertion loss across mated-pair: Less than 0.8 dB.

E. Acceptable manufacturers include Leviton, Berk-Tek, Lucent Technologies, Siecor, CommScope or approved equal.

2.04 DATA SWITCHES

A. All active equipment such as data switches, hubs and/or routers will be furnished by the owner, installed by the contractor.

2.05 UTP DATA WIRE TERMINATION PANELS (PATCH PANELS)

A. Minimum performance specifications: Must meet requirements for Category 6 of TIA/EIA.

B. Provide standard 8-pin, 8-position, RJ-45 style modular patch panels with printed circuit board IDC 110-type connectors, capable of 4-pair, UTP cable termination and wired in an TIA/EIA configuration. Connector spring wire contacts shall be phosphor bronze plated with 50 microinches of gold over 100 microinches of nickel.

C. Panels shall be mountable in a standard 19-inch equipment rack with capacity for up to 48 modular RJ-45 ports. Ports shall have individual numbers and white labels. Panels shall be UL listed and labeled Cat 6. Provide minimum of 20% spare port capacity.

D. Provide cable management retaining brackets on the back of the panels or other means of securing cables being terminated. Horizontal wire management devices to be placed between each patch panel.

E. Manufacturer: Leviton 69586-U48 or approved equal.

2.06 UTP DATA PATCH CORDS

A. Provide four pair UTP 24 AWG solid copper. Cable shall be PVC rated. Cross-connect patch cords used on "DATA" cross-connects must meet the impedance, attenuation and NEXT requirements for Category 6 horizontal cable of TIA/EIA.

B. Provide one patch cord for each patch panel for each data outlet.

C. Patch cords shall be standard manufacture’s length, minimum 5 feet.

D. Patch cords shall be factory manufactured with protective strain relief boot on each male plug, hand crimping is not acceptable.

E. Coordinate cross connections with Owner’s representative.

F. Manufacturer: Berk-Tek, Leviton or approved equal.

2.07 MODULAR DATA OUTLETS

A. Unless otherwise noted, provide single gang, modular voice/data outlets.

B. Data Jacks must meet the minimum performance specifications for Category 6 of TIA/EIA. All 8-position, modular jack inserts for data locations shall comply with TIA/EIA T568B specifications.
   1. Modular jacks shall be engraved 'CAT 6' on the face of the jack insert.

C. Contractor shall coordinate data wiring scheme (T568B or T568A) with owner.

D. All components shall be UL listed.

E. Unless otherwise indicated provide insert and faceplate colors:
   1. Single gang wall plate, white with two labels and label covers.
   2. Provide 4 port unless otherwise noted, coordinate number of ports with drawings.
   3. Data jack, blue.
   4. Blank jack (where applicable), white.

F. Manufacturer: Ortronics OR-KSFP series or approved equal.

G. For outdoor installation install outlets in weatherproof, white, polycarbonate in use cover.
   1. Manufacturer: Taymac MM410W or approved equal.

2.08 MAIN DISTRIBUTION FRAME (MDF) - EQUIPMENT MOUNTING RACKS

A. Provide 19 inch floor mounted 6061-T6 aluminum rack, 7’ 0” high with top and bottom angle for solid support. Rack shall have mounting holes for standard equipment support.

B. Provide duplex receptacle connected to dedicated circuit and horizontally mounted power strip with integral surge protection (equal to Wiremold # 7011 BDS20R) on each rack.

C. Provide horizontal and vertical cable management system appropriate for type of cabling being installed including:
   1. One horizontal cable management panel per patch panel, with cable supports and strain relief.
   2. Two single sided vertical cabling sections per rack.
   3. Grounding terminal blocks.
   4. Provide 12” open web cable tray above rack.

D. Provide seismic restraints as required to meet appropriate codes.

E. Manufacturer: Chatsworth or approved equal.

2.09 INTERMEDIATE DISTRIBUTION FRAME (IDF) - EQUIPMENT CABINETS

A. Provide wall mounted cabinets, 24” by 24” by 48” to house data, voice and CATV equipment.

B. Provide plexiglass front panel with reversible dual hinge for front and rear access.

C. Cabinet shall be lockable with rear access not available when cabinet is locked.

D. Coordinate color (black or white) with architect.

E. Manufacturer: Chatsworth 11900 series or approved equal.

PART 3 - EXECUTION

3.01 CABLE & WIRE INSTALLATION

A. General:

1. All data communications cables shall be terminated and tested under this contract.

B. Station Cables:
   1. Install station cabling, outlets and jacks as detailed on the Drawings. The typical configuration for most outlets is two unshielded twisted pair (UTP) cables of 4 pairs each.
   2. Each data outlet shall be clearly marked with the MDF/IDF, patch panel and port number to which they are connected.

3.02 QUANTITIES AND LOCATIONS OF ITEMS

A. Location and placement of splices, patch panels and other distribution hardware shall be as shown on the Drawings or defined herein. Where Drawings are not specific as to placement, refer below.

B. Quantities of racks, cabinets, splices and patch panels shown on the drawings are illustrative only and are meant to indicate the general configuration of the work. The contractor is responsible for providing the correct quantities of racks, patch panels, connectors and appurtenances necessary to terminate, cross connect and patch the volume of cable described herein and shown on the Drawings. Where less than all of the capacity of a patch panel is used to terminate cables, the Contractor shall provide the Owner with the number of connecting blocks, coupling panels, and couplings to completely fit out the patch panel:
   1. Properly install freestanding equipment mounting rack(s), securely mounted to floor, walls and structure above to meet all sway bracing and seismic requirements:
      a. Cable tray shall be installed directly above rack. Brace tray to walls and structure above.
   2. Provide lockable wall mounted equipment cabinets securely mounted to walls.
   3. Rack mount Fiber Optic Patch Panels and UTP Patch Panels installed at locations as noted on the drawings. Complete with all necessary hardware.
   4. MDF/IDF patch panels for station outlets shall be clearly marked to indicate the room/location served by each port.

3.03 CABLE TERMINATIONS

A. Fiber Optic cables:
   1. After dressing the cable to its final destination, sheath shall be removed to a point that allows the conductors to be splayed and terminated in a neat and uniform fashion. At this point all fibers will be terminated in strict compliance with the manufacturers instructions.
   2. Terminate both ends of each fiber optic cable with a SC type port, per manufacturer's recommendations. After termination, mount all connectors in fiber optic termination panels and label appropriately.

B. UTP cables:
   1. Each cable shall be terminated on an 8-pin modular jack as indicated in this specification section. Terminate each cable on an TIA/EIA T568 compliant outlet jack matching the cable's specification.
   2. Cable pair twists shall be maintained up to within 0.25 inch of the point of termination. Under no circumstances shall cable pairs be untwisted or otherwise altered prior to termination.

3.04 INSTALLATION OF WALL PLATES

A. General - Plates shall match the style of the device and shall be plumb within 1/16-inch of the vertical or horizontal.

B. Interior Locations, Finished Walls: Install non-metallic plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Oversized plates or sectional plates are not acceptable and shall not be used. If wall finish will not accommodate proper mounting of the plate, the situation shall be brought to the attention of the architect and the wall finish replaced appropriately.

C. Interior Locations, Unfinished Walls: Install stainless steel.

D. Exterior Locations: Install wiring devices in such a manner as to provide a rain tight weatherproof installation. Cover type shall match box type.

E. Future Locations: Install blanking cover plates on all unused outlets.

F. Prior to installation, coordinate labeling conventions with owner. Provide typed label(s) for faceplate, indentifying each jack on faceplate, uniquely identifying source and circuit number supplying jack, unless otherwise noted.

3.05 GROUNDING

A. Provide dedicated ground at MDF and each IDF. Bond all equipment to ground with insulated ground conductors.

3.06 TESTING

A. Fiber Optic Cable Testing:
   1. Pre-installation testing:
      a. Fiber Optic cables: Perform visible light continuity checks on each fiber. If one end is not accessible: perform OTDR test to assure fiber continuity.
   2. Post installation testing:
      a. After installation of connectors, visually inspect each fiber end-face at 10x magnification. Refinish fibers with visible defects and/or striations in the core area.
      b. Perform end-to-end, bi-directional attenuation (loss) test for each fiber strand at 850 NM and 1300 NM wavelengths. Conduct tests in accordance with TIA/EIA-526-14, Method B and with test instrument manufacturers' printed instructions.
      c. Demonstrate that measured link loss does not exceed the “worst case" allowable loss which is defined as the sum of: the connector losses (based on the number of mated connector pairs at the TIA/EIA-568 maximum allowable loss) and the Fiber Optic cable loss (based on length and the TIA/EIA-568 maximum allowable loss.)
      d. Strands whose measured attenuation fall outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault. At a minimum, an OTDR shall be used to: determine the-true loss for each connector pair, the exact length of the fiber and to identify the absence of any core damage,
      e. Faults related to connectorization shall be corrected, and the fiber re-tested as stated in prior paragraphs above, until acceptable attenuation measurements are recorded.
      f. Where defects are found inherent-in the fiber itself - replace any cable having fewer than the manufacturers guaranteed number of serviceable fibers.
      g. Submit the following information regarding the Fiber Optic cable testing:

i. Cable number, fiber count, individual fiber numbers, connector types, number of connectors/ patches, calculated maximum link loss, length of run, measured link loss for each fiber.

3. Recommended test equipment (obtain approval of Owner prior to using substitute test equipment):
   a. Fiber Optic power meter and Light Source: Siecor CPM-850/1300 meter and OS-100D Light Source or approved equal.
   b. OTDR: Tektronix TFP2 FiberMaster, Easer Precision TD-2000 or equal with 850 NM and 1300 NM emitter modules and hard copy printout or approved equal.
   c. Fiber Optic inspection scope: Cambridge Instruments 10X fiber-scope or approved equal.

B. Paired and Multi-Conductor UTP Cable Testing:
   1. After terminating both ends of all UTP cables, but before any cross connects are installed, test all UTP station cables for attenuation and cross-talk (NEXT) to 100 MHz. Test all UTP cables for continuity, ground fault, proper cross-connection, shorts and crossed pairs.
   2. After installing cross-connects, perform end-to-end testing of each cross connected cable pair for continuity, ground fault, proper cross-connection, shorts and crossed pairs.
   3. For multi-pair cables: For 100 pair or smaller replace entire cable if bad pair is found. For larger pair count cables, replace if more than 1% of pairs are bad.
   4. Submit the following information regarding the UTP station cable testing:
      a. Cable number, cable type, pair or conductor count; individual pair or conductor numbers; number of cross connects and/or patches in each pair; results of each test for each pair or conductor; total number of serviceable pairs or conductors in cable.
      b. Information required above shall be provided in printed format only.
   5. Recommended test equipment (Contractor shall obtain approval of Owner in writing prior to using substitute test equipment):
      a. Fluke DSP 1100 SR, no known equal. Equipment shall be equipped with latest software. Contractor shall refer to Owner to obtain required set-up parameters.

3.07 ACCEPTANCE

A. Upon receipt of the Contractor's documentation of proposed cable testing, the Owner will have the right to review and observe the installation and randomly request tests of the cables/wires installed. Once the testing has been completed and the Owner is totally satisfied, that all work is in accordance with the Contract Documents, the Owner will notify the Contractor in writing.

3.08 RECORD DRAWINGS

A. The Project record as-built drawings shall show the types and locations of installed:
   1. Fiber Optic Cables.
   2. Station Cables/Outlets.
   3. Main Distribution Frames.
   4. Intermediate Distribution Frames.
   5. Patch panels.

B. The Project record as-built drawings shall identify numbering on each cable identification label.

END OF SECTION

SECTION 273000

VOICE COMMUNICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing components for voice communications systems. Provide racks, cabinets, pathways, boxes, cabling, terminations, patch panels, 66 and/or 110 blocks, jacks and testing as required.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this Section:
   1. 27 05 00 General Requirements for Communication Systems
   2. 27 10 00 Communication System Wire and Cables
   3. 27 05 26 Communication System Grounding

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. EIA/TIA Standards:
      a. EIA/TIA 568B Commercial Building Telecommunications Cable Standard
      b. EIA/TIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces
      c. EIA/TIA 606 Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings
      d. EIA/TIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications
   2. IEEE Standards:
      a. IEEE 802.3 Ethernet 10Base-T LAN: Defines media and distance requirements for 10Mb/s LAN (issued in October 1990)
      b. IEEE 802.3z Gigabit Ethernet 1000Base SX and LX LAN: Defines media and distance requirements for 1000Mb/s LAN
   3. UL Standards:
      a. UL 910 Test method of Fire and Smoke Characteristics of Electrical and Optical Cables Used in Air Handling Spaces
      b. UL 1666 Standard Flame test for Flame Propagation Height of Electrical and Optical Cable Installed Vertically in Shafts

1.04 QUALIFICATIONS

A. The voice communications contractor shall have at least five years experience providing similar work, and shall provide a minimum of five references for similar projects completed with the last five years.

B. The voice communications installer(s) shall be certified category 6 cable installer(s) and shall provide proof of certification.

1.05 SUBMITTALS

A. Shop Drawings - In accordance with Section 27 05 00.

B. Submit the following items:
   1. Manufacturer's Catalog Data: Manufacturer's original catalog cuts and original description of data of all material and equipment with sufficient information provided so that the exact function of each device is known.
   2. Description of conductors to be used with a statement that all wire shall be in conduit.
   3. Floor plan of the point to point connections.
   4. Diagram of the wiring circuitry.
   5. Riser diagram.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

D. Closeout Submittals: Submit operation and maintenance data for all components of the telecommunications equipment specified herein. Submit certified test results. Submit in accordance with Division 1.

1.06 WARRANTY

A. Manufacturer shall provide a one year warranty for all system components.

PART 2 - PRODUCTS

2.01 MODULAR VOICE OUTLETS

A. Unless otherwise noted, provide single gang, modular voice outlets.

B. Voice Jacks must meet the minimum performance specifications for Category 6 of EIA/TIA. All 8-position, modular jack inserts for telephone locations shall comply with EIA/TIA T568B specifications.
   1. Modular jacks shall be engraved 'CAT 6' on the face of the jack insert.

C. Contractor shall coordinate data wiring scheme (T568B or T568A) with owner.

D. All components shall be UL listed.

E. Unless otherwise indicated provide insert and faceplate colors:
   1. Single gang wall plate, white with two labels and label covers.
   2. Provide 4 port unless otherwise noted, coordinate number of ports with drawings.
   3. Voice jack, gray.
   4. Blank jack (where applicable), white.

F. Manufacturer: Ortronics OR-KSFP series or approved equal.

G. For outdoor installation install outlets in weatherproof, white, polycarbonate in use cover.
   1. Manufacturer: Taymac MM410W or approved equal.

2.02 UTP VOICE WIRE TERMINATION BLOCKS (110 BLOCKS)

A. Minimum performance specifications: Must meet requirements for Category 6 of EIA/TIA.

B. Blocks shall be 110 style, mountable in a standard 19-inch equipment rack. Blocks shall comply with EIA/TIA T568B specifications and UL listed. Blocks shall be provided in 100 pair modules. Provide minimum of 20% spare port capacity.

C. Provide cable management retaining brackets on the back of the panels or other means of securing cables being terminated. Horizontal wire management devices to be placed between each patch panel.

D. Manufacturer: Leviton 41DBR series or approved equal.

PART 3 - EXECUTION

3.01 CABLE & WIRE INSTALLATION

A. General:
   1. All voice communications cables shall be terminated and tested under this contract.

B. Station Cables:
   1. Install station cabling, outlets and jacks as detailed on the Drawings. The typical configuration for most outlets is two unshielded twisted pair (UTP) cables of 4 pairs each.
   2. Each voice outlet shall be clearly marked with the MDF/IDF, 66 [110] block and circuit to which they are connected.

3.02 QUANTITIES AND LOCATIONS OF ITEMS

A. Location and placement of splices, patch panels and other distribution hardware shall be as shown on the Drawings or defined herein. Where Drawings are not specific as to placement, refer below.

B. Quantities of racks, cabinets, and patch panels, etc. shown on the drawings are illustrative only and are meant to indicate the general configuration of the work. The contractor is responsible for providing the correct quantities of racks, patch panels, connectors as other equipment necessary to terminate, cross connect and patch the volume of cable described herein and shown on the Drawings.
   1. Wall mount 66 blocks, rack mount 110 Blocks installed at locations as noted on the drawings. Complete with all necessary hardware.
   2. Blocks for station outlets shall be clearly marked to indicate the room/location served by each port.

3.03 CABLE TERMINATIONS

A. UTP cables:
   1. Each cable shall be terminated on an 8-pin modular jack as indicated in this specification section. Terminate each cable on an EIA/TIA T568 compliant outlet jack matching the cable's specification.
   2. Cable pair twists shall be maintained up to within 0.25 inch of the point of termination. Under no circumstances shall cable pairs be untwisted or otherwise altered prior to termination.

3.04 INSTALLATION OF WALL PLATES

A. General - Plates shall match the style of the device and shall be plumb within 1/16-inch of the vertical or horizontal.

B. Interior Locations, Finished Walls: Install non-metallic plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Oversized plates or sectional plates are not acceptable and shall not be used. If wall finish will not accommodate proper mounting of the plate, the situation shall be brought to the attention of the architect and the wall finish replaced appropriately.

C. Interior Locations, Unfinished Walls: Install stainless steel or cast metal cover plates.

D. Exterior Locations: Install cast metal plates with gaskets on wiring devices in such a manner as to provide a rain tight weatherproof installation. Cover type shall match box type.

E. Future Locations: Install blanking cover plates on all unused outlets.

F. Prior to installation, coordinate labeling conventions with owner. Provide typed label(s) for faceplate, indentifying each jack on faceplate, uniquely identifying source and circuit number supplying jack, unless otherwise noted.

3.05 GROUNDING

A. Provide dedicated ground at MDF and each IDF. Bond all equipment to ground with insulated ground conductors.

3.06 TESTING

A. Paired and Multi-Conductor UTP Cable Testing:
   1. After terminating both ends of all UTP cables, but before any cross connects are installed, test all UTP station cables for attenuation and cross-talk (NEXT) to 100 MHz. Test all UTP cables for continuity, ground fault, proper cross-connection, shorts and crossed pairs.
   2. After installing cross-connects, perform end-to-end testing of each cross connected cable pair for continuity, ground fault, proper cross-connection, shorts and crossed pairs.
   3. For multi-pair cables: For 100 pair or smaller replace entire cable if bad pair is found. For larger pair count cables, replace if more than 1% of pairs are bad.
   4. Submit the following information regarding the UTP station cable testing:
      a. Cable number, cable type, pair or conductor count; individual pair or conductor numbers; number of cross connects and/or patches in each pair; results of each test for each pair or conductor; total number of serviceable pairs or conductors in cable.
      b. Information required above shall be provided in printed format only.
   5. Recommended test equipment (Contractor shall obtain approval of Owner in writing prior to using substitute test equipment):
      a. Fluke DSP 1100 SR, no known equal. Equipment shall be equipped with latest software. Contractor shall refer to Owner to obtain required set-up parameters.

3.07 ACCEPTANCE

A. Upon receipt of the Contractor's documentation of proposed cable testing, the Owner will have the right to review and observe the installation and randomly request tests of the cables/wires

installed. Once the testing has been completed and the Owner is totally satisfied, that all work is in accordance with the Contract Documents, the Owner will notify the Contractor in writing.

3.08 RECORD DRAWINGS

A. The Project record as-built drawings shall show the types and locations of installed:
   1. Station Cables/Outlets.
   2. Main Distribution Frames.
   3. Intermediate Distribution Frames.
   4. 110 Blocks.

B. The Project record as-built drawings shall identify numbering on each cable identification label.

END OF SECTION

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SECTION 27 41 16.6

ASSISTIVE LISTENING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Furnish and install all materials and equipment including all required equipment and connectors, and provide all labor required and necessary to complete the work shown on the drawings and/or specified in all Sections of Division 27 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete assistive listening system. It is the intent of the drawings and specifications that the system be complete, coordinated with the existing local sound system, and ready for operation.

1.02 RELATED WORK

A. See the following Specification Section for work related to the work in this Section:
   1. 27 05 00 General Requirements for Communications Systems
   2. Refer to the General Conditions, Supplementary General Conditions, and Division 1 General Requirements.

1.03 CODES AND STANDARDS

A. Devices and equipment for the local public address system shall be listed by U.L. for the specific purpose the device or equipment is used.

B. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. 2007 Building Standards Administrative Code, Part 1, Title 24 California Code of Regulations (C.C.R.)
   2. 2007 California Building Code (CBC), Part 2, Title 24 C.C.R. - 2006 Uniform Building Code and California Amendments
   3. 2007 California Electric Code (CEC), Part 3, Title 24 C.C.R. - 2005 National Electric Code and California Amendments

1.04 SUBMITTALS

A. In accordance with Section 27 05 00.

B. Submit the following items:
   1. Manufacturer's Catalog Data: Manufacturer's original catalog cuts or original description of data of all material and equipment with sufficient information provided so that the exact function of each device is known.
   2. Maintenance manuals and part lists. Manual shall include schematic drawings and service instructions. All parts shall be identified with standard part numbers and electrical characteristics, which can be recognized by Owner's maintenance technicians.

1.05 SUBSTITUTIONS

A. If substitutions are proposed, the Contractor shall show by “proof of performance" test that the substitute equipment is equal or superior to the equipment specifications, to the satisfaction of

the Owner. This proof shall be shown by actual tests and not through printed literature. The Contractor shall provide qualified audio technicians and such test equipment as required to perform this test.

1. The cost of proof of performance tests shall be borne by the contractor and not included as part of the Contract.

1.06 WARRANTY

A. The transmitter and receiver shall have a 5 year warranty on parts and labor.

1.07 QUALIFICATIONS OF INSTALLER

A. Prior to installation, submit data for review showing that the contractor has at least 3 years experience successfully installed assistive listening systems of similar type and design, or that there is a contractual agreement with a subcontractor having related experience.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. General: The system shall provide for portable, wireless, FM based local distribution of voice and music from the local sound system through the assistive listening system to wireless stereo receivers with headsets. The system shall be portable and of modular design to facilitate expansion and shall be completely solid state.

1. Work included in this Section: Complete wireless assistive listening system Including but not limited to the following:
   a. Digital Wireless Transmitter
   b. Wireless Stereo Receivers with Headsets
   c. Charger and Carrying Case
   d. Test, operational check and demonstration of system operation

2.02 ASSISTIVE LISTENING SYSTEM

A. The Assistive Listening System shall consist of a single transmitter personal receiver. Provide personal receivers with rechargeable batteries and interface with existing local sound system. Provide a purpose made carrying case and battery recharger.

B. Transmitter:

1. Transmitter shall have an “on” indicator, a power button, push button control for monitoring source audio or transmitted audio and an input overload indicator.
2. Transmitter shall be microprocessor controlled with push button LCD digital configuration of:
   a. Bandwidth
   b. Frequency
   c. Audio Input Source (Microphone, Line, Simplex)
   d. High Pass Filter
   e. Low Pass Filter
   f. Compressor Slope
   g. Compressor Gain
   h. RF Output Power
3. The audio level shall be adjustable by push button control via a 10 LED array showing +9 to -18dB at 3dB intervals.

4. Transmitter shall have an operating range of up to 1000 feet.
5. Transmitter shall have 10 wideband and 7 non-standard wideband channels operating on 72.1–75.9 MHz. It shall have 77 narrowband channels operating on 72.025–75.975 MHz.
6. Transmitter shall have three pre-configured (selectable) application presets:
   a. Hearing Assist
   b. Music
   c. Voice
7. Transmitter shall have a 1/4" phone jack with push button volume control.
8. Transmitter shall be powered by 24 VAC power supply via a 3-pin Molex® connector.
9. Transmitter shall have a 75 ohm F-connector whip antenna on the top panel directly connected to the circuit board.
10. The transmitter shall have an RCA line output jack and a combination 1/4" phone/XLR audio input jack. It shall have an RF "Off" timer that turns off RF signal after 1 hour of no audio activity.
11. The transmitter shall be approved by the Federal Communications Commission (FCC) and be powered by a UL-approved wall transformer.
12. Manufacturer: Williams Sound - PPA T35, ANT 025 or approved equal

C. Wireless Stereo Receivers:
1. Provide twelve (12) wireless stereo receivers.
2. The receiver shall be tunable to any one of 17 preset wideband channels within 72-76MHz via a seek button located inside the battery compartment. The receiver shall have channel lock capability.
3. The receiver shall have an on/off switch and volume control, which adjusts the output level as required by the listener.
4. The receiver shall include an indicator light that lights when the power is on and flashes when the battery is low.
5. The receiver shall be capable of operating for up to 50 hours with two AA Alkaline batteries and up to 32 hours with two rechargeable AA NiMH batteries. Provide two AA rechargeable NiMH batteries per receiver.
6. The receiver shall be FCC approved.
7. The receiver shall have a 3.5mm stereo output jack, which accepts any one of the Williams Sound listening accessories.
   a. Provide one (1) standard stereo headset per receiver.
   b. Provide two (2) additional neckloop induction loop to transfer sound signals directly to a hearing aide equipped with a T-coil.
8. Manufacturer: Williams Sound - PPA R37, BAT 026, HED 026, NKL 001 or approved equal.

D. Charger and Carrying Case:
1. The charger shall be drop and style, capable of recharging up to 12 receivers equipped with two NiMH AA batteries at once.
2. The charging circuitry must be fully automatic. The charger shall be microprocessor controlled, timed 16 hour recharge. The charger must be capable of recharging the receiver batteries in 16 hours maximum when 1600 mA/Hr batteries are used. Once the timer has completed its charging cycle, the charger shall provide a maintain charge. The charger must be capable of recharging NiMH batteries without removal from the receiver.
3. Each bay on the charger shall have a red LED indicating charging status. The LEDs shall be on constantly during charging and will blink indicating batteries are fully charged.
4. The charger CHG 3512 shall be powered by an external switching power supply (90-240 VAC input; 5 VDC, 4A output) via a CD barrel connector.
5. Charger shall be enclosed in black, impact resistant, ABS plastic.

6. The carrying case shall have a large, foam-lined storage space for accessories, a locking lid, and a handle. The case shall have a pocket to contain the power wall transformer during storage.
7. Manufacturer: Williams Sound – CCS 030 S, with CHG 3512 or approved equal.

2.03 WIRES AND CABLES

A. Provide all required interconnection cables and required connectors.

B. All interconnection cables shall be professional type with very low impedance and gold contact connectors.

PART 3 - EXECUTION

3.01 INSTALLATION AND WORKMANSHIP

A. All components shall be assembled, installed and tested by a Contractor specializing in communications systems.

B. The Contractor shall take such precautions as are necessary to guard against electromagnetic and electrostatic hum and to install the equipment so as to provide maximum safety to the person who operates it.

3.02 TESTS

A. The Contractor shall perform an operational check to assure that the system complies with all requirements of these specifications. Operation tests shall be made in the presence of the Owner's representative, who shall be notified of the test date a minimum of ten (10) days prior to that date.

B. The Contractor at no additional cost to the Owner shall replace any system, material or equipment found to be defective.

C. Provide 1 hour of training to Owner to demonstrate system function.

END OF SECTION

SECTION 280500

GENERAL REQUIREMENTS FOR SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all required labor, supervision, materials and equipment (except equipment furnished by the Owner to be installed by the Contractor) to satisfactorily complete the work shown on the drawings and/or specified in all Sections of Division 28 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete and fully operating facility. The work shall include but not be limited to the following:
   1. Furnish and install all required in-place equipment, conduits, conductors, cables and any miscellaneous materials for the satisfactory interconnection and operation of all associated electrical systems.

1.02 RELATED WORK

A. This Section provides the basic Electrical Requirements which supplement the General Requirements of Division 1 and apply to all Sections of Division 28.

1.03 STANDARDS AND CODES

A. All work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Building Code (CBC)
   2. California Electrical Code (CEC)
   3. California Fire Code (CFC)
   4. American National Standards Institute (ANSI) Publications:
      a. C2-02 National Electrical Safety Code
   5. Code of Federal Regulations (CFR):
      a. 29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)
   6. Electronics Industries Association (EIA)
   7. Institute of Electrical and Electronics Engineers (IEEE)
   8. National Electrical Testing Association (NETA):
      a. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, Standard ATS
   9. National Electrical Manufacturers Association (NEMA)
   10. Occupational Safety and Health Act (OSHA) Standards
   11. State of California Public Utilities Commission:
      a. General Order 128 Rules for Construction of Underground Electric Supply and Communication Systems

B. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.

C. Underwriter Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, may be substituted for UL labeling and listing

if acceptable to the Owner. Provide service entrance labels for all equipment required by the NEC to have such labels.

1.04 SUBMITTALS

A. As specified in Division 1. Submit to the Engineer shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system specified. Obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review.

B. Submittals are required for all items, regardless of whether they are furnished as specified or are substituted.

C. Information to be submitted includes manufacturer's name, trade name, equipment model number, nameplate data, equipment drawings including: size, layout dimensions and capacity, manufacturer's descriptive literature of cataloged products, diagrams, test data, and performance and characteristic curves as applicable. Furnish project specification and paragraph reference, applicable Federal, Industry and Technical Society Publication References, and years of satisfactory service of each item required to establish contract compliance. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval.

D. If submittal information includes multiple products, items being submitted for approval shall be clearly identified and Items not to be used on the project shall be clearly marked out.

E. Organize submittals for equipment and items related to each specification section together as a package.

F. Submit submittal packages in digital form (PDF files or similar).
   1. Refer to specification section 01 33 00 for additional information

G. Substitutions:
   1. Refer to specification section 01 25 00 for additional information.

H. Closeout Submittals:
   1. Cost analysis: Submit final cost information including original bid and any change orders broken down by system, material and labor costs (as applicable):
      a. Fire Alarm System
      b. Intrusion System
      c. Surveillance System
      d. Card Access System

   2. Operation and Maintenance Manuals: Furnish O & M Manuals for equipment where manuals are specified in the equipment specifications or are specified in Division 1. Electrical O & M Manuals shall include as a minimum:
      a. Copies of equipment supplied on the project.
      b. Instruction manuals including operation instructions and maintenance requirements/recommendations.
      c. List of suppliers for all equipment with addresses and telephone numbers.
      d. List of service support for all equipment with addresses and telephone numbers.
      e. Copies of all test reports required in Division 28 specification sections.

f. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.
g. Other closeout documentation and test results as required under other sections of the specifications.
h. Provide in a single transmittal.
i. Warranty for all work, including contractor's general warranty.
j. All warranties begin as per the Contract, Division 1 or final acceptance of the Work by the Owner, Architect, Engineer, and Authority Having Jurisdiction, which ever is later:
    i. Manufacturer's Warrantees and Guarantees that are longer than the base contract/specified amount are to be provided with the manuals.
    ii. The Contractor is responsible for all Warranty and Guarantee work whether or not the Manufacturer also Warrantees and Guarantees the product.

1.05 CONTRACT DOCUMENTS

A. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations:
    1. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.
    2. All drawings and divisions of these specifications shall be considered as whole. This contractor shall report any apparent discrepancies prior to submitting bids.

B. Drawings:
    1. The Drawings shall govern the general layout of the completed construction.
        a. Locations of equipment, inserts, anchors, panels, pullboxes, manholes, conduits, stub-ups, fittings, devices, and ground connections are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
        b. The general arrangement and location of existing conduits, piping, apparatus, etc., is shown as existing on drawings or specified. The drawings and specifications are for the assistance and guidance of the contractor, exact locations, distances and elevations are governed by actual field conditions. Extreme accuracy of data given herein and on the drawings is not guaranteed. Minor changes may be necessary to accommodate work. The contractor is responsible for verifying existing conditions. Should it be necessary to deviate from the design due to interference with existing conditions or work in progress, claims for additional compensation shall be limited to those for work required by unforeseen conditions as determined by the Engineer.

1.06 COORDINATION

A. Coordinate the electrical work with the other trades, code authorities, utilities and the Engineer:
    1. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.
    2. Coordinate does not mean to only send a Request For Information. Coordinate implies that the contractor is to take the lead in bringing all of the necessary organizations together to coordinate the work and to provide for the associated costs.

B. Where connections must be made to existing installations, properly schedule all the required work, including the power and system shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the Owner's facilities:

1. Include costs for work during non-normal working hours and temporary facilities as may be required.
2. Include costs as necessary for sub-contractors to accomplish the specified work.

C. When two trades join together in an area, make certain that no electrical work is omitted. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.

D. Operations:
1. Perform all work in compliance with Division 1:
   a. Keep the number and duration of power and system shutdown periods to a minimum.
   b. Show all proposed shutdowns and their expected duration on the construction schedule.
      i. If the construction schedule is created and maintained by others, make sure that the associated information is incorporated.
      ii. Failure by the Contractor to properly schedule and plan for such activities is not a basis for additional compensation.
   c. Carry out shutdown only after the Engineer has favorably reviewed the schedule. Submit power/communications interruption schedule 15 days prior to date of interruption. Failure to provide schedule with adequate review time may result in rescheduling of the work at the Contractor's expense.

E. Construction Power:
1. See Division 1 Temporary Utilities.

F. Storage:
1. Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from sun, weather, condensation, dust, water, or construction operations.

G. Damaged Products:
1. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain approval from the Engineer before making repairs to damaged products.

H. Order material in such a timely manner and after approval of the same so as to insure that the approved material is available to be installed on site in a timely manner. Additional costs or substitutions necessitated because the Contractor failed to order material in a timely manner are not reimbursable. Costs associated with processing of paperwork by the owner and design consultants resultant of such failures to coordinate the work by the Contractor shall have such costs reimbursed by the Contractor

1.07 LOCATIONS

A. General:
1. Use equipment, materials and wiring methods suitable for the types of locations in which they are located:
   a. Dry Locations:
      i. All those indoor areas which do not fall within the definition below for Wet Locations and which are not otherwise designated on the Drawings.
   b. Wet Locations:
      i. All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.

1.08 SAFETY AND INDEMNITY

A. The Contractor is solely and completely responsible for conditions of the job site including safety of all persons and properly during performance of the work. This requirement will apply continually and not be limited to normal working hours:
   1. No act, service, drawing review or construction review by the Owner, the Engineer or their Consultants is intended to include reviews of the adequacy of the Contractors safety measures in or near the construction site.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY

A. Material and Equipment:
   1. Provide materials and equipment that are new and are current products of manufacturers regularly engaged in the production of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period includes use of equipment and materials of similar size under similar circumstances. For uniformity, only one manufacturer will be accepted for each type of product.

B. Service Support:
   1. Submit a certified list of qualified permanent service organizations including their addresses and qualification for support of the equipment. These service organizations shall be convenient to the equipment installation and able to render service to the equipment on a regular and emergency basis during the warranty period of the contract.

C. Manufacturer's Recommendations:
   1. Where installation procedures are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendation shall be cause for rejection of the equipment or material.

2.02 NAMEPLATES

A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings, the model designation, and shop order number.

B. Additionally, identify each piece of equipment and related controls with a rigid laminated engraved plastic nameplate. Unless otherwise noted, nameplates shall be melamine plastic 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches unless otherwise noted. Where not otherwise specified, lettering shall be a minimum of 0.25 inch high normal block style. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscriptions are indicated on the Drawings, furnish nameplates with appropriate inscriptions furnished by the Engineer upon prior request by the Contractor.

2.03 FASTENERS

A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel.

2.04 FINISH REQUIREMENTS

A. Equipment:
   1. Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish which as been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.

B. In finished areas, paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed.

C. Conduits for fire alarm or life safety raceways shall be factory painted red along their entire length.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ensure that all equipment and materials fit properly in their installation.

B. Perform any required work to correct improperly fit installation at no additional expense to the owner.

C. Equipment Installation:
   1. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
   2. Mount all metal panels or cabinets which are mounted on or abutting concrete walls or any outside walls ¼ inch from the wall, and paint the back sides of the panels with Mobil Hi-Build Bituminous Coating 35-J-10, Kopper Bitumastic Super Tank Solution, or equal. Film thickness shall be 10 mils minimum.

D. Cutting, Drilling and Welding:
   1. Provide the required cutting, drilling welding that is required for the electrical construction work. Comply with Division 1 requirements.
   2. Structural members shall not be cut or drilled, except after approval by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.
   3. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel. Where welding is required, it shall be accomplished by tradesmen certified to do such work. Provide fire and other protection as appropriate.

3.02 FIELD TESTS

A. Test shall be in accordance with Acceptance Testing specifications issued by the National Fire Protection Association (NFPA) 72 Chapter 7 for fire alarm and manufacturer's recommendations for security systems.

B. Perform equipment field tests and adjustments. Properly calibrate, adjust and operationally check all devices and components, and demonstrate as ready for service. Make additional calibration and adjustments if it is determined later that the initial adjustments are not

satisfactory for proper performance. Perform equipment field test for equipment where equipment field tests are specified in the equipment Specifications. Give sufficient notice to the Engineer prior to any test so that the tests may witnessed.

C. Provide instruments, supplies, other equipment, temporary facilities as may be necessary and material required for the tests. Instruments shall be of the type designed for the type of tests to be performed and shall be calibrated by a recognized testing laboratory within three months prior to testing.

D. Operational Tests: Operationally test all circuits to demonstrate that the circuits and equipment have been properly installed and adjusted and are ready for full-time service. Demonstrate the proper functioning of circuits in all modes of operation, including alarm conditions.

E. Re-testing will be required for all unsatisfactory tests after the equipment or system has been repaired. Re-test all related equipment and systems if required by the Engineer. Repair and re-test equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.

F. Perform calibration and adjustment on all equipment.

G. Maintain records of each test and submit five copies to the Engineer when testing is complete. All tests shall be witnessed by the Engineer. These records shall include:
   1. Name of equipment tested.
   2. Date of report.
   3. Date of test.
   4. Description of test setup.
   5. Identification and rating of test equipment.
   6. Test results and data.
   7. Name of person performing test.
   8. Owner or Engineer's initials.

H. Items requiring testing as a minimum:
   1. Fire Alarm System.
   2. Intrusion System.
   3. Surveillance System.
   4. Card Access System.

3.03 PAINTING OF EQUIPMENT

A. Factory Applied:
   1. Electrical equipment shall have factory applied painting system which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical section. Fire alarm raceways shall be factory painted red.

B. Field Applied:
   1. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.04 SIGNAGE

A. Nameplate Mounting:

1. Provide number, location and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws or two rivets.

3.05 "AS-BUILT" DRAWINGS

1. Comply with Section 01 78 39 - Project Record Documents.

3.06 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
   1. Single line diagrams, wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
   2. Start up, proper adjustments, operating, lubrication and shutdown procedures.
   3. Safety precautions.
   4. The procedure in the event of equipment failure, trouble or alarm.
   5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

3.07 INSTRUCTION TO OWNER'S PERSONNEL

A. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or systems has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall maintain an attendance sheet from each session which contains the following information:
   1. Attendees with associated arrival and departure time.
   2. Topics covered.
   3. Information provided.
   4. Signatures of attendees taken at the completion of the session.

3.08 CLEAN UP

A. Thoroughly clean all soiled surfaces of installed equipment and materials.

B. Upon completion of electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Engineer.

END OF SECTION

SECTION 28 05 13

WIRE AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all wire and cable rated 600 volts or less, including splices and terminations, as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following Specification Section for work related to the work in this Section:
   1. 28 05 00 General Requirements for Safety and Security Systems
   2. 28 05 28.33 Safety/Security System Raceways and Fittings
   3. 28 05 28.32 Safety/Security System Junction and Pull Boxes

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes:
   1. American Society for Testing and Materials (ASTM):
      a. B3-01, Specification for Soft or Annealed Copper Wire
      b. B8-99, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
      c. B173-01a, Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
   2. Federal Standards (FED. STD.):
      a. 228, Methods of Testing Insulated Cable and Wire
   3. Federal Specifications (FS):
      a. A-A-59544, Cable and Wire, Electrical
      b. A-A-55809, Pressure Sensitive Electrical Plastic Insulation Tape
   4. National Electrical Manufacturers Association (NEMA):
      a. WC 70-1999/ICEA S-95-658-1999, Cross-Linked Thermosetting Polyethylene, Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
   5. National Fire Protection Association (NFPA), National Electrical Code (NEC) - Latest Revision
   6. California Electrical Code (CEC)
   7. Underwriters Laboratories (UL):
      a. 44-83 (R1988), Rubber-Insulated Wires and Cable
      b. 83-1983 (R1989), Thermoplastic-Insulated Wires and Cables
      c. 510-1986, Insulating Tape

1.04 SUBMITTALS

A. As specified in Division 1 and Section 28 05 00.
   1. Catalog Data: Provide manufacturer's descriptive literature.
   2. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. General:
   1. Conductors shall be copper, Class B stranded and of the sizes indicated. All conductors 120 volts and above shall be in raceway unless otherwise noted. Minimum power and control wire size shall be No. 12 AWG unless otherwise specified by the Owner's Representative. All cable used on this Project shall be of the same type and conductor material.

B. Unless otherwise noted, conductors #6 and larger shall be XHHW insulation suitable for operation in wet or dry locations at temperatures not to exceed 75°C in wet locations and 90°C in dry locations. Conductors #8 and smaller shall be THHN in dry locations and THWN/THHN in wet locations. Control Cable shall be THHN.

C. Insulation Marking:
   1. All insulated conductors shall be identified with printing colored to contrast with the insulation color.

D. Special Wiring:
   1. Where special wiring is proposed by an equipment manufacturer, submit the special wiring requirements to the Owner's Representative and, if approved, provide same. Special wire shall be the type required by the equipment manufacturer.

E. Other Wiring:
   1. Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and as approved by the Owner's Representative.

F. Terminations:
   1. Cable Termination for Copper: Crimp style two hole NEMA spade terminals designed and rated for copper cable.
   2. Wire Terminations: Crimp on ring-tongue terminals, insulated sleeve, of proper size for the wire used.
   3. End Seals: Heat shrink plastic caps of proper size for the wire on which used.
   4. Manufacturer: T&B, Burndy or approved equal.

G. Manufacturer: BICC General Cable Inc., Southwire, or approved equal.

2.02 FIRE ALARM CABLES

A. Addressable Loop Cables:
   1. Verify recommended cable type with system manufacturer. Cable shall be minimum #16 shielded twisted pair, unless otherwise noted. Refer to drawings and 28 31 00 Fire Alarm system for additional requirements:
      a. Cable for all exterior, underground or wet locations shall be outdoor rated with water-blocked construction, sunlight and moisture resistance jacket. Manufacturer: West Penn AQ293 or approved equal.
      b. Cable for all interior areas shall be plenum rated cable. Manufacturer: West Penn 60975B or approved equal.

B. Notification Circuit Cables:
   1. Refer to section 2.01 Conductors for Notification Circuit Cables. Refer to drawings for size and quantity. Refer to Specification Section 28 31 00 - Fire Alarm System for additional requirements.

2.03 SECURITY CABLES

A. Verify recommended cable type with system manufacturer. Cable shall be minimum #16 shielded twisted pair. Refer to drawings for additional requirements:
   1. Cable for all exterior, underground or wet locations shall be outdoor rated with water-blocked construction, sunlight and moisture resistance jacket. Manufacturer: West Penn AQ293 or approved equal.
   2. Cable for all interior areas shall be plenum rated cable. Manufacturer: West Penn 60975B or approved equal.

2.04 TAPE

A. Tape used for cable marking shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform to FS HH-I-595 and UL 510.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION

A. Clean Raceways:
   1. Clean all raceways prior to installation of cables as specified in Specification Section 28 05 00 – Safety/Security System Raceways and Fittings.

B. Cable Pulling:
   1. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.

C. Bending Radius:
   1. Cable bending radius shall be per applicable code. Install feeder cables in one continuous length.

D. Equipment Grounding Conductors:
   1. Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any conduit or any raceway.

E. Wiring at Hinges:
   1. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing when the hinged member is moved.

F. All wiring and cable shall be supported from the structure above. All wiring below 100 volts shall be installed in conduit unless otherwise noted.

G. Low Voltage Cables:
   1. All cables provided inside buildings shall be plenum rated.
   2. All cables provide outside buildings shall be outdoor rated, gel filled cables.
   3. All low voltage wires and cables concealed in walls shall be run in EMT conduit from flush outlet boxes to above accessible ceilings. Provide conduit where cables penetrate floors and fire walls above ceilings. Where low voltage cables run parallel to line voltage (over 120 volts), they shall be installed a minimum of 12 inches apart.

3.02 CABLE TERMINATIONS AND SPLICES

A. Splices:
   1. All fire alarm and security cables shall be continuous below grade (i.e. no splices or terminations below grade).
   2. Use UL listed wirenuts for line voltage branch circuits in dry locations.

B. Terminations: Shall comply with the following:
   1. Make up and form cable and orient terminals to minimize cable strain and stress on device being terminated on.
   2. Burnish oxide from conductor prior to inserting in oxide breaking compound filled terminal.

3.03 FIELD TESTS

A. The Contractor shall perform the following tests at his expense:
   1. Continuity Test of Wire:
      a. Test each wire for continuity and accuracy of the identifying tags at both ends and at all locations marked. Submit a report to the Owner's Representative certifying the fact of the test and the accuracy of the marking.
   2. Insulation Resistance Tests:
      a. Perform insulation resistance tests on all wire and cable installed. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall be disconnected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading not less than 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.

END OF SECTION

SECTION 28 05 28.32

JUNCTION AND PULL BOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete all electrical installations shown on the drawings, included in these Specifications, or otherwise needed for a complete and fully operating facility. The work shall include but not be limited to the following:
   1. Furnish and install all required material, supports and miscellaneous material for the satisfactory interconnection of all associated electrical systems.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 28 05 00 General Requirements for Safety/Security Systems
   2. 28 05 28.33 Safety/Security System Raceways and Fittings
   3. 28 05 13 Safety/Security System Wire and Cables

1.03 STANDARDS AND CODES

A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes:
   1. California Electrical Code (CEC)
   2. National Electrical Manufacturers Association (NEMA):
      a. Type 1 For indoor use primarily to provide a degree of protection against contact with the enclosed equipment
      b. Type 3R For outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation
      c. Type 4 For indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water
   3. Underwriters Laboratories (UL):
      a. 50 Enclosures for Electrical Equipment
      b. 514A Metallic Outlet Boxes

1.04 SUBMITTALS

A. As specified in Division 1 and Section 28 05 00.

B. Catalog Data:
   1. Provide manufacturer's descriptive literature.
      a. Pull boxes larger than 6"x 6" x 4".

C. Single Submittal:
   1. A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 OUTLET, JUNCTION, AND PULL BOXES

A. For boxes in dry interior locations use NEMA 1 box. For boxes in wet or exterior locations use NEMA 4 box. NEMA 3R is acceptable for exterior locations if installed per manufacturer's recommendations.

B. Standard Outlet Boxes, per UL 514A: Galvanized, one-piece die formed or drawn steel, knockout type of size and configuration best suited to the application indicated on the Drawings. Minimum box size shall be 4 inches square by 1-1/2 inches deep with mud rings as required.
   1. Manufacturer: RACO or approved equal.

C. Switch boxes, per UL 514A: Two inch wide by three inches long galvanized steel switch boxes shall be used only for the installation of single switches. Install multiple switches in standard gang boxes with raised device covers suitable for the application indicated.
   1. Manufacturer: RACO or approved equal.

D. Cast metal Outlet Boxes per UL 514A: Four inch round, galvanized cast iron alloy with threaded hubs and mounting lugs as required. Boxes shall be furnished with cast cover plates of the same material as the box and with neoprene cover gaskets.
   1. Manufacturer: Crouse-Hinds VXF series, Appleton JBX series or approved equal.

E. Conduit bodies per UL 514A: Cadmium plated, cast iron alloy. Conduit bodies with threaded conduit hubs and neoprene gasketed, cast iron covers. Bodies shall be used to facilitate pulling of controls or to make changes in conduit direction only. Splices are not permitted in conduit bodies.
   1. Manufacturer: Crouse-Hinds Form 8 Condulets, Appleton Form 35 Unilets, or approved equal.

F. Sheet Metal Boxes per UL 50: Use standard outlet or concrete ring boxes wherever possible; otherwise use a minimum 16 gauge galvanized sheet metal, NEMA 1 box sized to Code requirements with covers secured by cadmium plated machine screws located six inches on centers.
   1. Manufacturer: Circle AW Products, Hoffman Engineering Company or approved equal.

G. Cast Metal Boxes per UL 50: Use standard cast malleable iron outlet or device boxes wherever possible; otherwise use cadmium plated, cast malleable iron junction boxes with bolt-on, interchangeable conduit hub plates with neoprene gaskets.
   1. Manufacturer: Appleton RS series, Crouse-Hinds RS series, or approved equal.

H. Flush Mounted Pull Boxes and Junction Boxes:
   1. Provide overlapping covers with flush head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.01 OUTLET BOXES

A. General:
   1. All outlet boxes shall finish flush with building walls, ceilings and floors except in mechanical and electrical rooms above accessible ceiling or where exposed work is called for on the Drawings.

2. Provide outlet boxes in sizes as code required for the number of conductors to be included in the box, but the minimum shall be as required in the previous section. Provide shallow boxes were required to meet installation conditions. Box size shall meet requirements for installation of manufacturer's equipment.
3. Install raised device covers (plaster rings) on all switch and receptacle outlet boxes installed in masonry or stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
4. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
5. Exposed outlet boxes and boxes in damp or wet locations shall be cast metal with gasketed cast metal cover plates.

B. Box Layout:
1. Outlet boxes shall be installed at the locations and elevations shown on the drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
2. Locate switch outlet boxes on the latch side of doorways unless otherwise indicated.
3. Outlet boxes shall not be installed back to back nor shall through-wall boxes be permitted.
4. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.
5. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height with required location for equipment served.

C. Supports:
1. Outlet Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Fixture outlet boxes installed in suspended ceiling of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
3. Fixture outlet boxes installed in suspended ceilings with acoustical tiles or panels shall be supported directly from the structure above where pendant mounted lighting fixture are to be installed on the box.
4. Fixture Boxes above tile ceilings with exposed suspension systems shall be supported directly from the structure above.
5. Outlet and/or junction boxes shall not be supported by grid or fixture hanger wires at any locations.

3.02 JUNCTION AND PULL BOXES

A. General:
1. Install junction or pull boxes were required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not shown on the Drawings.
2. Unless specifically noted on the drawings, size junction and pull boxes to meet code requirements for number and size of conduits connected to box.
3. Locate pull boxes and junction boxes in concealed locations above removable ceilings or exposed in electrical rooms, utility rooms, or storage areas.
4. Install raised covers (plaster rings) on boxes in stud walls or in furred, suspended, or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
5. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
6. Exposed boxes and boxes in damp or wet locations shall be cast metal with gasketed cast metal cover plates.

7. Identify circuit numbers and panel on cover of junction box with clear adhesive backed label with permanent black letters.

B. Box Layouts:
1. Boxes above hung ceilings with concealed suspension systems shall be located adjacent to openings for removable recessed lighting fixtures.

C. Supports:
1. Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Boxes installed in suspended ceilings of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
3. Boxes installed in suspended ceilings with acoustical tiles or panels shall be supported directly from the structure above.
4. Boxes mounted above suspended acoustical tile ceilings with exposed suspension systems shall be supported directly from the structure above.

END OF SECTION

SECTION 280528.33

RACEWAYS AND FITTINGS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of furnishing and installing conduits, raceways and fittings for above grade installations, underground duct installations and inside buildings as shown on the Drawings and as described herein.

1.02 RELATED WORK

A. See the following specification sections for work related to the work in this section:
   1. 28 05 00 General Requirements for Safety and Security Systems

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC):
      a. 230.8 Raceway Seal
      b. 300.5(G) Raceway Seals
   2. American National Standards Institute (ANSI):
      a. C80.1 Specification for Zinc Coated Rigid Steel Conduit
      b. C80.3 Specification for Zinc Coated Electrical Metallic Tubing
   3. Federal Specifications (FS):
      a. A-A-55810 Flexible Metal Conduit
   4. National Electrical Manufacturers Association (NEMA):
      a. TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit (EPC 40 and EPC 80)
   5. Underwriters Laboratories (UL):
      a. 797 Electrical Metallic Tubing - Steel
      b. 360 Liquid-Tight Flexible Steel Electrical Conduit
      c. 514B Fittings for Cable and Conduit
      d. 6 Rigid Metal Conduit
      e. 651 Schedule 40 and 80 Rigid PVC Conduit
      f. 1479 Fire Tests of Through-Penetrations Firestops
      g. 1 Flexible Metal Conduit

1.04 SUBMITTALS

A. As specified in Division 1 and Section 28 05 00.

B. Catalog Data:
   1. Provide manufacturer's descriptive literature.

C. Single Submittal:
   1. A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 CONDUITS, RACEWAYS

A. Galvanized Rigid Steel Conduit (GRS) shall be hot-dip galvanized after fabrication, conforming to ANSI C80.1 and UL 6.

B. Electrical Metallic Tubing (EMT) shall be steel, hot-dip galvanized after fabrication, conforming to ANSI C80.3 and UL 797. Uni-couple EMT is acceptable.

C. Flexible conduit: Flexible metal conduit (Greenfield) shall be galvanized steel or aluminum interlocked from a continuous metal strip and shall conform to UL 1 and FS A-A-55810.

D. Liquidtight flexible conduit: Liquidtight flexible metal conduit shall be liquid-tight (Sealtight) of galvanized steel interlocked from a continuous metal strip with an extruded polyvinyl chloride cover and shall conform to UL 360 and FS A-A-55810.

E. Rigid non-metallic conduit: Rigid non-metallic conduit for concrete encasement shall be Type EB, all others shall be PVC Schedule 40 (PVC-40 or NEMA TC2 Type EPC-40) conduit approved for underground use and for use with 90°C wires, and shall conform to UL 651:

1. Conduit for use for utility feeders shall comply with utility requirements.

2.02 CONDUIT SUPPORTS

A. Channels:
1. Supports for multiple conduits shall be cold rolled, carbon steel channels unless otherwise noted.
2. All channels used in exterior, damp, wet or corrosive locations shall be hot dipped galvanized unless otherwise noted. Associated hardware shall have manufacturer's recommended compatible finish.
3. Channels used in dry interior, non-corrosive environments shall be hot dipped galvanized or Dura-Green finished. Associated hardware shall have manufacturer's recommended compatible finish.
4. Manufacturer: B-Line B series Strut Systems or approved equal.

B. Supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer.

C. Supports for individual EMT conduits shall be galvanized pressed steel single hole straps.

D. Hardware for supports shall be Kadee clamps and connectors as appropriate for the job conditions, or approved equal.

E. Clamp fasteners shall be by wedge anchors. Shot in anchors shall not be used.

F. Provide seismic calculations on individual conduit installations 2" and larger and on conduit racks with supports in excess of 12".

2.03 FITTINGS

A. Provide threaded-type couplings and connectors for galvanized rigid steel (GRS) conduits:

1. Union couplings shall be Erickson type.
2. Fittings shall be galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers.
3. Set-screw type and compression-type shall not be used.
4. Threadless couplings shall not be used.
5. Provide threaded couplings and raintight conduit ("Meyers") hubs for rigid steel conduit exposed to weather.
6. Locknuts and bushings shall not to be used in liquidtight applications

B. Provide steel set-screw type or compression-type couplings and connectors for electrical metallic tubing (EMT) conduits. Where set-screw fittings are utilized, the screws are to be "dimpled" and not pointed.

C. Diecast fittings or aluminum fittings shall not be used.

D. Fittings for Liquidtight Flexible Metal conduit shall have neoprene gaskets.

E. Fittings for use with rigid non-metallic conduit shall be PVC and have solvent-weld-type conduit connections.

2.04 BUSHINGS

A. Bushings shall be the insulated type.

B. Bushings for rigid steel shall be insulated grounding type.

2.05 CONDUIT SEALANTS

A. Fire Retardant Types:
1. Fire stop material shall be reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL 1479. Coordinate with requirements in other sections of the documents. Contractor shall obtain approval of the product and its application from the authority having jurisdiction and is responsible to insure that the application is appropriate for the actual installation.

B. Water Retardant Types:
1. Link seals are to be used on all below building penetrations.

PART 3 - EXECUTION

3.01 CONDUIT, RACEWAY AND FITTING INSTALLATION

A. Installation shall comply with the CEC.

B. Provide a nylon pull cord in each empty raceway. Cord shall be ¼" in all raceways 1" and larger.

C. The minimum size raceway shall be 3/4-inch unless indicated otherwise noted.

D. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees regardless of direction. Back to back elbows in any direction without a

straight section a minimum of ten times the diameter of the raceway are prohibited without specific approval in writing by the Engineer.

E. Treat cut steel surfaces or damaged ends with manufacturer's recommended corrosion-resistant coating. Application shall follow manufacturer's recommendation.

F. Coordinate minimum conduit bending radius with type and size of cable to be installed. Conduits for voice / data / video installations are to also confirm to TIA / EIA standards. If a conflict is identified, the more stringent requirement shall prevail.

G. All exposed conduit and hardware shall be painted per Section 28 05 00.

H. All conduit openings are to have bushings. If omitted, the conductors shall be removed and replaced after the bushings are installed.

I. All fire alarm or life safety conduits are to be painted red by the manufacturer.

3.02 LOCATION

A. Galvanized rigid steel conduit shall be used for:
   1. All above ground exterior work.
   2. Exposed interior work up to eight feet above finished floor including mechanical and electric rooms.
   3. Conduits embedded in concrete or grout unless otherwise noted.
   4. Conduits in corrosive atmospheres.

B. Electrical Metallic Tubing (EMT) shall be used for:
   1. Interior concealed work.
   2. Interior exposed conduit above eight feet as acceptable to the local authority having jurisdiction.

C. Flexible metal conduit (Greenfield) shall be used for:
   1. Interior work in short lengths (six foot maximum).
   2. Connection of any vibrating equipment, unless otherwise noted or where liquid tight flexible metal conduit is required.
   3. Flexible metal conduit shall be supported within twelve inches of each end where used for expansion purposes.

D. Liguidtight flexible metal conduit (Sealtight) shall be used wherever flexible conduit is required and moisture may be present including:
   1. Vibrating equipment where moisture may be present.
   2. When making connections between two building structures.
   3. Liquidtight flexible metal conduit is to be supported within twelve incuse of each end where used for expansion purposes.

E. Rigid non-metallic conduit (PVC) for all underground exterior work, unless otherwise noted. Associated vertical elbows shall be galvanized rigid steel.

3.03 ROUTING

A. Run all concealed conduits above ceilings and inside walls parallel to building lines, unless otherwise noted.

B. Run all exposed conduits parallel to building lines, unless otherwise noted.

C. Coordinate conduit locations with equipment, fixtures, and with structural and architectural elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows.

3.04 CONDUIT SUPPORTS

A. Properly support all conduits as required by the code. Wherever possible, run all conduits concealed except where otherwise shown on the drawings.
   1. Provide "J" hangers on threaded rods or multiple conduits on trapezes consisting of channels supported by minimum 3/8" threaded rod from the structure above. Conduits shall not be supported from ceiling support wires or t-bar grids. Conduits shall not be supported from ductwork, water, fire sprinkler or HVAC lines.
   2. Treat damaged channel finishes with manufacturer's recommended corrosion-resistant coating. Application shall follow manufacturer's recommendation.
   3. Exposed Conduits:
      a. Support exposed conduits within three feet of any junction box, coupling, equipment, fixture or device and at intervals not exceeding code requirements.
      b. Wherever possible, group conduits together and support on common supports located away from walls. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps.
      c. Group together exposed conduits in horizontal runs and support on trapeze hangers unless otherwise noted. Arrange such conduits uniformly and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of rods or other suitable means from the structure above the ceiling.
      d. Support conduit risers in shafts with channels and straps.

3.05 MOISTURE SEALS

A. Provide in accordance with CEC paragraphs 230.8 and 300.5(G).

3.06 FLEXIBLE CONDUIT

A. Flexible metallic conduit shall have a maximum length of six feet unless otherwise noted.

B. Flexible metallic conduit shall not be considered as a ground conductor. Flexible metallic conduit shall be installed only in exposed or accessible locations.

3.07 UNDERGROUND RACEWAY

A. Conduits embedded in concrete floors on grade shall be installed between grids of reinforcing steel, or shall be encased below the floors, provided the concrete is thickened as shown on the Drawings. EMT shall not be embedded in concrete.

B. Slope all underground raceways to provide drainage. Slope conduit from equipment located inside a building to the pull box or manhole located outside the building.

C. All PVC conduits terminating into pull boxes and vaults shall be provided with bell fittings at ends.

D. PVC direct buried conduits shall be installed in soil, covered with sand under a warning tape and compacted soil. Minimum depth 18" below grade. All PVC conduit installed below grade shall be provided with galvanized rigid steel elbows and risers. Rigid Steel shall be wrapped with 20 mil tape and extend minimum 12" above finished grade.

E. Where multiple conduits are run in parallel, install spacers on five-foot centers so as to maintain three-inch spacing between conduits.

F. PVC conduits installed under slabs shall be installed in soil, covered with sand under a vapor barrier and crushed rock. Minimum depth 6" below slab. All PVC conduit installed below slab shall be provided with galvanized rigid steel elbows and risers. Rigid steel shall be wrapped with 20 mil tape and extend minimum 12" above finished grade.

G. Where conduits penetrate structural members, obtain approval for the associated sleeves and windows from the structural consulting engineer and provide as required.

3.08 STORAGE OF PVC CONDUITS

A. Store rigid PVC conduit on a flat surface and shielded from the sun. PVC conduits 3" and larger shall be provided with 48" radius bends. If utilized for voice / data / video conductors, radiuses shall conform to TIA / EIA standards.

END OF SECTION

SECTION 280543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of furnishing and installing raceways, raceway spacers, reinforcing steel, anchors and encasing material with necessary excavation for underground ducts.

B. Encasement - Encasement shall be sand or concrete, at the Contractor's option, for all other raceways.

C. Where required - All raceways for medium voltage cable and all other raceways, where run underground and in excavation, shall be installed in compliance with the requirements of this Section. Conduits run underground without encasement shall be as indicated in the Drawings.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 28 05 00 General Requirements for Safety/Security Systems
   2. 28 05 28.33 Safety/Security System Raceways and Fittings

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC):
      a. 300.50 Underground Installations
      b. 352 Rigid Nonmetallic Conduit
   2. State of California Public Utilities Commission:
      a. General Order 128 Rules of Construction of Underground Electric Supply and Communication Systems

1.04 SUBMITTALS

A. As specified in Division 1 and Section 28 05 00.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. As specified in Section 28 05 28.33 Safety/System Raceways and Fittings.

B. Spacers:
   1. Molded plastic as furnished by the raceway manufacturer, to cradle and position the raceways in the excavation for placing the encasement.
   2. Shape to accurately fit the raceway, provide the correct raceway spacing, to interlock in place and stack.

PART 3 - EXECUTION

3.01 EXCAVATION

A. As specified in Division 2 and as required for the work shown on the Drawings.

3.02 RACEWAY

A. Install cable supports at maximum 5 foot intervals along ductbank.

B. Install raceways per code and utility requirements. Refer to CEC Table 300.5 for minimum burial depth requirements and install per CEC 300.50.

C. Provide minimum 12 inch separation between raceways for high voltage (over 100 volts) and low voltage (under 100 volts) systems.

D. Provide minimum 12 inch separation between electrical conduit and other utilities.

3.03 SAND ENCASEMENT

A. As specified in Division 2.

3.04 BACKFILL

A. As specified in Division 2.

END OF SECTION

SECTION 280544

IN GRADE PULL BOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of providing all labor, supervision, tools, materials, and performing all work necessary to furnish and install pre-cast concrete pull boxes with necessary excavation.

1.02 RELATED WORK

A. See the following specification sections for work related to the work of this section:
   1. 28 05 00 General Requirements for Safety and Security Systems
   2. 28 05 43 Safety/Security System Underground Ducts and Raceways

1.03 STANDARDS AND CODES

A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. California Electrical Code (CEC)
   2. American Concrete Institute (ACI):
      a. 318 Building Code Requirements for Structural Concrete
   3. American Society for Testing and Materials (ASTM):
      a. A185 Steel Welded Wire Reinforcement for Concrete
      b. A615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
      c. C33 Concrete Aggregates
      d. C150 Portland Cement

1.04 SUBMITTALS

A. As specified in Division 1 and Section 28 05 00.

B. Catalog Data:
   1. Provide manufacturer's descriptive literature.

C. Single Submittal:
   1. A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General Requirements:
   1. Concrete pull boxes for electrical power, controls and other communication circuits shall consist of pre-cast reinforced concrete boxes, extensions' bases, and covers as specified herein and as indicated on the Drawings. Pre-cast units shall be the product of a

manufacturer regularly engaged in the manufacture of pre-cast vaults and pull boxes. Acceptable manufacturers are Christy, Utility Vault, Brooks, or approved equal.

B. Construction:
   1. Pre-cast concrete pull boxes for electrical power distribution and communication circuits with associated risers shall conform to ACI 318. Pull box tops in non-traffic areas shall conform to ACI 318. Pull boxes shall be the type noted on the Drawings and shall be constructed in accordance with the applicable details as shown. Walls shall consist of reinforced concrete. Walls shall be of monolithic concrete construction.

C. Covers:
   1. The words "FIRE ALARM" shall be cast in the top face of all fire alarm cable boxes.
   2. The word "SIGNAL" shall be cast in the top face of all telecom, intercom, CATV, data, EMS, security and/or clock cable boxes.

D. Concrete:
   1. Aggregates used in the concrete mix, either coarse or fine, excluding light weight aggregates, shall conform to ASTM C33. Aggregates shall be properly graded and free of deleterious substances to produce a homogeneous concrete mix when blended with cement.

E. Cement:
   1. The cement shall be Type II low alkali Portland cement and shall meet the requirement of ASTM C150.

F. Compressive Strength:
   1. Sufficient cement content shall be used per batch to produce a minimum compressive strength of 3,000 psi at 28 days.

G. Reinforcing Steel:
   1. Welded wire mesh for street lighting boxes shall conform to ASTM A 185.
   2. Reinforcing bars for primary and secondary electrical pullboxes, and communication pull boxes shall be intermediate grade billet steel conforming to ASTM A615.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pre-cast pull boxes shall be installed approximately where indicated on the Drawings. The exact location of each pull box shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. All cable boxes and secondary pull boxes shall be installed with a minimum of 6-inch thick crushed rock bedding.

B. Install junction or pull boxes were required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that not all boxes are necessarily shown on the Drawings.

C. Unless specifically noted as larger on the drawings, size junction and pull boxes to meet code requirements for number and size of conduits connected to box.

D. Paved areas:

1. Pull boxes located in areas to be paved shall be installed such that the top of the cover shall be flush with the finished surface of the paving.

E. Unpaved Areas:
   1. In unpaved areas, the top of pull box covers shall be approximately 2 inches above finished grade.

F. Traffic Areas:
   1. In areas subject to vehicular traffic including roads, driveways, parking lots and other similar areas, provide traffic rated boxes and covers.

G. Trenching, Backfilling, and Compaction:
   1. Trenching, backfilling and compaction shall be as specified in previous sections of the specification.

END OF SECTION

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SECTION 283100

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Furnish and install all materials and equipment including all required equipment, panels, raceways, conductors and connections, and provide all labor required and necessary to complete the work shown on the drawings and/or specified and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete addressable fire alarm installation including all accessories and appurtenances required for testing the systems. It is the intent of the drawings and specifications that all systems be complete, and ready for operation. No extra charge will be paid for furnishing items required by regulations, but not specified herein, or on drawings.

B. See site drawings for specific requirements for the site.

1.02 RELATED WORK

A. Refer to the General Conditions, Supplementary General Conditions, and Division 1 General Requirements.

B. See the following specification sections for work related to the work in this section:
   1. 28 05 00 General Requirements for Electronic Safety and Security
   2. 28 05 28.33 Raceways and Fittings for Electronic Safety and Security
   3. 28 05 13 Wire and Cable for Electronic Safety and Security

1.03 STANDARDS AND CODES

A. Devices and equipment for fire alarm system shall be U.L. listed. Underwriters Laboratories (UL) Standards:
   1. UOJZ Control Units
   2. 38 Manual Operation Signal Boxes
   3. 268 Smoke Detectors for Fire Alarm Signaling Systems
   4. 268A Smoke Detectors for Duct Application
   5. 464 Audible Signal Appliances
   6. 521 Heat Detectors for Fire Protective Signaling Systems
   7. 864 Control Units and Accessories for Fire Alarm Systems
   8. 1635 Digital Alarm Communicator System Units
   9. 1971 Signaling Devices for Hearing Impaired

B. Devices and equipment for fire alarm system shall be listed by the California State Fire Marshal for the specific purpose the device or equipment is used.

C. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
   1. 2010 California Building Code (CBC), Volumes #1 and #2 (Part 2, Title 24, CCR).
   2. 2010 California Electrical Code (Part 3, Title CCR).

3. 2010 California Mechanical Code (CMC) (Part 4, Title 24, CCR).
4. 2010 California Plumbing Code (CPC) (Part 5, Title 24, CCR).
5. 2010 California Energy Code (Part 6, Title 24, CCR).
6. 2010 California Fire Code (CFC) (Part 9, Title 24).
7. 2010 California Green Code (Part 11, Title 24, CCR).
8. 2010 California Referenced Standards Code (Part 12, title 24, CCR).
9. 2010 NFPA 72 National Fire Alarm Code.
10. 2010 NFPA 13 Standards for Fire Sprinkler Systems.
11. ADA Standards for Accessible Design: ADA Accessibility Guidelines (ADAAG) 28, Part 36 Appendix A.
12. ADA Standards for Accessible Design: Code of Regulations (Including Amendments)

1.04 SUBMITTALS

A. In accordance with Section 28 05 00.

B. Submit the following items:
1. Manufacturer's Catalog Data: Manufacturer's original catalog cuts and original description of data of all material and equipment with sufficient information provided so that the exact function of each device is known. Each item supplied shall be clearly identified including both U.L. number and a copy of the State Fire Marshal's listing.
2. Description of conductors to be used with a statement that all wire shall be in conduit.
3. Voltage drop calculations: Verify that voltage drop on signal device circuits does not exceed 10%.
4. Battery Calculations: Verify that battery capacity exceeds supervisory and alarm power requirements, minimum twenty-four (24) hours supervisory plus 5 minutes at full alarm.
5. Floor plan of the point to point connections.
6. Diagram of the power circuitry.
7. Riser diagram.
8. Copy of California State DIR Fire/Life Safety Certificate of installer.
9. Letter on contractor’s letterhead certifying that contractor has at least 3 years experience successfully installing fire alarm systems of similar type and design, or that there is a contractual agreement with a subcontractor having at least 3 years experience successfully installing fire alarm systems of similar type and design.

1.05 SUBSTITUTIONS

A. See section 28 05 00.

1.06 QUALIFICATIONS OF INSTALLER

A. NICET level 2 or greater.

B. Prior to installation, submit data for review showing that the contractor has at least 3 years experience successfully installing fire alarm systems of similar type and design, or that there is a contractual agreement with a subcontractor having at least 3 years experience successfully installing fire alarm systems of similar type and design.

C. One contractor shall furnish and install a complete Fire Alarm and Smoke Detection System as described herein and drawn. Installation shall be by a factory authorized installer of the fire alarm system.

1.07 WARRANTIES

A. The contractor shall warrant all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance. The contractor shall without additional expense to the owner, replace any defective materials or equipment provided by him under this contract within the warranty period.

B. FACP shall have a five year manufacturer's warranty from the date of final acceptance.

C. Signaling devices shall have a two year manufacturer's warranty from the date of final acceptance.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Products listed below are to establish minimum criteria:
   1. Main Fire Alarm Control Panel – DMP XR100FC:
   2. Manual Pull Station – DMP 850D
   3. Smoke Detector – DMP 521LX.
   4. Heat Detector (Fixed Temperature and Combination Fixed Temperature/Rate of Rise) – DMP 521LX.
   5. Remote Notification Power Supply – Wheelock PS-12/24-8CP, CSFM 7315-0785:162.
   6. Strobe - Wheelock RSS-24MCW-FR, CSFM 7125-0785:141.
   7. Horn/strobe - Wheelock AS-24MCW-FR, CSFM 7125-0785:131.
   8. Horn - Wheelock AH-24-R, CSFM 7125-0785:131.
   9. Exterior Horn/strobe - Wheelock ASWP-2475W-FR, CSFM 7125-0785:131.
   10. Exterior Horn - Wheelock AH-24WP-R, CSFM 7125-0785:131.

2.02 SYSTEM DESIGN

A. Alarm System:
   1. Provide a complete, class "B", automatic, addressable, electrically supervised, non-coded, networked, fire alarm system with multiple FACP's and redundant digital alarm communications transmitters.

B. Operation:
   1. Normal alarm operation:
      a. The actuation of any manual pull station, smoke or heat detector, water flow switch or Ansul unit shall cause:
         i. System alarm LED will light and a local audible device in all FACP's and Remote Annunciators will sound.
         ii. Campus evacuation audible alarm notification devices to sound using a Code 3 Temporal pattern.
         iii. Building evacuation visual alarm notification devices to flash.
         iv. All doors normally held open by door control devices shall release. All doors normally held open by door control devices shall also release upon AC power failure.
         v. Appropriate annunciator lamps to light.
         vi. DACT shall automatically transmit an alarm to a UL listed central monitoring station.

vii. All FACP's and Remote Annunciators will display the alarm point and its location in the premises.

2. Activation of an AHU Duct Smoke Detector shall shut down the associated AHU via the Duct Smoke Detector relay base.
3. Activation of a Duct Smoke Detector in a duct penetrating a rated fire wall shall cause the associated Fire/Smoke damper to close via the Duct Smoke Detector relay base.
4. Activation of an Ansul Unit shall shut cause shunt trips to shut down all cooking equipment and receptacles under the associated hood.
5. Activation of an Smoke Detector in an elevator lobby, elevator hoistway or elevator machine room shall cause the elevator to recall to the ground floor unless the alarm is at the ground floor lobby then the elevator shall go to an alternate floor.
6. Activation of a Heat Detector in an elevator hoistway or elevator machine room shall cause shunt trips to shut down all power to elevator machine room.
7. Trouble alarm operation:
   a. An audible trouble alarm at the FACP shall be caused by:
      i. A ground fault condition which prevents system operation
      ii. A single break or an open condition in any circuit
      iii. The loss of AC power
      iv. Removal of any alarm initiating and signal device
      v. Trouble signals shall sound continuously until acknowledged
      vi. Operation of a tamper switch or post indicator valve.

C. Each system shall have electrically supervised:
   1. Class A or Class B alarm initiating device circuits.
   2. Alarm notification device (audio and visual) circuits.
   3. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the FACP.
   4. Normal power supply. Any power failure shall be audible and visually indicated at the FACP.
   5. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

2.03 COMPONENTS

A. Colors:
   1. Provide finish colors under this section in accordance with FED-STD-595.

2.04 FIRE ALARM CONTROL PANEL (FACP)

A. The FACP shall provide power, annunciation, supervision and control for the detection and alarm system, as well as alarm signaling to alert occupants of a fire. FACP shall be a factory wired assembly containing components and equipment necessary to perform the specified annunciation, control and supervisory functions of the system. Construction shall be modular with solid state, microprocessor based electronics.

B. Software:
   1. The system shall be capable of self-programming upon initialization. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a nonvolatile programmable memory within the FACP. Loss of primary and secondary power shall not erase the instructions stored in memory. System programming shall be password protected and shall include full upload and download capability.

2. The system shall feature full flexibility for selective input/output control functions based on ANDing, ORing; NOTing, timing, and special coded operations shall also be incorporated in the resident software programming of the system.
3. Resident software shall allow for full configuration of initiating circuits. The system shall require no additional hardware to change from sensing normally open contact devices to sensing normally closed contacted devices or vice versa. Nor shall the system require additional hardware to change from sensing normally open contact devices to sensing—and distinguishing between—a combination of current limited and non-current limited devices on the same circuit. Nor shall the system require additional hardware for changing from a non-verification circuit to a verification circuit or vice-versa.
4. There shall be no limit, other than maximum system capacity, to the number of intelligent/analog devices which may be in alarm simultaneously.

C. Primary Power:
1. Provide 120 VAC service, transformed through a two-winding isolation-type transformer and rectified to 24 VDC for operation of initiating, alarm notification, trouble signal, and alarm transmitting circuits. All primary power supplies for the system shall be via separate, lockable, circuit breakers, dedicated to fire alarm equipment. The circuit breakers shall be identified "Fire Alarm System" with a red and white engraved plastic sign permanently affixed to the face of the circuit breaker:
   a. The incoming power to the system shall be supervised so that any power failure will be audibly and visually indicated at the FACP.

D. Auxiliary Power:
1. Provide 24 VDC auxiliary power for system operation in the event of a primary power source failure. Independent auxiliary power systems shall be located in each FACP and RNPS. Transfer from normal to auxiliary power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm:
   a. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel and the remote annunciator. House batteries either within the control panel cabinet or a separate battery cabinet adjacent to the FACP. The cabinet shall be sized to hold twice the volume of batteries it will contain initially.
   b. Batteries:
      i. Provide rechargeable batteries with sufficient ampere-hour rating to operate the system under supervisory and/or trouble conditions, including audible trouble signal devices for 24 hours and audible and visual notification devices under alarm conditions for an additional 5 minutes.
   c. Battery Charger:
      i. Provide solid state, automatic, variable type, battery charger, capable of recharging completely discharged batteries to fully charged condition in 24 hours or less.

E. FACP shall have a minimum of one set of normally-open and one set of normally-closed alarm-operated dry contacts.

F. Local Audible Device:
1. A local audible device shall sound during Alarm, Trouble or Supervisory conditions. Audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel.
2. Audible device also shall sound during each “key-press” to provide an audible feedback to ensure that the key has been pressed properly.

G. Primary Controls shall be visible through a front access panel. Controls shall include:
   1. 4 line by 40 character LCD display
   2. Individual red LED's for system alarm and pre-alarm.
   3. Individual yellow LED's for supervisory service, trouble, and security.
   4. Green LED for "power on".
   5. Switches: Alarm Acknowledge, Supervisory Acknowledge, Trouble Acknowledge, Alarm Silence, Reset and Manual Evacuation (drill).

H. Alarm Sequence:
   1. Smoke Detector Alarm Verification:
      a. The activation of any system smoke detector shall initiate an alarm verification operation whereby the panel will reset the activated detector and wait for a second alarm activation.
      b. If within one minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm. If no second alarm occurs within one minute the system shall resume normal operation.
      c. The alarm verification operation shall be selectable by zone.
   2. Alarm Initiation: The actuation of any alarm initiating device shall automatically initiate the following operations:
      a. All audible alarm indicating appliances shall sound a fire alarm signal until the System Acknowledge key or the Signal Silence key is depressed.
      b. All visible alarm indicating appliances shall flash continuously until the System Acknowledge key or the Signal Silence key is depressed.
      c. The off-site central monitoring station shall be notified automatically until the System Acknowledge key or the Signal Silence key is depressed.
      d. Shutdown of the corresponding HVAC system equipment shall occur until the System Acknowledge key or the Signal Silence key is depressed.
      e. Activation of all programmed outputs assigned to the initiating device shall occur until the System Acknowledge key or the Signal Silence key is depressed.
      f. Any subsequent zone alarm shall reactivate the alarm indicating appliances.
   3. FACP Alarm Indication:
      a. The top line of the FACP LCD display shall show the point label and the second line shall show the device type identifier.
      b. The system alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged the LED shall latch on.
      c. A pulsing alarm tone shall occur within the FACP until the event has been acknowledged.
      d. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel. The LCD display shall indicate the new alarm information.
      e. A pulsing alarm tone shall occur within the local building control panel, and where applicable, the remote annunciator until the event has been acknowledged.
      f. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, all alarm
      g. The system shall have a single key that will allow the operator to display all alarms, troubles, and supervisory service conditions including the time of each occurrence functions will occur.
      h. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause an audible signal to sound at the FACP for four seconds indicating a trouble condition.
   4. FACP Alarm Acknowledgment:
      a. Acknowledge Function shall feature password protection.

b. Users without sufficient privilege to acknowledge an alarm shall be able to view the points without acknowledging them.
c. After all points have been acknowledged, the LED's shall glow without blinking and the audible signal shall be silenced.
d. The total number of alarms supervisory and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be clearly defined.

5. Alarm Silencing:
   a. When the "Alarm Silence" button is pressed all alarm signals shall cease operation, except during alarm silence inhibit mode.
   b. It shall be possible to selectively program signal circuits as non-silenceable.
6. System Reset:
   a. The system reset button shall return the system to its normal state after an alarm condition has been remedied.
   b. The LCD display shall step the user through the reset process with simple English Language messages including a final message indicating the system has been returned to the normal condition.

I. The FACP interface shall provide the following functions:
   1. Setting of time and date
   2. LED testing
   3. Alarm, trouble and abnormal condition listing
   4. Enabling and disabling of each monitor point separately
   5. Activation and deactivation of each control point separately
   6. Changing operator access levels
   7. Walk Test enable
   8. Running diagnostic functions
   9. Displaying software revision level
   10. Displaying historical logs
   11. Displaying card status
   12. Point listing

J. Point Lists Menu:
   1. For maintenance purposes the following lists shall be available from the point lists menu:
      a. All points list by address
      b. Monitor point list
      c. Signal/speaker list
      d. Auxiliary control list
      e. Feedback point list
      f. Utility point list
      g. LED/switch status list

K. Menu Lists:
   1. Scrolling through the menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user.
   2. Menu lists shall be password protected.
   3. Acknowledgment for each abnormal condition shall be provided in accordance with NFPA 72 requirements.

L. Condition Display Order:
   1. The System shall display the first unacknowledged condition.

M. Function Keys:
   1. Additional function touch switches shall be provided to access status data for the following points:
      a. Initiating device circuits
      b. Indicating appliance circuits
      c. Auxiliary relays
      d. Feedback points
      e. All other input/output points

N. Available Status Data:
   1. The following status data shall be available:
      a. Primary State of point
      b. Zone, Point Address and Card type information
      c. Circuit Status
      d. Current priority of outputs
      e. Disable/Enable status
      f. Automatic/Manual Control Status of output points (Hand-Off/Auto Switches)
      g. Relay Status

O. Utility Points:
   1. Each control panel shall have dedicated utility point supervisory and acknowledge buttons. Activation of a utility point shall activate the system supervisory service audible signal and illuminate the appropriate utility point LED on the control panel, at the Master Control Console and at the guard shack network control panel.
   2. Pressing the appropriate acknowledge button shall silence the audible alarm, while maintaining the LED 'ON' indicating the OFF-normal condition.
   3. Restoring the condition to its normal position, or locally resetting the acknowledge switch shall extinguish the LED, indicating normal conditions.
   4. The following utility point status shall be available:
      a. Door monitor contact status for each door on system

P. History Log:
   1. The FACP shall be capable of logging and storing up to 1000 events in the History Log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.
   2. The following Alarm History events shall be stored:
      a. Alarms, alarm acknowledgment, alarm silence, system reset, alarm historical log cleared.
   3. The following Trouble History events shall be stored:
      a. Trouble conditions, supervisory alarms, trouble acknowledgment, supervisory acknowledgment, walk test results and trouble historical log cleared.
   4. The system shall have the capability of recalling alarm and trouble conditions in chronological order for the purpose of recreating an event history.

Q. Access Levels:
   1. There shall be four (4) access levels with level 4 being the most secure level.
   2. Level 1 actions shall not require a passcode.
   3. Passcodes shall be numerical and shall consist of up to six (6) digits. Changes to passcodes shall be made only by authorized personnel.

R. Printer/CRT Interface Card:

1. The FACP shall include an output port (RS-232) capable of operating remote CRT's and/or printers from a Central Processing Unit.

S. Addressable Points:
1. All addressable devices shall have the capability of being disabled or enabled individually.
2. System shall be capable of connecting up to 126 addressable devices per loop. Provide 4 loops. The system shall not require factory programming to add or delete devices.
3. The communication format shall allow t-tapping of the circuit wiring.
4. The FACP shall provide communication with initiating and control devices individually. The FACP will individually annunciate Alarm, Trouble, Open, Short, and Device missing/failed from each point.

T. Alarm Signaling:
1. The FACP shall provide sufficient power and signal circuit capability to meet the requirements of the plans and specifications and to comply with Americans with Disabilities Act (ADA) requirements.
2. The FACP and Power Supplies shall be designed to accommodate all signaling circuits and 20% spare capacity.
3. The FACP shall allow for field programming operation of the signal circuits (i.e. march time, zone coded, zone-signal linking, etc.) This capability shall be included in the system firmware with no additional cost to the Owner.

U. Cabinets and Consoles:
1. The Fire Alarm Control Panel and annunciator cabinets shall be sized to accommodate all components and modules specified and required for a complete system.

V. Digital Alarm Communications Transmitter (DACT):
1. DACT shall supervise up to 2 telephone lines to call a central station and transmit group specific information including: Alarm, Supervisory, Waterflow and Trouble information for up to 256 groups or software zones; between the FACP and a UL listed central station, in accordance with UL 1635 and as approved by local AHJ.
2. DACT shall supervise telephone lines at one minute intervals. Failure of a line shall result in a Trouble signal at the FACP. Restoration of a failed line shall result in a Line Trouble Restored signal to the FACP. Failure of the primary line shall result in automatic transfer to the secondary line. If one line fails, the DACT shall automatically transmit a maintenance call to the central station at a 24 hour interval.
3. DACT shall be capable of transmitting multiple events during a single call session. Up to three attempts shall be made to transmit a message during a single call attempt. DACT shall be capable of tone or pulse dialing. DACT shall be capable of seizing lines if used in conjunction with a local premise telephone line.
4. DACT shall be mounted internally in the FACP and UL 864 listed for use as in slave applications with a listed Fire Alarm Control Panel.

W. Network Interface:
1. Provide a peer to peer network interface that allows all FACP's on the site to be linked into a single network. All events shall be displayed on all FACP's and RA's. Network shall be capable of working with either class A and class B wiring.
2. The network shall be capable of automatically continued communication around isolated FACP's using a fully duplex 9 bit protocol providing simultaneous transmit and receive signals between FACP's.
3. Network shall be capable of either wire or fiber optic connections between FACP's.

4. Each FACP shall be capable of maintaining its own program specific to its area of protection while communicating with the network. Isolated FACP's shall be capable of continuing independent, stand alone operation.
5. Provide one primary network router at the main FACP, and one redundant network router and one serial interface module in every FACP.

2.05 REMOTE ANNUNCIATOR (RA)

A. RA shall be fully supervised, have EIA-232 serial ports for network connection and have a remote printer interface. RA shall provide remote 4 line by 40 character LCD display and control functions for the FACP. Control functions shall be enabled and disabled via a key switch.

B. Alarm Indication:
   1. A pulsing alarm tone shall occur within the RA until the event has been acknowledged. The top line of LCD Display shall show the point label and the second line shall show the device type identifier.
   2. The system alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on.
   3. A subsequent alarm received from another zone shall flash the system alarm LED. The LCD display shall indicate the new alarm information.
   4. A pulsing alarm tone shall occur within the RA until the event has been acknowledged.
   5. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause an audible signal to sound at the RA for four seconds indicating a trouble condition.

C. RA shall have individual switches and LED's for:
   1. Remote Acknowledge
   2. Reset
   3. Signal Silence
   4. Lamp Test
   5. Display First Event
   6. Display Next Event
   7. Display Previous Event

2.06 ALARM INITIATION DEVICES

A. Initiation Devices shall be documented as compatible with the control equipment to which they are connected.

B. Smoke Detector and Heat Detectors shall be listed for both ceiling and wall mount applications. Each detector shall be scanned by the control panel for its type identification to prevent inadvertent substitution of another detector type. The control panel shall operate with the installed device but shall initiate a "Wrong Device" trouble condition until the proper type is installed or the programmed sensor type is changed.

C. Manual Pull Stations:
   1. Provide semi-recessed, non-coded, ADA approved, single-action type manual pull station with mechanical reset features. Mount pull stations with the centerline at 48" above the finished floor. Provide separate screw terminal for each conductor connected to the manual alarm pull station. Provide housings labeled "Fire". The pull stations shall not be resettable without the use of a key in a tumbler type lock. Provide an addressable module with each pull station.

2. In existing buildings, back boxes may be surface-mounted. Surface mounted back boxes shall be the same color as the manual pull stations.

D. Smoke Detector:
1. Smoke Detectors shall be off-white flame retardant plastic, individually addressable, analog, solid state, photoelectric type, which complies with UL 268.
2. Smoke Detectors shall digitally transmit analog visible smoke level value to the FACP for analysis. Each detector shall contain a LED that will flash each time it is scanned by the FACP. When the FACP determines that a sensor is in the alarm or a trouble condition, the control panel shall command the LED on that sensor to turn on steady indicating the abnormal condition.
3. Smoke Detectors shall be plug in type and fit into a base that is common with both the addressable heat detectors and addressable photoelectric smoke detectors and shall be compatible with all other addressable devices on the same circuit.
4. Smoke Detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the FACP. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the FACP.

E. Duct Smoke Detector:
1. Duct Smoke Detectors shall be off-white flame retardant plastic, individually addressable, analog, solid state, photoelectric type, which complies with UL 268, in duct smoke detector housing for detection of smoke in HVAC ducts.
2. Duct Smoke Detector shall be housed in an airtight smoke chamber. Detectors shall be capable of sensing smoke in ducts between 2 ½ and 10 feet in width and at air speeds between 300 and 4,000 feet per second. Detectors shall use sampling tubes. Detector shall have separate sampling tube and exhaust tube. Contractor shall size and install sampling tube per manufacturers' recommendations.
3. Duct Smoke Detector shall communicate actual smoke chamber values to the FACP. Each detector shall contain a LED that will flash each time it is scanned by the FACP. When the FACP determines that a sensor is in the alarm or a trouble condition, the FACP shall command the LED on that sensor to turn on steady indicating the abnormal condition. Detectors shall be compatible with all other addressable devices on the same circuit.
4. Detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the FACP. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the FACP.
5. Duct Smoke Detector shall be provided with two isolated sets of form C contacts rated for 10 Amps, 24 VDC resistive, for HVAC shutdown. . Provide power and transformer as required for control circuit.

F. Heat Detector (Fixed Temperature and Combination Fixed Temperature/Rate of Rise):
1. Heat Detectors shall be off-white flame retardant plastic, analog, individually addressable, solid state, with thermistor sensing circuit.
2. Detectors shall digitally transmit temperature values to the FACP for analysis:
   a. Fixed Temperature Heat Detector: FACP shall be set to 190°F to initiate an alarm.
   b. Combination Fixed Temperature/Rate of Rise Heat Detector: FACP shall be set to 135º F or a rate-of-rise of 15º F per minute to initiate an alarm.
3. Each detector shall contain a LED that will flash each time it is scanned by the FACP. When the FACP determines that a sensor is in the alarm or a trouble condition, the FACP shall command the LED on that sensor to turn on steady indicating the abnormal condition.
4. Detectors shall be plug in type and fit into a base that is common with both the addressable heat detectors and addressable photoelectric smoke detectors and shall be compatible with all other addressable devices on the same circuit.

5. Detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the FACP. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the FACP.

G. If the proposed type of detector has an area coverage capability less than required by NFPA 72, revise detector layout and submit for approval with the detail drawings. Mount detectors at the underside of ceiling or roof decks unless otherwise indicated. Each detector shall be designed for outlet box mounting, supported independently of wiring connections, and connected by separate screw terminals for each conductor. No detector shall be located closer than 12 inches to any part of any lighting fixture. Detectors, located in areas subject to moisture or exterior atmospheric conditions, or hazardous locations as defined by NFPA 70, shall be approved for such locations.

H. Addressable Monitor Module:
1. Monitor Modules shall be provided for monitoring normally open direct contact devices to an addressable signaling line circuit.
2. Monitor Modules shall be used for monitoring all contact closure type fire alarm system related devices including: conventional heat detectors, fire smoke damper position switches, waterflow switches, valve tamper switches, post indicator valves, and chemical or gas fire suppression systems.
3. Monitor Modules shall be designed for concealed mounting within an electrical backbox and will be wired class B.
4. Monitor Modules shall be compatible with all other addressable devices on the same circuit.

2.07 ADDRESSABLE RELAY MODULE

A. Relay Modules shall be provided for control of electrical devices during fire alarm.

B. Relay Modules shall be provided for control of all peripheral fire alarm related equipment, including HVAC equipment, fire/smoke dampers, magnetic door holders, fire/smoke doors and elevators.

C. Relay Modules shall be provided with one normally open / normally closed, set of form C contacts rated for 0.2 Amps, 120 VAC or 2.0 Amps, 30 VDC. An LED for indicating that the Module is energized. Relay Modules shall be capable of mounting in a standard 4 inch square, 2 1/8 inch deep electrical box, and will be wired class B. Provide control power to RM as required.

D. Relay Modules shall be compatible with all other addressable devices on the same circuit.

2.08 SIGNAL CONTROL ELEMENT

A. Signal control element shall be provided to create an additional supervised notification circuit from an addressable loop. All supervision and trouble reporting to the FACP shall be via the addressable loop.

B. Power for the device and any indicating devices shall be provided via the associated RNPS.

2.09 DUAL SYNC MODULES (DSM)

A. DSM's shall be capable of synchronizing both horns and strobes on a single pair of wires. DSM's shall synchronize two class "B" notification circuits. Horns shall be synchronized to sound in a temporal (code 3) pattern. Provide DSM's for all notification circuits supplied directly by the FACP.

2.10 REMOTE NOTIFICATION POWER SUPPLY (RNPS)

A. RNPS shall provide additional supervised, notification appliances circuits to the fire alarm system.

B. Primary Power:
   1. Provide 120 VAC service to each RNPS, transformed through a two-winding isolation-type transformer and rectified to 24 VDC for operation of alarm notification circuits. All primary power supplies for the system shall be via separate, lockable, circuit breakers, dedicated to fire alarm equipment. The circuit breakers shall be identified "Fire Alarm System" with a red and white engraved plastic sign permanently affixed to the face of the circuit breaker.

C. Auxiliary Power:
   1. Provide 24 VDC auxiliary power for system operation in the event of a primary power source failure. Independent auxiliary power systems shall be located in each RNPS. Transfer from normal to auxiliary power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

D. RNPS shall be provided with sufficient battery capacity to operate all output circuits upon loss of normal 120 VAC power in a normal supervisory mode for a period of twenty-four (24) hours followed by 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure.

E. Battery Charger:
   1. Provide solid state, automatic, variable type, battery charger, capable of recharging completely discharged batteries to fully charged condition in 24 hours or less.

      a. Batteries 24 V, rechargeable, gelled electrolyte, totally sealed, fully charged with all interconnections ready for service. Maintenance free, long-life.

F. RNPS shall be modular with solid state microprocessor based electronics. RNPS shall provide stand alone power supply for powering notification appliance circuits. RNPS shall have capacity for up to four class "B" notification appliances circuits. RNPS shall contain built in synchronization to synchronize Code 3 Temporal horns and flashes of strobes. RNPS shall provide the ability to silence horns while maintaining strobe functions. RNPS shall interface with the addressable fire alarm system by means of a Notification Appliance Circuit Module connected to the initiation circuits.

G. RNPS shall provide up to 200 milliamps of continuous auxiliary output for control functions.

2.11 NOTIFICATION DEVICES

A. All alarm notification devices shall be synchronized.

B. Strobe:

1. Provide recessed mounted visual alarm device consisting of a strobe light assembly suitable for use in an electrically supervised circuit. Lamps shall be the xenon flashtube type, and powered from the fire alarm control panel alarm or remote notification power supply signaling circuit. Strobe shall have field selectable candela ratings of 15, 35, 75 or 100 cd. Candela setting for individual strobe shall be as indicated on the drawings. Strobes shall flash 60 times per minute unless otherwise noted. Lamps shall be protected by a clear polycarbonate lens. Housing shall be labeled "FIRE" in white lettering. Strobes shall have a separate screw terminal for each conductor connection. Locate strobes as indicated.

C. Horn/Strobe:
1. Provide recessed mounted, audio/visual alarm devices consisting of a grille face, electro-mechanical horn and strobe light assembly suitable for use in an electrically supervised circuit. Horn shall have field selectable minimum sound rating of 90, 95, 99 (anechoic) dBA at 10 feet. Strobe shall have field selectable candela ratings of 15, 35, 75 or 100 cd. Candela setting for individual strobe shall be as indicated on the drawings. Strobes shall flash 60 times per minute unless otherwise noted. Lamps shall be protected by a clear polycarbonate lens. Housing shall be labeled "FIRE" in white lettering. Horns/strobes shall have a separate screw terminal for each conductor connection. Locate horn/strobes as indicated.

D. Horn:
1. Provide recessed mounted, audio alarm devices consisting of a grille face, electro-mechanical horn suitable for use in an electrically supervised circuit. Horn shall have field selectable minimum sound rating of 90, 95, 99 (anechoic) dBA at 10 feet. Horns shall have a separate screw terminal for each conductor connection. Horns shall be provided with a red grill. Locate horns as indicated.

E. Exterior Horn/Strobe:
1. Provide surface mounted, audio alarm devices consisting of a grille face, electro-mechanical horn and strobe light assembly suitable for use in an electrically supervised circuit. Horn shall have field selectable minimum sound rating of 90, 95, 99 (anechoic) dBA at 10 feet. Strobe shall have candela ratings of 75 cd at -31ºF and 180 cd at 77ºF. Candela setting for individual strobe shall be as indicated on the drawings. Strobes shall flash 60 times per minute unless otherwise noted. Lamps shall be protected by a clear polycarbonate lens. Housing shall be red, tamper resistant grill, labeled "FIRE" in white lettering and weatherproof backbox. Horn/strobes shall have a separate screw terminal for each conductor connection. Horn/strobes located in areas subject to moisture or exterior atmospheric conditions, shall be approved for outdoor use. Locate exterior horn/strobes as indicated.

F. Exterior Horn:
1. Provide surface mounted, audio alarm devices consisting of a grille face, electro-mechanical horn suitable for use in an electrically supervised circuit. Horn shall have field selectable minimum sound rating of 90, 95, 99 (anechoic) dBA at 10 feet. Horns shall have a separate screw terminal for each conductor connection. Horns shall be provided with a red, tamper resistant grill, and weatherproof backbox. Horns located in areas subject to moisture or exterior atmospheric conditions, shall be approved for outdoor use. Locate exterior horns as indicated.

2.12 WIRING

A. See section 28 05 13. Provide wiring in accordance with NFPA 72. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

B. Conductors shall be solid copper. Wiring shall be in accordance with local, state and national codes and as recommended by the manufacturer of the fire alarm system. Conductors for 120 volt circuits shall be No. 12 AWG minimum; conductors for low-voltage DC circuits shall be No. 14 AWG minimum for annunciation circuits and No. 18 AWG minimum for initiation circuits.

C. Provide color-coded conductors. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Each conductor used for the same specific function shall be distinctively color coded. Use different color codes for each interior alarm circuit. Each circuit color code wire shall remain uniform throughout the circuit.

D. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).

E. Pigtail or "T" tap connections to evacuation alarm horns, horn/strobes and strobes are not acceptable.

2.13 CONDUITS

A. See section 28 05 13. All fire alarm wiring from the FACP to final devices shall be run in conduit unless other wise noted.

B. Identification of Conduit: New conduits containing fire alarm system conductors shall be permanently banded with red phase tape, 3/4" wide at ten (10) foot on center maximum. Junction boxes, covers, gutters, and terminal cabinets, containing fire alarm system conductors, shall be painted red or provided with engraved plastic identification signs permanently attached to the equipment.

C. Fire alarm circuits shall not be run in the same conduit with non-fire alarm circuits. AC circuits shall not be run in the same conduit with DC circuits.

D. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage or vandalism.

E. Conceal conduit in finished areas of new construction and wherever practical in existing construction. Conduit runs shall be straight, neatly arranged, properly supported, and parallel or perpendicular to walls and partitions. Identify conductors within each enclosure where a tap, splice, or termination is made.

F. Underground circuit or circuits in wet areas shall be Type UF or USE cable in schedule 40 PVC conduit.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with the NFPA publications and as modified herein.

B. Follow manufacturers' directions in all cases for installation, testing and energizing.

C. Accurately set, level, support and fasten all equipment.

D. Batteries:
   1. All batteries shall have the date of installation hand written on the side in a location clearly visible to service personnel.
   2. Replace any existing batteries over 4 years old or of unknown age with new compatible, rechargeable, gelled electrolyte, totally sealed, fully charged batteries.

E. Smoke and heat detectors:
   1. Locate detectors in accordance with NFPA 72. If the proposed type of detector has an area coverage capability less than required by NFPA 72, revise detector layout and submit for approval with the detail drawings. Mount detectors at the underside of ceiling or roof decks unless otherwise indicated.
   2. No detector shall be located closer than 12 inches to any part of any lighting fixture. Detectors, located in areas subject to moisture or exterior atmospheric conditions, or hazardous locations as defined by NFPA 70, shall be approved for such locations.

F. Conduit where exposed shall be installed parallel with walls or structural elements; vertical runs to be plumb; horizontal runs level or parallel with structure; conduit grouped neatly together with straight runs, all bends parallels and uniformly spaced.

G. Earthquake Resistant installation/fastening of all electrical equipment shall conform to seismic code requirements. Where anchorage details are shown or not shown on the Drawings, the field installation shall be approved by a Structural Engineer.

3.02 PRELIMINARY TESTS

A. Before final acceptance of the work, pre-test system to demonstrate compliance with the contract requirements. System shall be subjected to complete functional and operational tests, including tests in place for each detector. Correct deficiencies pertaining to these requirements prior to formal functional and operational tests of the system. When tests have been completed and corrections made, submit test results and a signed and dated request for formal inspection and final test witnessing.

B. Conduct the following tests during installation of wiring and system components. Preliminary test shall be performed in the presence of the Local Fire Authority and Project Inspector of Record to determine conformance with the specified requirements:
   1. Visually inspect all strobes and horn/strobes to ensure that strobe settings are as shown on the drawings.
   2. Ground Resistance:
      a. Measure the resistance of each connection to ground. Ground resistance shall not exceed 10 ohms.
   3. Dielectric Strength and Insulation Resistance:
      a. Test the dielectric strength and the insulating resistance of the system interconnecting wiring by means of an instrument capable of generating 500 volts DC and equipped to indicate leakage current in megohms. For the purpose of this test, connect the instrument between each conductor on the line and between each conductor and

ground at the control panel end of the line, with the other extremity open circuited and all series-connected devices in place. The system shall withstand the test without breakdown and shall indicate a resistance of not less than 50 megohms, the measurement being taken after an electrification of 1.0 minute with a DC potential of 500 volts.

4. Standby Battery Test:
   a. Prior to formal inspection and tests, place the fire alarm system on standby battery power for twenty-four (24) hours; immediately thereafter, sound the building evacuation alarm signaling devices for 5 minutes. When the test is complete, allow fire alarm system battery charger to recharge the standby batteries for 24 hours and place the fire alarm system on standby battery power for an additional twenty-four (24) hours; immediately thereafter, sound the building evacuation alarm signaling devices for 5 minutes. Certify that the Fire Alarm System has satisfactorily sounded building evacuation alarms for 5 minutes after the second twenty-four (24) hours on battery power.

3.03 FIELD INSPECTION AND FINAL TEST

A. Perform the formal inspection and final test in the presence of the in the presence of the manufacturer's representative, the owners representative, Local Fire Authority and Project Inspector of Record (IOR). NFPA 72 "Inspection and Testing Form" shall be filled out completely and signed by those performing and witnessing the final test:
   1. Randomly test a minimum of 10% of all automatic fire detection devices, selected by the Project Inspector of Record (IOR):
      a. Where application of heat would destroy any heat detector, it may be manually activated.
   2. The communication loops and the indicating appliance circuits shall be opened in at least two (2) locations per zone to check for the presence of correct supervisory circuitry.

B. Test Equipment: It shall be the responsibility of the installing Contractor to furnish tools, instruments, and materials required for the thorough test of the system. This includes, but is not limited to, the following:
   1. VOM meter
   2. Manufacturers recommended smoke detector testing device and sensitivity test equipment.
   3. Heat source for testing rate of rise heat detectors.
   4. Keys to all control panels
   5. Ladders

3.04 TRAINING

A. Provide minimum four hours on site training by FACP manufacturer factory trained and authorized personnel.

B. Training sessions shall provide:
   1. Instruction on operating the fire alarm system.
   2. "Hands-on" demonstrations of the operations of all system components.
   3. Instruct process for changing program and functions.

C. Permanently attach Sequence of Operation for fire alarm panel on wall next to FACP. Coordinate exact location with Owner.

3.05 PROJECT CLOSEOUT

A. As Built Drawings:
   1. Provide a complete set of reproducible "as-built" drawings showing installed wiring, color coding, and wire tag notations for exact locations of all installed equipment, specific interconnections between all equipment, and internal wiring of the equipment upon completion of system:
      a. Drawings shall include actual voltage drop calculations as installed for all new or modified notifications circuits.
      b. Drawings shall include actual battery calculations as installed for any new FACP's or RNPS's or any FACP's or RNPS's whose loads have been modified.

B. Operating and Instruction Manuals:
   1. Operating and instruction manuals shall be submitted prior to testing of the system. Four (4) complete sets of operating and instruction manuals shall be delivered to the owner upon completion.
   2. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and a trouble shooting manual explaining how to test the primary internal parts of each piece of equipment shall be delivered to the owner upon completion of the system.
   3. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
      a. Instruction on replacing any components of the system, including internal parts.
      b. Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.
      c. A complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.
      d. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit in accordance with U.L. Standard 864.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

1.00 GENERAL

1.01 REFERENCES

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 01 apply to the work of this Section as if printed herein.

B. Document: Geotechnical Investigation, dated May 2013, prepared by Cotton, Shires and Associates, Inc. Copies of this report are available for review in appendix.

1.02 SECTION INCLUDES

A. Clearing and grubbing.

B. Remove paving, curbs, and other surface improvements.

C. Protect trees indicated to remain.

D. Remove trees and other vegetation.

E. Remove root system of trees and shrubs.

F. Topsoil stripping and stockpiling.

1.03 RELATED SECTIONS

Not Applicable.

1.04 REGULATORY REQUIREMENTS

A. Comply with all applicable codes, standards, and regulations in the execution of the work.

1.05 PROJECT CONDITIONS

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

2.00 PRODUCTS

Not Applicable

3.00 EXECUTION

3.01 PREPARATION

A. Verify that existing heritage trees designated to remain are tagged or identified.

B. Indicated locations of existing utilities are approximate; determine exact locations before commencing work.

3.02 PROTECTION

A. Locate, identify, and protect utilities that remain from damage.

B. Tree Protection shall be in accordance with Document 00823 – Tree Protection.

C. Protect benchmarks and existing improvements on adjoining properties and existing improvements on Owner's property designated to remain, from damage or displacement.

1. Restore damaged improvements to their original condition, as acceptable to City.

3.03 CLEARING

A. Clear areas required for access to site and execution of work.

B. Remove paving, curbs, and sidewalks as shown on the plans.

C. Remove trees and shrubs not designated to remain. Remove stumps, main root ball, root system to a depth of at least six inches.

D. Strip site to sufficient depth to remove all surface vegetation and topsoil containing greater than 3 percent organic matter by volume.

3.04 REMOVAL

A. Remove debris, rock, and extracted plant life from site. Remove underground foundations buried approximately 2 feet below surface as referenced on sheet C1.0 of civil plans.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed or delivered to the City of Cupertino if item to be salvaged is City property.

C. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify affected utility companies in advance and obtain approval before starting this work. Contractor to coordinate vault lid adjustment and replacement with full traffic cover with PG&E or AT&T as required for vaults within driveways. Contractor to pay all fees required and cost for work done on vaults.

1. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

2. Contractor to pothole and verify all utility locations prior to starting construction of any kind.

3.05 TOPSOIL EXCAVATION

A. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 3 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.

END OF SECTION

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SECTION 31 20 00

EXCAVATING

1.00 GENERAL

1.01 REFERENCES

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 01 apply to the work of this Section as if printed herein.

B. Document: Geotechnical Investigation, dated May 2013, prepared by Cotton, Shires and Associates, Inc. Copies of this report are available in the appendix for review.

1.02 SECTION INCLUDES

A. Excavating for building foundations.

B. Excavating for paving.

C. Excavating for site structures.

1.03 RELATED SECTIONS

A. Section 31 23 33 - Trenching: Excavation for utility trenches.

1.04 FIELD MEASUREMENTS

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

2.00 PRODUCTS

Not applicable.

3.00 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Locate, identify, and protect utilities that remain, from damage.

C. Notify utility company to remove and relocate utilities.

D. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

3.02 EXCAVATION

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil required to accommodate building foundations, slabs-on-grade paving and site structures, and construction operations.

C. Machine slope banks to angle of repose or less, until shored.

D. Do not interfere with 45 degree bearing splay of foundation.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation.

F. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

G. Stockpile excavated material in area designated on site and remove excess material not being reused, from site.

3.03 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Soil Engineer.

B. Provide for visual inspection of bearing surfaces.

3.04 PROTECTION

A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

END OF SECTION

SECTION 31 23 33

TRENCHING

1.00 GENERAL

1.01 REFERENCES

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 01 apply to the work of this Section as if printed herein.

B. Document: Geotechnical Investigation, dated May 2013, prepared by Cotton, Shires and Associates, Inc. Copies of this report are available in the appendix for review.

1.02 SECTION INCLUDES

A. Excavating trenches for utilities from 5 feet outside building to municipal utilities.

B. Compacted fill from top of utility bedding to subgrade elevations.

C. Backfilling and compaction.

1.03 RELATED SECTIONS

A. Section 31 20 00 - Excavating: General building excavation.

B. Section 33 31 00 - Site Sanitary Sewerage System: Sanitary sewer piping and bedding from building to utility service.

1.04 REFERENCES

A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

1.05 DEFINITIONS

A. Utility: Any buried pipe, conduit, or cable.

1.06 FIELD MEASUREMENTS

A. Verify that survey bench mark and intended elevations for the Work are as shown on drawings.

1.07 COORDINATION

A. Verify work associated with lower elevation utilities are complete before placing higher elevation utilities.

2.00 PRODUCTS

2.01 FILL MATERIALS

A. As specified in the Geotechnical Investigation, dated May 2013, prepared by Cotton, Shires and Associates, Inc.

2.02 ACCESSORIES

A. Filter Fabric: Non-biodegradable, non-woven, 140 N, manufactured by Mirafi or approved equal.

3.00 **EXECUTION**

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

C. Maintain and protect above and below grade utilities which are to remain.

D. Cut out soft areas of subgrade not capable of in situ compaction. Remove soft, yielding and pumping areas. Backfill with on-site material compacted to at least 90% relative compaction.

3.02 EXCAVATION

A. Excavate subsoil required for installation of utilities.

B. Cut trenches sufficiently wide to enable installation and allow inspection.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Hand trim for bell and spigot pipe joints. Remove loose matter.

E. Remove lumped subsoil, and rock larger than 2.5 inches.

F. Correct areas over excavated in accordance with Section 31 20 00.

G. Stockpile excavated material in area designated on site.

H. Trenching within tree canopy/root zone shall be completed by hand digging

I. There shall be no cutting of tree root **4"** or more in diameter without approval from City or Arborist. Comply with Section 00823 – Tree Protection.

3.03 BACKFILLING

A. Backfill trenches to contours and elevations.

B. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Excavated on-site material can be re-used as trench backfill provided it is free of organic material and other debris and rocks greater than 4 inches in maximum dimension.

D. Backfill Material: Place and compact material in continuous layers not exceeding 8 inches uncompacted depth.

E. Employ a placement method that does not disturb or damage foundation perimeter drainage or utility.

F. Backfill should be moisture conditioned to at least optimum moisture content and compacted to at least 90% relative compaction and 95% under pavements and structures.

3.04 TOLERANCES

A. Top Surface of Backfilling: Plus or minus 0.1 feet from required elevations.

3.05 FIELD QUALITY CONTROL

A. Field testing will be performed under provisions of the Soil Engineer.

B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.

C. If tests indicate work does not meet specified requirements, remove work, replace, compact, and retest.

3.06 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.07 SCHEDULE

A. Storm and Sanitary Piping:

1. Cover pipe and bedding with Class 2 AB to 6" over top of pipe then backfill with native or excavated suitable on-site material placed in 8-inch thick loose lifts and moisture conditioned to at least optimum moisture content and compacted to at least 90% relative compaction.

B. Water Pipe:

1. Cover bedding with sand then backfill with native or excavated suitable on-site material, moisture conditioned to at least optimum moisture content and compacted to at least 90% relative compaction to subgrade elevation, and 95% under pavements and structures.

END OF SECTION

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SECTION 31 30 00

EARTHWORK

1.00 **GENERAL**

1.01 REFERENCES

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 01 apply to the work of this Section as if printed herein.

B. Document: Geotechnical Investigation, dated May 2013, prepared by Cotton, Shires and Associates, Inc. Copies of this report are available for review in appendix.

1.02 SECTION INCLUDES

A. Excavating and replacing non-engineered fill material.

B. Backfilling

C. Grading

1.03 RELATED SECTIONS

A. Section 31 10 00 - Site Clearing
B. Section 31 20 00 – Excavating
C. Section 31 23 33 - Trenching

1.04 REGULATORY REQUIREMENTS

A. Comply with all applicable codes, standards, and regulations in the execution of the work.

1.05 PROJECT CONDITIONS

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

2.00 **PRODUCTS**

Not Applicable

3.00 **EXECUTION**

3.01 REMOVING AND REPLACING NON-ENGINEERED FILL MATERIAL

A. The contractor shall excavate and remove the approximately 6 feet of material including non-engineered fill encountered during subsurface exploration by Geotechnical engineer and replace it with engineered fill, as shown on the Drawings, as specified in the Geotechnical Investigation report dated May 2013, and as directed by the Engineer. The planned location of the Environmental

Education Center building shall be excavated to a uniform minimum depth of 6 feet below the existing ground surface and at least a horizontal distance of 5 feet beyond the outside edge of the planned perimeter foundation.

B. The contractor shall remove and dispose of buried man-made objects (e.g. concrete or metal foundations, abandoned pipes, etc.) encountered in an excavation. This work shall be considered as part of the excavation work.

C. The excavated material shall be disposed of in a suitable legal location offsite or stored on-site for later use based upon approval of Engineer.

3.02 BACKFILL

A. Excavated on-site material can be used for structural fill provided it is free of organic material and other debris and rocks greater than 4 inches in maximum dimension.

B. Imported fill material, if required, should free of organics, it should contain no material larger than 4 inches and have a plasticity index of less than 15, it should be free of hazardous contamination (per State of California requirements), and it should be free of Asphaltic Concrete grindings.

C. The fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness, moisture conditioned to at least optimum moisture content, and compacted in lifts to at least 95 percent relative compaction beneath structures, and 90 percent relative compaction elsewhere.

3.03 GRADING

A. Site clearing shall conform to Section 31 10 00.

B. Trenching work shall conform to Section 31 23 33.

C. Excavation for planned grades shall conform to Section 31 20 00. Soft and/or yielding materials in the location of the planned structures should be over-excavated and replaced with engineered fill.

D. Where PCC pavement is to be placed, the grading plane must not extend above the grade established by the Engineer

E. Construct slopes to the lines and grades established by the Engineer.

F. Overbuild slopes and cut back to design grades.

G. Round the tops of excavation slopes and ends of excavation.

END OF SECTION

SECTION 32 10 12

DECOMPOSED GRANITE PAVING

PART 1 GENERAL

1.01 General Requirements

A. The requirements set forth in the General Conditions shall be in addition to the standards provided herein.

B. The requirements set forth in the Supplemental Conditions shall be in addition to the standards provided herein.

1.02 Description

A. Furnish all labor, materials and equipment for the complete installation of decomposed granite paving, including redwood headers as shown in the Plans and as specified herein.

1.03 References

A. CalTrans' Standard Specifications, latest edition.

1.04 Submittals

A. Submit the following items for approval:

1. Product Data: A copy of the manufacturer's product sheet together with instructions for installation of filter fabric and solidifying emulsion 5 days before installation.

2. Certificates of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the following items no more than 5 days before construction:

2.1. Filter fabric
2.2. Solidifying emulsion

3. Samples: A five pound sample of proposed decomposed granite before delivery of materials to the site.

PART 2 PRODUCTS

2.01 General

A. "California or Felton Gold", crushed granite rock, graded from 3/8-inch particles to dust graded between #4 and #200. Rock shall be high quality and well-graded.

B. " Aggregate base" shall be Class 2 and shall conform to the provisions in Section 26, "Aggregate Bases," of the Standard Specifications and these Technical Specifications. Aggregate gradation shall be ¾ inch maximum. No "reclaimed" material shall be allowed.

C. Binding Material: shall be included in the decomposed granite material and shall be a non-toxic, colorless, odorless, organic binder as distributed by "Stabilizer", Phoenix Arizona (800) 336-2468 or accepted equal.

2.02 Headerboard

A. Shall be 2" x 10" redwood headerboard to be set flushed with grade per detail shown on drawing.

2.03 Soil Sterilant

A. Sterilizer shall be standard, quick-acting, short-lived and non-selective weed and grass killer, commonly used under roadway/transportation projects. Application of the sterilant shall pose no short or long term health threats to the installer or the general public. Submit analysis for acceptance prior to applying.

PART 3 EXECUTION

3.01 Preparation

A. Upon completion of grading operations, compact the subgrade at the required elevation to a relative compaction density of 95%, unless otherwise noted on the Plans.

B. Apply soil sterilant per manufacturer's directions. Limit the work zone of the sterilant application to the area to receive paving plus three feet (2') on each side.

C. Completely install redwood header as shown on the drawings.

D. Surfaces to receive filter fabric, immediately prior to placing, shall be free of loose or extraneous material and sharp objects that may damage the filter fabric during installation. Align and place fabric in a wrinkle-free manner. Overlap adjacent rolls of the fabric between 12 inches to 18 inches. The preceding roll shall overlap the following roll in the direction the material is being spread. Fasten fabric with staples or stakes flush with the fabric to prevent movement of fabric by placement of decomposed granite. Repair or replace fabric damaged during placement of decomposed granite with sufficient fabric to comply with overlap requirements. Damage to the fabric resulting from the Contractor's vehicles, equipment or operations shall be replaced or repaired by the Contractor at the Contractor's expense.

E. No material shall be placed in muddy conditions, nor shall any material be placed during or immediately after inclement weather, i.e. rain storms, etc.

3.02 Installation

A. Provide a 10' by specified width test sample, to be approved prior to installation. This sample shall be the basis of overall approval.

B. Install header as shown on the Plans and in the details.

C. Prior to placement of crushed granite material, thoroughly combine binder into granite fines as a concentrated powder, uniformly and thoroughly rototilled to achieve a uniform mixture at the distributor's plant.

D. Spread crushed granite fine/binder material in two (2) one and one half inch (1-1/2") lifts.

E. Wet and roll each lift to form a uniform, smooth surface. Compact each lift to a 95%. Compaction must not begin less than 6 hours after placement, nor more than 48 hours.

F. Upon completion of the final lift, fill any depressions, holes or divots and re- roll using the above process.

G. Provide a Certificate of Compliance verifying that the binder/stabilizer has been mixed per manufacturer's recommendations.

3.03 Clean Up and Protection

A. Thoroughly clean all areas where work has occurred. Remove from site excess material, debris and rubbish.

B. Take all precautions to protect completed work. Immediately repair or replace all damaged areas due to tire ruts, erosion, compaction failure, etc.

END OF SECTION

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SECTION 32 12 16

ASPHALT PAVING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. General Conditions, Supplementary Conditions, and applicable portions of Division 01 apply to the work of this Section as if printed herein.

1.02 SECTION INCLUDES

B. Provide asphalt concrete paving, aggregate base and aggregate subbase complete in place.

1.03 RELATED SECTIONS

Not Applicable.

1.04 QUALITY ASSURANCE

A. Regulatory and Reference Standards: Comply with the following applicable standards.

State Standard Specifications, "California Department of Transportation Standard Specifications."

B. Upon completion of the work, the job shall be checked to see that all grades fall evenly to drain water to catch basins or gutters.

1.05 SUBMITTALS

A. Submit samples of the seal coat screening and of other materials under this Section as may be required by the Architect. Obtain written acceptance thereof before beginning delivery of material to the building site. Finished work shall match accepted samples. Submit a certified copy of the exact asphaltic concrete mix proportion to be used for review by the Engineer and approval by the Testing Laboratory.

2.00 PRODUCTS

2.01 MATERIALS FOR PAVING

A. "Asphalt Concrete Surfacing" shall conform to the State Standard Specifications Section 39.

B. Aggregate base used under paved areas shall conform to the State Standard Specification Section 26.

C. Fog seal materials shall meet the requirements of the State Standard Specifications Section 37.

3.00 EXECUTION

3.01 INSPECTION

A. Work covered under this Section shall be performed under the inspection of the Soil Engineer. The Soil Engineer shall be present at the site to inspect the work and perform field and laboratory tests to evaluate material quality and compaction. The costs of reinspection and retesting of unsuitable work shall be paid by the Contractor.

B. The Soil Engineer may at any time during paving installation require samples to determine quality and compaction of asphaltic concrete and aggregate base. The samples shall be taken by the Soil Engineer and repaired by the Contractor.

3.02 PERFORMANCE

A. Asphalt concrete paving, and aggregate base shall be compacted to a minimum of 95% relative compaction in accordance to the ASTM D1557-12 test procedure.

B. Aggregate Base: No aggregate base shall be deposited upon any portion of the subgrade until the subgrade has been approved by the Soil Engineer. The aggregate bases shall be spread on the prepared subgrade to such a depth that when thoroughly compacted it will conform to the grades and dimensions indicated on the drawings. Aggregate bases shall be spread and compacted in accordance with Section 26 of the State Standard Specifications.

C. Asphalt Concrete: Asphalt concrete surfacing shall be in accordance with Section 39 of the State Standard Specifications. The surface shall be free of excess water and clean. Provide positive drainage from all areas to the inlets.

D. Asphalt concrete mix temperature shall never be less than 250° F. Combined mix temperature and air temperature shall be held between 280° F minimum and 375° F maximum.

E. Seal Coat: Apply seal coat in accordance with Section 37 of the State Standard Specifications to new asphaltic concrete paving. Mask adjoining surfaces and areas, including curb faces, and take all other necessary precautions as required to prevent over-spray and splatter of the seal coat material on the adjacent surfaces or areas. In the event the precautions taken are not adequate, clean all traces of over-spray and splatter from all surfaces, to the satisfaction of the Engineer.

END OF SECTION

SECTION 32 13 14

PERVIOUS CONCRETE PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General & Special Conditions and all Specification sections, may apply to work of this section.

1.02 DESCRIPTION OF WORK

A. The Work to be completed under this contract includes the furnishing of all labor, materials and equipment necessary for construction of Pervious Concrete Pavement for trails in conformance with the plans and specifications.

1.03 REFERENCES

A. American Concrete Institute
   1. ACI 305 "Hot Weather Concreting"
   2. ACI 522 "Pervious Concrete Committee Recommendations" (when available)\
   3. ACI 522R-10 "Report on Pervious Concrete"

B. American Society for Testing and Materials
   1. ASTM C29 "Test for Unit Weight and Voids in Aggregate"
   2. ASTM C33 "Specification for Concrete Aggregates"
   3. ASTM C42 "Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."
   4. ASTM C117 "Test Method for Material Finer than 75 microns (No. 200) Sieve in Mineral Aggregates by Washing."
   5. ASTM C138 "Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete."
   6. ASTM C140 "Test Method for Concrete Masonry Units
   7. ASTM C150 "Specifications for Portland Cement"
   8. ASTM C172 "Practice for Sampling Fresh Concrete"
   9. ASTM C260 "Specification for Air-Entraining Admixtures for Concrete"
   10. ASTM C494 "Specification for Chemical Admixtures for Concrete"
   11. ASTM C595 "Specification for Blended Hydraulic Cements" (Types IP or IS only)
   12. ASTM C618 "Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."
   13. ASTM C989 "Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars."
   14. ASTM C1077 "Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and criteria for Laboratory Evaluation."
   15. ASTM D1557 "Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 Pound Rammer and 18-inch Drop."
   16. ASTM E329 "Standard Recommended Practice for Inspection and testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction."

1.04 QUALITY ASSURANCE

A. ACI Certified Concrete Flatwork Finishers are recommended.

1.05 SPECIAL EQUIPMENT

Pervious concrete requires specific equipment for compaction and jointing. The pavement shall be compacted using one of two methods.

A. Rolling compaction shall be achieved using a minimum 10-inch diameter steel pipe that spans the width of the section placed and exerts a vertical pressure of at least 10 psi on the concrete. Approximate weight of 12 ft roller is 500 lbs.
B. Plate compaction shall be achieved using a standard soil plate compactor that has a base area of at least two square feet and exerts a minimum of 10 psi vertical pressure on the pavement surface.
C. Joints may either be constructed by rolling or sawing. Rolled joints shall be formed using a "salt roller" to which a beveled fin has been welded around the circumference. Sawed joints shall be constructed as soon as the pervious pavement can be sawed without raveling the sawed edge and before initial cracking occurs using either a dry-cut or wet saw. At no time during the sawing process shall more pavement surface be exposed than that needed for sawing.

1.06 SUBMITTALS

Prior to commencement of the work the contractor shall submit the following:

A. General: Submit under the provisions of Document 00700, General Conditions, Submittals.
B. Concrete materials:
    1. Proposed concrete mixture proportions including all material weights, volumes, unit weight, water cement ratio, aggregate cement ratio and void content.
    2. Aggregate type, source and gradation data.
    3. Cement, fly ash and admixture manufacturer certifications
    4. Integral Color
    5. Test panels, placed jointed and cured per 1.07
C. Qualifications: Evidence of qualifications listed under Document 00450
D. Project details: Specific plans, details, schedule, construction procedures and quality control plan.
E. Subcontractors: List all materials suppliers and subcontractors to be used on the work.
F. Base: Gradation data
G. Fabric: Specification Sheet
H. Geogrid: Specification Sheet

1.07 TEST PANELS

Prior to construction, a test panel shall be placed to the satisfaction of the City unless this requirement is waived by the City.

A. Each test panel shall be a minimum of 25 sq. ft (5' x 5') and shall be placed, jointed and cured using materials, equipment, and personnel proposed for the project.
B. Test panels, if acceptable, can be incorporated into the project.
C. Test panel cost, and removal if necessary, shall be included.
D. Quality: Test panels shall have acceptable surface finish, color, joint details and porosity and shall comply with the testing and acceptance standards listed in 3.07 Quality Control section of this specification.
E. If test panels placed at the site are found to be deficient in thickness, unit weight or percentage of voids, or of an unacceptable appearance, they shall be removed at the contractor's expense and taken to an approved landfill or recycling facility. If test panels are found to be satisfactory, they may be left in-place and included in the completed work.

PART 2 – MATERIALS

2.01 Base:

A. Class 2 Aggregate Base, 3/4-inch maximum aggregate size, as specified in Section 26 of the State Standard Specifications.

2.02 Cement:

A. Portland cement Type II or V conforming to ASTM C150 or Portland cement Type IP or IS conforming to ASTM C595.

2.03 Supplementary Cementitious Materials:

A. Fly ash conforming to ASTM C618 may be used in amounts not to exceed 25% of total cementitious material.

B. Ground Iron Blast-Furnace Slag conforming to ASTM C989 may be used in amounts not to exceed 50% by weight of total cementitious material.

2.04 Chemical Admixtures:

A. Air entraining agents shall comply with ASTM C260.

B. Water Reducing Admixtures shall comply with ASTM C494

C. Hydration stabilizer shall meet the requirements of ASTM C494. Hydration stabilizers are recommended to increase concrete placement time to 90 minutes and improve placement and finishing operations.

2.05 Color:

A. Pigment colors shall be metallic oxide unless otherwise specified. Integral colors shall be manufactured by Solomon, or approved equal. Color shall be Solomon ColorFlo #757 Buckwheat or approved equal approved by City.

2.06 Aggregates:

A. Use a maximum 1/4" coarse aggregate that meets ASTM C33 (1/4" x No. 8). Fine aggregate meeting ASTM C33, if used, shall not exceed 3 cu. ft. If other aggregate sizes are proposed, testing to assure unit weight, void content and workability must be submitted for approval.

2.07 Non woven Fabric:

A. Mirafi 140N or equal

2.08 Geogrid:

A. Tensar TX160 or equal

2.09 Water: Potable water shall comply with local water standards.

2.10 Mixture Proportions:

A. **Cementitious Content:** For vehicle pavements, total cementitious content not less than 630 lbs/cy. For pedestrian pavements, total Cementious not less than 600 lbs/cy.

B. **Supplementary cementitious content:** Fly ash: 25% maximum. Slag: 50% maximum

C. **Water / Cementitious Ratio:** For vehicle pavements: 0.30

D. **Aggregate Content:** The volume of aggregate per cubic yard shall be equal to 27 cubic foot when calculated as a function of the unit weight determined in accordance with ASTM C29 jigging procedure.

E. **Admixtures:** Admixture shall be used in accordance with the manufacturer's instructions and recommendations.

F. **Mix Water:** Mix water quantity shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. Mix water yielding a cement paste with a dull-dry appearance has insufficient water for hydration. Insufficient water results in inconsistency in the mix and poor bond strength between aggregate particles. High water content results in the paste reducing or eliminating the void system required for porosity.

PART 3 – EXECUTION

3.01 Subgrade and Base:

A. **Typical Trail Subgrade Preparation:** Scarify to a depth of 6 inches, water condition at least two percent over optimum and compact sub-grade to 95% as per ASTM D 1557-07 and place Geogrid.

B. **Fill:** If fill material is required to bring the subgrade to final elevation, it shall be clean and free of deleterious materials. It shall be placed in 8-inch maximum layers, and compacted by a mechanical vibratory compactor to a minimum density of 95% within 12 inches of the subgrade as established by ASTM D1557.

C. **Special Tree Root Zone Trail Subgrade Preparation Compaction:** Check for yielding areas by proof-rolling with a loaded water truck or equivalent. Any yielding areas should be removed and replaced with compacted crushed rock. Place Geogrid.

D. **Base:** Compacted to 95%.

E. **Moisture:** The subgrade and base moisture content shall be 1% - 3% above optimum as determined by ASTM D1557.

F. City shall inspect subgrade preparation, elevations, and conduct density tests for conformance to specifications.

3.02 Formwork:

A. Forms may be of wood or steel and shall be the depth of the pavement. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation of plan profiles following spreading, strike-off and compaction operations. Forms may have a removable spacer of ½" to ¾" thickness placed above the depth of pavement. The spacers are removed following placement and vibratory strike-off to allow roller compaction.

3.03 Mixing and Hauling:

A. **Mixing:** Truck mixers shall be operated at the speed designated as mixing speed by the manufacturer for 75 – 100 revolutions.

B. **Transportation:** The Pervious concrete mixture may be transported or mixed on site and shall be used within one (1) hour of the introduction of mix water to the cement unless a hydration stabilizer is utilized in the concrete mixture. Times may be extended to 90 minutes using a hydration stabilizer.

C. **Discharge:** Each truckload will be inspected for consistency of concrete mixture as per the description listed under Water Content in the Materials section of this specification. Water may be added to obtain the required mix consistency. A minimum of 30 revolutions at the manufacturer's designated mixing speed shall be required following the addition of any water to the mix. Discharge shall be a continuous operation and shall be completed as quickly as possible. Concrete shall be deposited as close to its final position as practical and such that fresh concrete enters the mass of previously placed concrete.

3.04 Placing and Finishing:

A. The Contractor shall provide either slip form or vibratory form riding equipment to place the concrete unless otherwise approved by the City in writing. No internal vibration shall be allowed. Normal placement procedures involve utilizing a mechanical vibratory screed to strike off the concrete ½" to 3/4" above final height, utilizing the form spacers described in Formwork.

B. Workers shall avoid stepping on the plastic concrete immediately after its placement. Foot pressure can compress and force cement paste into the voids at the bottom of the slab, forming resistance to the percolation through the slab. Apparent defects in the surface shall be carefully remedied by placing fresh concrete into any depressions and compacting with a hand tamper**.**

C. Following strike-off, remove spacers and compact the concrete to the form level, utilizing either a steel roller or a plate compactor or other method approved by the City. This compaction secures the surface materials assuring pavement durability. Care shall be taken during compaction that sufficient compactive force is achieved without working the concrete surface enough to seal off the surface porosity**.**

D. Finish/chamfer edges of concrete to match adjacent Phase 1 trail finish.

E. Hand tampers shall be used to compact the concrete along the slab edges immediately adjacent to the forms. After compacting and defect inspection and repair, no further finishing shall be performed on the concrete. Do not overwork the surface which can bring up too much paste and seal off the surface porosity. Surface shall be immediately cured.

F. The pervious concrete pavement shall be compacted to the required cross-section and shall not deviate more than +/- 3/8 inch in 10 feet from profile grade.

3.05 Curing:

A. Curing procedures shall begin no longer than 20 minutes after final placement operations. The pavement surface shall be covered with a minimum of six (6) mil thick heavy duty polyethylene sheet or other approved covering material. The cover shall overlap all exposed edges and shall be secured to prevent dislocation due to winds or adjacent traffic conditions. For additional guidance on hot weather concreting, see ACI 305.

B. The low water/cement ratio and high amount of exposed surface of pervious concrete makes it especially susceptible to drying out. Keep the surface moist using a spray applied curing compound and/or evaporation retarder immediately after screeding.

C. The curing cover shall remain securely in place for 7 days minimum. No auto traffic shall be allowed on the pavement until curing is complete and no truck traffic shall be allowed for 14 days unless authorized by the City.

3.06 Jointing:

A. Control (contraction) joints shall be installed at regular intervals not to exceed 10 feet. The control joints shall be installed at ¼ the depth (to a maximum depth of 1½") of the thickness of the pavement. These joints can be installed in the plastic concrete or saw cut.

B. Jointing plastic concrete: Joints installed in the plastic concrete are generally rolled in utilizing a small roller with a beveled flange welded to the circumference. This type of jointing is done immediately after roller compaction and prior to curing.

C. Jointing hardened concrete: Joints may be saw-cut using an early entry saw. Saw-cuts shall be made as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking. Early entry sawing occurs later with pervious concrete than with conventional concrete. For either method, the curing cover shall be removed and the surface kept misted to prevent moisture loss. After sawing the curing cover shall be securely replaced for the remainder of the curing cycle.

D. Transverse construction joints: Transverse construction joints shall be installed whenever placing is suspended for 30 minutes or whenever concrete is no longer workable.

Isolation joints: Isolation joints shall used when abutting fixed vertical structures such i.e. light pole bases, building foundations, etc.

E. Isolation Joints: Shall use preformed expansion joint filler per ASTM D1751 and Caltrans Standard Specification Section 73.

3.07 Quality Control:

A. Inspection and testing maybe performed by the City. Re-testing due to defective materials or workmanship will be back charged to the Contractor. The testing laboratory shall conform to the requirements of ASTM E329 and ASTM C1077. All personnel engaged in testing shall be certified by the American Concrete Institute as ACI Concrete Field Technicians and be able to present their wallet cards upon request.

B. Traditional portland cement pavement testing procedures based on strength and slump control are not applicable to this type of pavement material. Concrete tests shall be performed for each 150 cubic yards or fraction thereof with a minimum of one test for each day's placement.

C. Plastic concrete shall be sampled in accordance with ASTM C 172 and tested for unit weight in accordance with ASTM C 29 using the jigging procedure for compaction. The unit weight of the delivered concrete shall be +/- 5 pcf of the design unit weight.

D. Plastic void content shall be calculated as per ASTM C138, Gravimetric Air Determination and compared to the void percentage used in Hydraulic design. Void content shall normally be between 15% and 25%.

E. Hardened concrete shall be tested at a rate of one set of three cores per 150 cy of concrete placed on one day or fraction thereof. The cores shall be drilled in accordance with ASTM C 42. The cores when measured for length shall not be less than the specified design thickness.

F. The cores shall be tested for saturated unit weight using ASTM C42 and void content using ASTM C140. Measured unit weight shall be +/- 5 pcf of the design unit weight. Measured void content shall not be less than the void content used in the hydraulic design.

END OF SECTION

SECTION 32 14 00

CONCRETE CURB AND SIDEWALKS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 01 apply to the work of this Section as if printed herein.

1.02 SECTION INCLUDES

A. This Section describes the requirements for materials, fabrications and installation of:

1. Concrete curbs and gutters and other concrete as indicated, complete with formwork and reinforcing.

1.03 RELATED SECTIONS

A. Asphalt Paving: Section 32 12 16.

1.04 QUALITY ASSURANCE

A. Standards: Comply with the following applicable standards unless otherwise specified herein:

1. City of Cupertino Standard Plans.

2. ASTM - American Society for Testing and Materials.

3. State Standard Specifications "California Department of Transportation Standard Specifications."

B. Damage and Repair: Prevent damage to adjacent concrete curbs, walks, etc., during installation. Contractor to repair any damage to concrete edges or breaks in concrete at no cost to the City, by removal and replacement of complete sections. Patching will not be acceptable.

C. Construction of curbs and sidewalks shall be done in accordance with Standard Specifications and Drawings, City of Cupertino Department of Public Works requirements.

1.05 SUBMITTALS

A. Procedures.

B. Concrete mix designs.

1.06 ACCEPTANCE OF SITE CONDITIONS

A. Any discrepancy between existing conditions and this contract set of plans shall immediately be brought to Engineer's attention in writing. Commencement of any part of the work shall constitute acceptance of existing site conditions as satisfactory.

2.00 PRODUCTS

2.01 CONCRETE STRENGTH AND USAGE

A. Concrete curbs, curb and gutter, driveways and sidewalks shall conform to the City of Cupertino Standard Plans.
B. 2 lb. max lamp black (black oxide) per cubic yard of concrete to be mixed at the batch plant. Color to match approved sample.

2.02 FORMS

A. Forms for curbs, curb and gutter, driveways and sidewalks shall conform to the State Standard Specifications Section 73.

2.03 OTHER MATERIALS

A. Expansion joints shall be in accordance to the State Standard Specifications.

B. Curing compound shall be in accordance to the State Standard Specifications.

C. Reinforcing steel shall be in accordance to the State Standard Specifications.

D. Base Rock: Class 2 Aggregate Base, 3/4-inch maximum aggregate size, as specified in Section 26 of the State Standard Specifications.

3.00. EXECUTION

3.01 CONSTRUCTION

A. Construction of off-site curb, curb and gutter, driveways and sidewalks shall be in accordance to the City of Cupertino Standard Drawings.

3.02 QUALITY CONTROL

A. The City Engineer will inspect reinforcing steel and concrete placement, measure slumps and take and test cylinders as specified in the State Standard Specifications.

END OF SECTION

SECTION 32 16 00

TRAFFIC STRIPES AND PAVEMENT MARKINGS

PART 1. GENERAL

1.01 REFERENCES

1. Painting of surfaces shall be as described in "Traffic Stripes and Pavement Markings", of the State Standard Specifications, the manufacturer's specifications and these provisions.

1.02 SECTION INCLUDES

1. Construction Signs
2. Temporary Traffic Striping and Messages
3. Painted Parking Stall Stripes
4. Pavement Markings

1.03 REGULATORY REQUIREMENTS

1. REGULATIONS: All materials must comply with Air Pollution Control Regulations such as LA County APCD Rule 66, Bay Area PCD Reg. 3, etc., Federal Lead Contact requirements, and California Air Resources Board (CARB) Rule 1113.

PART 2. PRODUCTS

2.01 MATERIALS

1. Refer to Section 84-2.02 of State Standard Specifications

PART 3. EXECUTION

3.01 SCOPE OF WORK

1. The work to be done consists of furnishing all materials, labor, tools, equipment, and all other necessary equipment and supplies to perform a complete and thorough job of completing the designated work items above.

END OF SECTION

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SECTION 32 92 20

HYDROSEEDING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Providing existing topsoil and planting of hydroseeded areas, complete.

1.02 SUBMITTALS

A. Product Data: Submit for each type of product indicated.

B. Product Certificates: Submit for each type of manufactured product, signed by product manufacturer, and complying with the following:
   1. Manufacturer's certified analysis for standard products.
   2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Qualification Data: Submit for landscape Installer.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of contract grown California native plants.
   1. Licensing Requirements: Contractor shall possess a State of California Landscape Contractor's license, and must meet the State of California Licensing Requirements for the application of herbicides.
   2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when hydroseeding is in progress.

1.04 SCHEDULING AND CONDITIONS

A. Hydroseeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. Any variance from the Scheduling and Conditions specified above shall be submitted to and approved by the Engineer in writing prior to installation.

PART 2 – PRODUCTS

2.01 EXISTING PLANTING SOIL (TOPSOIL):

A. Existing Planting Soil (TOPSOIL) is defined as on-site surface soil. Satisfactory planting soil shall be free of subsoil, clay, lumps, stones, and other objects over 4" in diameter, and without weeds, roots, and other objectionable material.

B. Strip planting soil to whatever depths encountered, a maximum of 12 inches in a manner to prevent intermingling with the underlying subsoil or other objectionable material. Topsoil stripping is limited to area outside "Drip Line" of existing trees to remain and areas approved by the City.

C. Remove heavy growths of grass from areas before stripping.

D. Stockpile topsoil in storage piles where designated by the City. Do not mix topsoil with subsurface soils. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust.

2.02 HYDROSEEDING MIX

A. Revegetation Hydroseed Mix:

PLS/ACRE (Pounds)	PLANT SPECIES Botanical Name / Common Name
0.5	Achillea Millifolium / White Yarrow
12.0	Bromus Carinatus / California Brome
10.0	Elymus Glaucus / Blue Wild Rye
2.0	Eschscholzia Californica / California Poppy
8.0	Nassella Pulchra / Purple Needlegrass
3.0	Sisyrinchium Bellum / Blue Eyed Grass
35.5	Total

2.03 SOURCE QUALITY CONTROL

A. General: Ship seed with certificates of inspection required by governing authorities. Comply with regulations applicable to materials.

B. Substitutions are not desired. If specified seed is not obtainable, submit proof of non-availability to the City, together with proposed equivalent materials for review at least two weeks prior to scheduled planting time.

C. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas to receive hydroseeding for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SITE PREPARATION

A. Site clearance work shall be done prior to the installation of hydroseeding. The Landscape Contractor shall be responsible for the removal of all herbaceous weeds and grasses to the satisfaction of the Engineer. The Landscape Contractor shall protect all existing plant material to be preserved from damage and destruction during the above work procedure.

B. Herbaceous vegetation including grasses and forbs shall be cut to a height no greater than 3 inches throughout the project site prior to planting. Native tree and shrub species that have colonized between plantings shall be protected.

C. All existing trees indicated to remain shall be protected from all damage during the progress of the job. No debris or material shall be stockpiled around the base of the trees; no signs, lumber or wires shall be attached in any way to the trees. Tradesmen shall not dump debris or fluids within the drip line of any tree (plaster, paint, thinner, etc.). Vehicles shall not be permitted within the driplines of the trees; see complete tree protection requirements elsewhere.

D. All soil preparation and planting work shall be done while soil is in a dry, friable condition. Contractor shall not work in soil areas wet enough to become overly compacted or muddy. Any work done while soil is too wet is subject to rejection.

3.03 PLANTING TOPSOIL PLACEMENT

A. Planting Soil Placement:
   1. Inspect planting areas and remove all base rock and other foreign material. Verify placement of planting soil within dripline of trees with Engineer. Except within tree driplines, rip all planting areas in two directions full depth of compacted fill (to a minimum of 12 inches) into undisturbed native soil prior to backfilling. Scarification of any planting area which cannot be accomplished with a tractor shall be accomplished by an alternative method approved by the Engineer to the specified depth to ensure proper percolation/drainage.
   2. Prior to placing planting soil secure the Engineer's acceptance of the planting areas subgrade condition. Test depth of loose soil with hand shovel in presence of Engineer in several locations as directed. After acceptance of the planting areas subgrade condition, uniformly distribute and spread planting soil backfill over scarified subgrade in planting areas as specified and compact to a maximum of 85% relative compaction.
   3. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.
   4. Water settling, puddling, and jetting of fill and backfill materials as a compaction method is not acceptable.
   5. Provide a minimum of 12" depth at areas of new fill, or more where shown or specified otherwise.

B. All planting areas soil shall be loose and friable prior to planting. Rip any overly compacted and re-compacted planting areas in two directions full depth of compacted soil prior to planting.

C. Planting operations shall be performed only during periods when beneficial results can be obtained. When excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped until conditions are satisfactory.

D. Thoroughly wet down the planting areas to settle the soil and confirm irrigation coverage and operation. Allow soil to dry so as to be workable as described herein.

E. Drag to a smooth, even surface. Grade to form all swales. Pitch grade with uniform slopes to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas that shall be uniformly sloped between finish elevations. Slope surface away from walls so water will not stand against walls or buildings. Control surface water to avoid damage to adjoining properties or to finished work on the site. Take required remedial measures to prevent erosion of freshly graded areas and until such time as permanent drainage and erosion control features have been installed.

F. Finish Grade: Hold finish grade and/or mulch surface in planting areas 1/2-inch below adjacent pavement surfaces, tops of curbs, manholes, etc.

G. In Situ Soil Preparation:
   1. Spread organic amendment, iron and Type A fertilizer evenly over installed and rough graded on-site topsoil in all planting areas including turf, ground cover and shrub areas at the following rates:
      a. Organic Amendment: 6 cubic yards per 1,000 square feet
      b. Fertilizer: Type-A (6-20-20) at 20 lbs. per 1,000 square feet.
      c. Iron Sulfate: 10 lbs. per 1,000 square feet
   2. In the case of a contradiction between the quantity of organic amendment required by the Contractor-obtained soils laboratory analysis and the specified quantity shown above, the greater of the two quantities shall take precedence.
   3. Rototill above additives into soil 6 to 8 inches deep. Keep iron sulfate off pavement and other surfaces to prevent rust staining. Correct all rust damage to work.
   4. Planting soil shall have a pH range of 6.5 to 7.5.

H. After the rototill work, float areas to a smooth, uniform grade as indicated on the Drawings. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Remove rocks, sticks and debris 1 inch and larger in size in turf areas and 2 inches or larger in shrub and ground cover areas. Secure approval of the grade by the Engineer before any planting.

3.04 HYDROSEEDING

Two-Step Hydraulic Straw Treatment

Step 1

Lbs/Acre	Kg/Hectare	Hydroseed Mix
800		100 % Wood Fiber – Conwed or equal
400		Hydrostraw + Guar ™
400		Humate – 40
1200		7-2-1 BioSol
As specified	As specified	Mix as specified
60		AM 120 mycorrhizal inoculant

Step 2	Lbs/Acre	Kg/Hectare	Hydroseed Mix
	1600		100 % Wood Fiber – Conwed or equal
	800		HydroStraw + Guar ™

A. Lightly till and re-grade the top 1 - 2" after site preparation is complete, removing all dead weeds, debris, etc. prior to seeding or sodding.

B. Hydroseeding Water: Contractor is responsible for obtaining potable, clean hydroseed water from a source using legal means, at Contractor's expense.

C. Lightly rake in pre-plant fertilizer (product and rate as recommended by the hydroseed manufacturer and as acceptable to the Engineer.)

D. Hydroseed at the rates described above unless noted otherwise on the Drawings, applying the hydro-seeding in a slurry form. When hydraulically sprayed onto the soil, the mulch shall form a blotter-like material. Direct the spray operation so that this procedure will drill and mix the slurry components into the soil, the slurry spray will also penetrate the soil surface, thus ensuring maximum impregnation and coverage. The impregnation and mixing of the components will help in retaining moisture while stabilizing soil surface from superficial erosion.

E. Do no leave the hydro-seeding slurry components in the hydro-seeding machine for more than (2) hours because of possible seed destruction. If slurry components are left for more than two hours in the machine, add 50% more of the originally specified seed mix to any slurry mixture which has not been applied within the two hours after mixing. Add 75% more of the original seed mix to any slurry mixture which has not been applied (8) hours after mixing. All mixtures more than (8) hours old must be disposed of, off-site, at the Contractor's expense.

F. Spray the area with a uniform visible coat, using the dark color of the cellulose fiber as a visual guide. The slurry shall be applied in a downward drilling motion via a fan stream nozzle. Insure that all of the slurry components enter and mix with the soil. Insure the uniformity of the hydro-seed application. The hydraulic contractor shall be approved by the City's Representative.

G. Exercise special care to prevent any of the slurry from being sprayed onto hardscape areas including concrete walkways, fences, walls, buildings, etc. Remove all slurry sprayed onto these surfaces at the contractor's expense.

H. Exercise special care to prevent any of the slurry from being sprayed onto new or existing plant material. If plant material gets sprayed, notify the City immediately; and replace plant material as directed.

I. Contractor shall save all seed and fertilizer tags and fiber mulch bags for the Engineer to verify compliance with the drawings and specifications.

J. Keep protective barriers, similar to sod, in place around hydroseed areas until final acceptance of the project.

K. Hydroseeded turf shall be mowed as recommended by manufacturer.

L. Areas showing germination failure shall be re-seeded at 10 day intervals until a good stand of vegetation has been developed.

3.05 ESTABLISHMENT OF SEEDED AREAS

A. All seeded areas shall be adequately protected from construction activity.

3.06 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off City's property.

3.07 FINAL INSPECTION AND ACCEPTANCE

A. Inspection of Completed Work: Inspection of work will be made at the Contractor's request upon completion of work. Written notice requesting inspection shall be submitted to the Engineer at least 5 days prior to the anticipated inspection date.

END OF SECTION

SECTION 33 10 00

SITE WATER LINES

1.00 **GENERAL**

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General, and Supplementary conditions apply to this Section.

1.02 SECTION INCLUDES

A. Pipe and fittings for site water line including domestic water line and fire water line.

1.03 RELATED SECTIONS

A. Trenching - Section 31 23 33

1.04 REFERENCES

A. ANSI/ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

B. ANSI/ASME B16.22 Wrought copper and Copper Alloy Solder Joint Pressure Fittings.

C. ANSI/ASTM D1557 - Test Methods for moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 Kg) Rammer and 18-inch (457 mm) Drop.

D. ANSI/ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

E. ANSI/AWS A5.8 - Brazing Filler Metal.

F. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

G. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other liquids.

H. ANSI/AWWA C111 - Rubber-Gasket Joins for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.

I. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

J. ANSI/AWWA C500 - Gate Valves, 3 through 48 in NRS, for Water and Sewage Systems.

K. ANSI/AWWA C510 - Backflow Preventers

L. ANSI/AWWA C511 - Backflow Preventers

M. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.

N. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.

O. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water.

P. ASTM B88 - Seamless Copper Water Tubs.

Q. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

R. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

S. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

T. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.

U. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, ½ inch through 3 inch, for Water

1.05 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.06 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of piping mains, valves, connections, and invert elevations.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with the municipality.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions as specified by the City of Cupertino.

B. Deliver and store valves in shipping containers with labeling in place.

2.00 **PRODUCTS**

2.01 PIPE

A. Ductile Iron Pipe: ANSI/AWWA C151.

1. Fittings: Ductile iron, standard thickness.

2. Joints: ANSI/AWWA C111, rubber gasket with rods.

3. Jackets: ANSI/AWWA C105 polyethylene jacket, double layer, half lapped, 10 mil polyethylene tape.

B. Copper Tubing: ASTM B88, Type K, annealed:

1. Fittings: ANSI/ASME B16.18, cast copper, or ANSI/ASME B16.22, wrought copper.

2. Joints: Compression connection or ANSI/AWS A5.8, BcuP silver braze.

C. PVC Pipe: ASTM D1785, Schedule 40 or Schedule 80:

1. Fittings: ANSI/ASTM D2466, PVC.

2. Joints: ASTM D2855, solvent weld.

3. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters.

D. PVC Pipe: ANSI/AWWA C900 Class 150:

1. Fittings: ANSW/AWWA C111, cast iron.

2. Joints: ASTM D3139 compression gasket ring.

3. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters.

2.02 GATE VALVES - Up to 4 Inches

A. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression IPS ends, with valve key.

2.03 GATE VALVES - 4 Inches (100 mm) and Over

A. ANSI/AWWA C509, Iron body, epoxy-coated, stainless steel trim, non-rising stem with square nut, single wedge, resilient seat, flanged or mechanical joint ends.

2.04 BALL VALVES - Up to 2 Inches (50 mm)

A. Brass body, Teflon coated brass ball, rubber seats and stem seals, tee stem pre-drilled for control rod, AWWA inlet end, compression or IPS outlet and valve key.

2.05 BEDDING MATERIALS

A. Bedding: Approved site soil or select approved import material as specified in the Geotechnical Investigation, dated May 2013, prepared by Cotton, Shires and Associates, Inc.

2.06 ACCESSORIES

A. Concrete for Thrust Blocks: Concrete type as specified by the City of Cupertino.

B. Backflow Preventer: Reduced-pressure principle, City of Cupertino approved size as shown on the plans.

C. Meter: As required by the City of Cupertino, size as shown on the plans.

3.00 **EXECUTION**

3.01 EXAMINATION

A. Verify that building service connection and municipal utility water main size and location are as indicated.

3.02 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

3.03 TRENCHING

A. Excavate pipe trench in accordance with Section 31 23 33 for work of this Section.

B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches uncompacted depth, compact to 95 percent.

C. Backfill around sides and to top of pipe with fill, tamped in place and compacted to 95 percent.

D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.04 INSTALLATION

A. Maintain separation of water main from sewer piping in accordance with the Uniform Plumbing Code.

B. Install piping and fittings to ANSI/AWWA C600 for ductile iron or ANSI/ASME B16 for copper tubing.

C. Route pipe in straight line.

D. Install pipe to allow for expansion and contraction without stressing pipe or joints.

E. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main, in conformance with City of Cupertino Standard Details.

F. Establish elevations of buried piping to ensure not less than 3 feet of cover.

G. Backfill trench in accordance with Section 31 23 33.

3.05 TESTING AND DISINFECTION

A. Before connection to the San Jose Water Company, test the on-site system for leakage in accordance with the City of Cupertino standards.

B. After completion of leakage testing, flush and disinfect system in accordance with the City of Cupertino standards.

3.06 SERVICE CONNECTIONS

A. Provide water service to City of Cupertino requirements with reduced pressure backflow preventer and water meter.

3.07 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of the City of Cupertino Standard Specifications.

B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

END OF SECTION

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SECTION 33 31 00

SITE SANITARY SEWERAGE SYSTEM

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions apply to this Section.

1.02 SECTION INCLUDES

A. Sanitary sewerage drainage piping, fittings, accessories and bedding.

B. Connection of building sanitary drainage system to municipal sewers.

1.03 RELATED SECTIONS

A. Section 31 23 33 - Trenching

1.04 REFERENCES

A. ASTM D 3350 – High Density Polyethylene (HDPE) Plastic Pipe.

1.05 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.06 SUBMITTALS

A. Product Data: Provide data indicating pipe, pipe accessories, and fittings.

B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.07 PROJECT RECORD DOCUMENTS

A. Record location of pipe runs, connections, cleanouts, and invert elevations.

1.08 REGULATORY REQUIREMENTS

A. Contractor's Registration: Prior to any Sanitary Sewer facility work, contractor shall register with the District Manager of the Cupertino Sanitary District (CSD). Contractor must be licensed under the State Contractor's License Law and must carry insurance as specified in Chapter V of the CSD Operations Code. Contractor shall call on the District office for application forms and assistance at 20863 Stevens Creek Blvd. Ste 100, Cupertino, California 95014, Tel. (408)253-7071.

B. Conform to Uniform Plumbing Code for materials and installation of the Work of this section.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements and elevations are as indicated.

1.10 COORDINATION

A. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service and trenching.

2.00 **PRODUCTS**

2.01 SEWER PIPE MATERIALS

A. HDPE Pipe: ASTM D3350, unperforated; inside nominal diameter of 4 inches, bell and spigot end joints.

2.02 PIPE ACCESSORIES

A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.03 CLEANOUTS

A. Lid and Frame: HDPE material molded or formed to suit pipe size and end design.

B. Base Pad: Cast-in-place concrete or precast utility box.

3.00 **EXECUTION**

3.01 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.02 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with approved site soil or select approved import material, compacted to 95%.

B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.03 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal joints watertight.

B. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

C. Refer to Section 31 23 33 for trenching requirements. Do not displace or damage pipe when compacting.

D. Connect to building sanitary sewer outlet and municipal sewer system.

E. Connection to municipal sewer system main shall be per Detail G – Standard Banded Wye Installation as shown on sheet C7.0 of the project drawings.

3.04 INSTALLATION - CLEANOUTS

A. Install a new cleanout within 5 feet of existing property line or easement as required by the Cupertino Sanitary District.

B. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.

C. Establish elevations and pipe inverts for inlets and outlets as indicated.

D. Mount lid and frame level in grout, secured to riser to finished grade.

E. Install two-way combination cleanout in root-bound areas or when advantageous, as directed by the Project Inspector.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of City of Cupertino and Cupertino Sanitary District requirements. Closed circuit video of the new property line cleanout and point of connection to sewer main is required prior to clearance for City of Cupertino final inspection. Contractor shall call the Cupertino Sanitary District at least 48 hours prior to video inspection to schedule a District inspector. District will provide Building Department with written notification upon completion of inspection

B. Testing of sanitary sewer system for leakage will be in accordance with City of Cupertino and Cupertino Sanitary District requirements.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

D. After backfilling has been completed, sanitary sewer system will be flushed and cleaned in accordance with City of Cupertino and Cupertino Sanitary District requirements.

3.06 PROTECTION

A. Protect pipe from damage or displacement until backfilling operation is in progress.

END OF SECTION

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SECTION 33 46 13

RETAINING WALL BACKDRAINS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Filter fabric and drain rock for retaining wall drainage systems, complete.
   2. Perforated subdrain pipe.

B. Related Sections:
   1. Section 07 13 26 - Self-Adhering Sheet Waterproofing.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data, specifications, installation instructions, and recommendations.

B. Test Results: Submit test results from an independent laboratory showing flow rates and creep performance adequate to meet the requirements of the soils report and the design conditions.

C. Samples: Submit 12 x 12 inch sample of filter fabric.

1.03 QUALITY ASSURANCE

A. Test Results: Provide filter drainage fabric which provide filtration of soil particles to prevent silt build-up in drainage pipes, tested by an independent laboratory documenting the specified flow rate in the plane of the core and creep performance of the polymer core, in accordance with ASTM D4716.

B. Pre-installation Meeting: Prior to beginning of installation, convene a meeting to be attended by the Engineer, representative of the drainage fabric manufacturer, waterproofing subcontractor, and other subcontractors involved with the installation. Discuss coordination, details of installation, and clarification of installation procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in their original unopened packages, clearly identified, and protected from exposure to ultraviolet light.

B. Store materials in a location protected from exposure to direct sunlight. Limit total exposure of panels to direct sunlight to 7 days or less.

1.05 WARRANTY

A. Warrant for a period of five (5) years that the drainage system shall be free of defects in material and workmanship and that it will not plug up, collapse, puncture due to lateral pressures, deteriorate, or otherwise fail to perform as required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Perforated Subdrain Pipe:
   1. Manufacturer: Advanced Drainage Systems "N12", Hancor Inc. "EcoFirst Pipe", manufactured in Bakersfield, CA (Tel 888-367-7473), or equal.
   2. Type: High density polyethylene (HDPE) plastic, perforated, dual-wall, corrugated on outside and, smooth on inside, bell-and-spigot joints. PVC drain pipe not permitted.
   3. Size: 4 inch diameter.

B. Drain Rock: Either of the following:
   1. CalTrans Standard Specifications (CSS) Section 26, Class 2 Permeable Material, 3/4 inch maximum size rock, compacted to minimum 90 percent RC.
   2. Clean Crushed Drain Rock, 1/2 x 3/4 inch size, with 100 percent passing 3/4 inch sieve, and 0 - 4 percent passing No. 4 sieve.

C. Geotextile Fabric: Mirafi 140N, or equal.

D. Accessories: As recommended by the fabric manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the substrate and conditions under which the installation of filter panels is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. At perimeter foundation walls and retaining walls, place and compact impervious fill material under the drain pipe and adjacent to bottom of walls to achieve indicated and proper slope of drain pipe.

3.03 INSTALLATION

A. Lay drain pipe with perforations down and joints tightly closed in accordance with pipe manufacturer's recommendations. Provide collars and couplings as required. Clean and glue pipe joints using manufacturer's approved products.

B. Test or check lines before backfilling to assure free flow of water. Remove obstructions, replace damaged components, and retest system until satisfactory.

C. Wrap fabric around drain pipe cavity at bottom of walls. Lap edges and ends of geotextile fabric to maintain continuity.

D. Install drain rock in lifts a minimum 12 inches wide x 12 inches high against retaining walls. Backfill with native fill against drain rock as installation of drain rock proceeds.

END OF SECTION