MONTEREY COUNTY
RESOURCE MANAGEMENT AGENCY

PUBLIC WORKS AND FACILITIES –
ARCHITECTURE

VOLUME THREE OF THREE

PROJECT MANUAL

JAIL HOUSING ADDITION
PROJECT NO. 8819
BID NO. 10568

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DIVISION 21
FIRE SUPPRESSION

SECTION 21 00 50 – BASIC FIRE SPRINKLER MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric motors.

B. Motor starters.

C. Valve Boxes.

D. Access doors.

E. Expansion loops.

F. Insulation.

1.2 RELATED DOCUMENTS

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

B. This Section is part of each Division 21 Section.

1.3 ADDITIONAL REQUIREMENTS

A. Furnish and install incidental work not shown or specified necessary to provide a complete and workable system.

B. Make temporary connections required to maintain services during the course of the Contract without additional cost to Owner. Notify Owner seven days in advance before interrupting services.

1.4 REFERENCED STANDARDS

A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at time of bid shall be used.

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing and Materials
3. CCR - California Code of Regulations
    a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36
4. NCPWB - National Certified Pipe Welding Bureau
5. CEC - California Electrical Code

6. NEMA - National Electrical Manufacturers' Association
7. NFPA - National Fire Protection Association, as amended by the CBC
8. OSHA - Occupational Safety and Health Act
9. UL - Underwriters' Laboratories, Inc.

1.5 DRAWINGS

A. Examine Contract Documents prior to bidding of Work and report discrepancies in writing to Architect.

B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The fire protection Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.

1. Architectural and structural Drawings are part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over fire protection Drawings.
2. Because of the small scale of fire protection Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in locations shown. Obtain Architects' approval prior to relocation of equipment and materials.
3. Relocate equipment and materials installed without prior approval of Architect. Remove and relocate equipment and materials at Contactors' expense upon Architects' direction.
4. Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.

C. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. The publications listed below form part of this Specification. Comply with provisions of these publications except as otherwise shown or specified.

1. California Building Code, 2013
2. California Electrical Code, 2013
3. California Energy Code, 2013
4. California Fire Code, 2013
5. California Green Building Standards Code, 2013
6. California Mechanical Code, 2013

7. California Plumbing Code, 2013
8. California Code of Regulations, Title 24
9. California Health and Safety Code
10. CAL-OSHA
11. California State Fire Marshal, Title 19 CCR
12. National Fire Protection Association
13. Occupational Safety and Health Administration
14. Other applicable state laws

B. Nothing in Drawings or Specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or Specifications to repeat requirements of codes except where necessary for clarity.

C. Comply with State of California 2010 2013 Energy Code for systems, equipment, and construction.

D. When Contract Documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

E. No material installed as part of the Work shall contain asbestos.

1.7 FEES AND PERMITS

A. Obtain and pay for permits and service required in installation of the Work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with the requirements of Division 1.

B. Arrange for utility connections and pay charges incurred, including excess service charges.

1.8 UTILITY CONNECTIONS

A. Bear the cost of construction related to utility services, from point of connection to utility services shown on Contract Documents. This includes piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work, and the like, whether or not Work is performed by Contractor, local water/sanitation district, public utility, other governmental agencies or agencies' assigns.

1.9 FRAMING, CUTTING AND PATCHING

A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.

B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.

1.10 SUBMITTALS

A. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used. Refer to Division 01 for complete instructions.

1. Partial or incomplete submittals will not be reviewed.
2. Quantities are Contractor's responsibility and will not be reviewed.
3. Provide materials of same brand or manufacturer for each class of equipment or material.
4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
6. Organize submittals in same sequence as in Specification Sections.
7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
    a. Submit shop drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
    b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
    c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
    d. Catalog cuts and published material may be included with supplemental scaled drawings.

B. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.

C. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect shop drawings or submittals on all items of equipment and materials provided. Provide submittal in at least seven copies and in complete package.

1. Shop drawings and submittals shall include Specification Section, Paragraph number, and Contract Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from Contract Documents shall be clearly identified and appear at the

beginning of submittal package, and shall be referenced to applicable Contract Documents requirements.

D. Provide layouts for fire protection systems, for inclusion in coordinated layout specified in Section 23 80 00. Comply with requirements for layouts specified in Section 23 80 00.

E. Provide coordination drawings for fire protection systems in accordance with the requirements of Specification Section 21 10 00.

F. Furnish to Project Inspector complete installation instructions on material and equipment before starting installation.

G. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.

H. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of the California Health and Safety Code Section 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

I. Delegated-Design Submittal: For supports, anchorages, and seismic restraints indicated to comply with performance requirements and design criteria.

1. Calculations performed for use in selection of supports, anchorages, and seismic restraints shall utilize criteria indicated in Structural Contract Documents.

2. Supports, anchorage and seismic restraints for piping and equipment shall be an OSHPD pre-approved system such as Tolco, Afcon, ISAT, Badger, Mason, or equal. Pipes and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code and NFPA 13. System shall have current OPA number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.

    a. Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.

3. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, equipment, and seismic restraint locations, and detailing supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with California Building Code and NFPA 13.

4. Additional Requirements: In addition to the above, conform to State and local requirements.

1.11 SUBSTITUTIONS

A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 1 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.

B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.

C. Substitutions will be interpreted to be manufacturers other than those specifically listed in Contract Documents by brand name, model, or catalog number.

D. Only one request for substitution will be considered for each item of equipment or material.

E. Substitution requests shall include the following:

1. Reason for substitution request.
2. Complete submittal information as described herein; see “Submittals.”
3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
5. Explanation of impact on connected utilities.
6. Explanation of impact on structural supports.

F. Installation of reviewed substitution is Contractors’ responsibility. Any mechanical, electrical, structural, or other changes required for installation of substituted equipment or material must be made by Contractor without additional cost to Owner. Review by Architect of substituted equipment or material, will not waive these requirements.

G. Contractor may be required to compensate Architect for costs related to substituted equipment or material.

1.12 OPERATION AND MAINTENANCE MANUAL

A. Instruct Owner's authorized representatives in operation, adjustment, and maintenance of mechanical equipment and systems. Provide three copies of certificate signed by Owner's representatives confirming that instruction is completed.

B. Furnish three complete sets of Operating and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operating and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Start compiling data upon approval of submittals.

1. Sets shall incorporate the following:

a. Service telephone number, address and contact person for each category of equipment or system.

b. Complete operating instructions for each item of fire sprinkler system.

1) Original manual of NFPA-25 for fire sprinkler system.

c. Copies of guarantees/warrantees for each item of equipment or systems.

d. Test data as specified.

e. Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.

f. Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.

g. A complete list or schedule of scheduled valves giving the number of the valve, location and the rooms or area controlled by the valve. Identify each valve with a permanently attached metal tag stamped with number to match schedule. Post list in frame under plastic on wall in mechanical room or where directed by Architect.

h. Check test and start reports for each piece of fire protection equipment provided as part of the Work.

i. Commissioning and Preliminary Operation Tests required as part of the Work.

C. Post service telephone numbers and addresses in an appropriate place designated by Architect.

1.13 SITE CONDITIONS

A. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by Architect and shall be made without additional cost to Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify Architect if services are found which are not shown on Drawings.

1.14 WARRANTY

A. Refer to Division 01 for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.

B. Repair or replace defective work, material, or part that appears within warranty period, including damage caused by leaks.

C. On failure to comply with warranty requirements within a reasonable length of time after notification is given, Architect/Owner shall have repairs made at Contractor's expense.

1.15 RECORD DRAWINGS

A. Refer to Division 01, Record Documents, for requirements governing Work specified herein.

B. Upon completion of the Work and as precedent to final payment, deliver to Architect the following:

1. Originals of drawings showing the Work exactly as installed.

2. One complete set of reproducible drawings showing the Work exactly as installed.

3. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.

4. Provide Contractor's signature, verifying accuracy of record drawings.

C. Obtain signature of Project Inspector for record drawings.

1.16 DELIVERY AND STORAGE

A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.17 COORDINATION

A. General:

1. Coordinate Work in this Section with trades covered in other Specification Sections to provide a complete and operable installation of highest quality workmanship.

B. Electrical Coordination:

1. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified in this Section. Contractor has full responsibility for the following items of work:

a. Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.

b. If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of bid.

c. Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

C. Mechanical Coordination:

1. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.

2. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during progress of construction.

3. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.

B. All sizes, capacities, and efficiency ratings shown are minimum.

C. Refer to Section 21 10 00 for specific system piping materials.

2.2 MATERIALS

A. California Green Building Code Compliance:

1. Fire protection equipment shall not contain CFCs.

2. Fire protection equipment shall not contain Halons.

2.3 ELECTRIC MOTORS

A. U.S. Motors, Century Electric, General Electric, Lincoln, Gould or equal. Minimum efficiencies shall be as defined by IEEE 112 Test Method B and NEMA MG1. Provide NEMA 3R enclosure where exposed to outdoors.

2.4 MOTOR STARTERS

A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.

B. Where three phase motors are provided for two-speed operation, provide two speed motor starters.

1. All three-phase starters shall have the following:

a. Provide magnetic motor starters for equipment provided under the fire protection Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.

b. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.

c. Three ambient compensated thermal overload.

d. Fused control transformer (for 120 or 24 volt service).

e. Pilot lights, integral with starters. Starters located outdoors shall be installed in NEMA IIIR enclosures.

2.5 VALVE BOXES

A. General:

1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular “vault” type adequately sized for condition and similar in construction to those specified above.

2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.

3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.

B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.

C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or equal, 8 inches inside diameter by 30 inches long, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.

D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron or steel locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or equal, with extension to suit conditions.

2.6 ACCESS DOORS

A. Where floors, walls, or ceilings must be penetrated for access to fire protection equipment or devices, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.

1. Access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.

B. Access doors shall match those supplied in Division 08, except as noted in this Section.

C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for other areas.

D. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with Architect when access is required in these areas.

E. Where specific information or details relating to access panels different from the above is shown or given on Drawings or other Divisions of work, that information shall supersede this specification.

F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:

1. Milcor

a. Style K (plaster)

b. Style DW (gypsum board)

c. Style M (masonry)

d. Style "Fire Rated” where required

2.7 EXPANSION LOOPS

A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend or center section of flexible hose. Flexible hose shall consist of corrugated metal inner hose and braided outer sheath.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

C. Metraflex Inc., Fireloop series.

1. Unisource Manufacturing, Inc., V series.

2.8 EQUIPMENT IDENTIFICATION

A. Identify each piece of equipment with a permanently attached engraved bakelite plate, 1/2 inch high white letters on black background.

B. Text of Signs: Provide identification of equipment unit number, and room or area served. Coordinate name of area served with final room names and numbers for the facility. In addition, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

2.9 PIPE IDENTIFICATION

A. Identify each piping system and indicate the direction of flow by means of Seton, Inc., Marking Services Inc., Reef Industries, Inc., or equal, pre-tensioned, coiled semi-rigid plastic pipe labels formed to circumference of pipe, requiring no fasteners or adhesive for attachment to pipe.

B. The legends and flow arrows shall conform to ASME A13.1.

2.10 INSULATION WORK

A. General:

1. Adhesives shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

2. The term "piping" used herein includes pipe, valves and fittings.

a. Apply insulating cement to fittings, valves and strainers and trowel smooth to equal the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to bonnet. Leave strainer cleanout plugs accessible.

b. Provide pre-formed PVC valve and fitting covers.

c. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.

3. Test insulation, jackets, and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723, ASTM E84, or NFPA 255.

4. Clean thoroughly, test and have approved, piping and equipment before installing insulation and/or covering.

5. Repair damage to existing pipe insulation whether or not caused during Work of the Contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.

B. Insulation of Piping Exposed to Weather:

1. Insulate fire protection piping where exposed to weather for freeze protection with 1 inch thick 3-1/2# minimum density fiberglass with ASJ-SSL jacket for sizes up to and including 2 inches. For larger sizes, provide 1-1/2 inch thick 3-1/2# minimum density fiberglass insulation and ASJ-SSL jacket.

2. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch aluminum bands on 12 inch centers. Cover fittings with glass cloth, two coats of Foster Sealfas 30-36, and Zeston 2000, or equal, PVC fitting covers. Insulation shall be vapor tight before applying metal jacket or PVC covers.

a. Pipes 10 inches diameter and smaller: Minimum .016 inch thick jacket.

b. Pipes 12 inches diameter and larger: Minimum .020 inch thick jacket.

PART 3 - EXECUTION

3.1 ELECTRICAL REQUIREMENTS

A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the fire protection Work with the electrical Work to comply.

B. Furnish necessary control diagrams and instructions for controls. Before permitting operation of equipment which is furnished, installed, or modified under this Section, Contractor shall review associated electrical work, including overload protection devices, and assume complete responsibility for correctness of electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. Equipment and connections exposed to weather shall be installed in NEMA IIIR enclosures with factory wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.

C. All line voltage and low voltage wiring and conduit associated with fire protection system are included in this Section. Wiring and conduit shall comply with Division 26.

D. Electric Motors:

1. Motors shall be rated for continuous operation at 115% of nameplate amperage but shall be selected to operate at less than nameplate amperage throughout entire operating cycle. Motors found to exceed nameplate amperage shall be promptly replaced at no cost to Owner. Horsepower shown is minimum and shall be increased as necessary to comply with above requirements. Furnish motors with splash-proof or weatherproof housings, where required or recommended by motor manufacturer. Match the nameplate voltage rating with electrical service supplied. Check electrical Drawings. Provide transformer for each motor not wound specifically for system voltage.

E. Motor Starters:

1. Provide magnetic motor starters for equipment provided under the fire protection Work. Starters shall be non-combination type. Provide part-winding or reduced voltage start motors on motors 50 – HP and larger, or where shown or as hereinafter specified. Minimum size starter shall be Size 1. Three-phase starters shall have the following:

   a. Cover-mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.

   b. Three ambient compensated thermal overload.

   c. Fused control transformer (for 120 or 24 volt service).

   d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIR enclosures.

2. Starters for single-phase motors shall have thermal overloads, Westinghouse Type MSTOLSLIP, Square D, or equal, toggle-operated with pilot light, NEMA I enclosure for starters located indoors, NEMA IIIR enclosure for starters located outdoors.

3. Provide OSHA label indicating that the device starts automatically.

3.2 PIPING SYSTEM REQUIREMENTS

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

3.3 PRIMING AND PAINTING

A. Perform all priming and painting on the equipment and materials as specified herein.

B. Priming:

1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed. Black steel pipe exposed to weather shall be painted one coat of Rust-Oleum #1069 primer for black steel piping or Rust-Oleum #5260, Kelly Moore, or equal, primer for galvanized piping.

2. Metal surfaces of items to be jacketed or insulated except piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the highest grade zinc rich primer. After erection or installation, primed surfaces shall be properly cleaned of foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Abrasion or other damage to shop or field prime coat shall be properly repaired and touched up with same material used for original priming.

3. Where equipment is provided with nameplate data, the nameplate shall be masked off prior to painting. When painting is completed, remove masking material.

C. See Painting Section for detailed requirements.

3.4 EXCAVATING

A. Perform excavating required for Work of this Section. Provide the services of a pipe/cable locating service prior to excavating activities to determine location of existing utilities.

B. Unless shown otherwise, provide 3 foot minimum cover for fire piping, or 1 foot below frost line, whichever results in deepest installation. Trim trench bottom by hand or provide a 4 inch deep minimum bed of sand to provide a uniform grade and firm support throughout entire length of pipe. For PVC pipe, bed pipe in 4 inch deep minimum sand bed. Pipe bedding materials should be clean crushed rock, gravel or sand of which 100 percent will pass a 1 inch sieve. For pipes that are larger than 10 inches in diameter, at least 95 percent should pass a 3/4 inch sieve, and for pipes 10 inches in diameter or smaller, 100 percent should pass a 1/2 inch sieve. Other materials should have minimum sand equivalent of 50. Only a small proportion of native soils will meet these requirements without extensive processing; therefore, importation of pipe bedding materials should be anticipated. Pipe bedding materials shall be compacted in lifts not exceeding 6 inches in compacted thickness. Each lift shall be compacted to not less than 90 percent relative compaction at or above the optimum moisture content, in accordance with ASTM Specification D2940, except that bedding materials graded such that less than 100 percent will pass a No. 200 sieve shall be compacted in 6 inch lifts using a single pass of a flat-plate, vibratory compactor or vibratory drum. Pipe bedding materials should extend at least to the spring line.

C. Maintain warning signs, barricades, flares, and red lanterns as required.

D. For trenches 5 feet or more in depth, submit copy of permit, and detailed drawings showing shoring, bracing, sloping, or other provisions to be made for worker protection from hazard of caving ground during excavation of such trenches. Obtain a permit from Division of Industrial Safety prior to beginning excavations. A copy of permit shall be available at the Project site.

3.5 BACKFILLING

A. Backfill shall comply with applicable provisions of Division 31 of these Specifications.

B. Except under existing or proposed paved areas, walks, roads, or similar surfaces, backfill for other types of pipe shall be made using suitable excavated material or other approved material. Place backfill in 8 inch layers, measured before compaction, and compact with impact hammer to at least 90 percent relative compaction per ASTM D2940.

1. Backfill plastic pipe and insulated pipe with sand for minimum distance of 12 inches above the top of pipe. Compact using mechanical tamping equipment.

C. Entire backfill for excavations under existing or proposed pavements, walks, roads, or similar surfaces, under new slabs on grade, shall be made with clean sand compacted with mechanical tamping equipment vibrator to at least 90 percent relative compaction per ASTM D2940. Remove excess earth. Increase minimum compaction within uppermost two feet of backfill to 95 percent.

D. Replace or repair to its original condition sod, concrete, asphalt paving, or other materials disturbed by trenching operation. Repair within warranty period.

E. Thrust Blocks:

1. Provide concrete anchors or thrust blocks on PVC and cast iron water lines installed underground. Install thrust blocks at changes in direction and at connections to mains 1-1/2 inches and larger. Form thrust blocks by pouring concrete between pipes and trench wall. Thrust blocks shall be adequate in size and placed to take thrusts created by the maximum internal water pressure; sizing and placement shall be per manufacturer's recommendations and in accordance with requirements of NFPA 24.

2. Anchor piping to building construction.

3.6 INSTALLATION OF PIPING SYSTEMS

A. At time of final connection, and prior to opening valve to allow pressurization of water piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on fire protection piping is greater than 175 psi, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.

B. General:

1. Piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.

2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.

3. Install piping to permit application of insulation where required and to allow valve servicing.

4. Where piping or conduit is left exposed within a room, the piping or conduit shall be run true to vertical, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.

5. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from Architect.

6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.

7. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.

8. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.

9. Install horizontal valves with valve stem above horizontal.

10. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.

11. Verify final equipment locations for roughing-in.

12. Service Markers: Mark location of each plugged or capped pipe with 4 inch round by 30 inch long concrete marker, set flush with finished grade. Provide 2-1/2 inch diameter engraved brass plate as part of service marker.

13. Where piping is installed in walls within one inch of face of stud, provide 16 gauge sheet metal shield plate on face of stud. The shield plate shall extend minimum 1-1/2 inches beyond outside diameter of pipe.

C. Expansion Loops:

1. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.

2. Install expansion loops of sizes matching sizes of connected piping.

3. Install grooved-joint expansion joints to grooved-end steel piping.

4. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by piping system in which expansion loop is installed.

D. Sleeves:

1. Install AMI Products, Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations, as directed, shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.

2. At Contractor's option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate pipe from concrete.

E. Floor, Wall, and Ceiling Plates:

1. Fit pipes, with or without insulation, passing through walls, floors, or ceilings, and hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

F. Firestopping:

1. Pack annular space between pipe sleeves and pipe through floors and walls with UL listed fire stop, and seal at ends. Pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.

   a. Install fire caulking behind fire protection services installed within fire rated walls, to maintain continuous rating of wall construction.

2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators, or equal, for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and with Chapter 7, CBC requirements.

3. Sleeve penetrators shall have built in anchor ring for waterproofing and anchoring into concrete pours or use special fit cored hole penetrator for cored holes.

4. Copper and steel piping shall have SpecSeal plugs, or equal on both sides of penetrator to reduce noise and to provide waterproofing.

5. All above systems to be installed in strict accordance with manufacturer's instructions.

6. Alternate firestopping systems are acceptable if approved as equal. Contractor is responsible for determining suitability of alternate products for their intended use, and shall assume all risks and liabilities in connection with the use of alternate products.

G. Flashing:

1. Flashing for penetrations of metal or membrane roof for fire protection items shall be coordinated with roofing manufacturer and roofing installer for specific roofing type utilized. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for fire protection work.

   a. Furnish and install flashing and counterflashing in strict conformance with requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.

   b. Furnish and install counterflashing above each flashing required. Elmdor/Stoneman Model 1540, or equal.

2. For other types of roofing systems, furnish and install around each pipe, where pipe passes through roof, a flashing and counterflashing. Flashing shall be made of four pound seamless sheet lead with 6 inch minimum skirt and steel reinforced boot. Counterflashing shall be cast iron. Elmdor/Stoneman Model 1100-4, or equal.

H. Hangers and Supports:

1. General: Support equipment and piping so that it is firmly held in place by approved iron hangers and supports and special hangers as required. Hangers and supports shall be UL listed for fire protection service. Components shall support weight of equipment, pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, shall be of same size as pipe or tubing on which used, or nearest size available. Architect shall approve hanger material before installation. Do not support piping with plumbers' tape, wire rope, wood, or other makeshift devices. Where building structural members do not match piping support spacing, provide “trapeze” (bridging) support members attached to building structural members by methods approved by structural Engineer.

   a. Materials, design, and type numbers per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.

2. Hanger components shall be provided by one manufacturer. B-Line, Grinnell, Tolco, Afcon, Loos & Co., Uni-Strut, or equal.

3. Hanger and Supports:

   a. Vertical Piping: Tolco Fig. 6, or equal, clamps attached to pipe above each floor to rest on floor. Provide intermediate support for vertical piping greater than 25 feet in length.

   b. Individually Suspended Piping: Tolco Fig. 200 or Fig. 1 Clevis, complete with threaded rod, or equal.

Pipe Size	Rod Size
4" and Smaller	3/8"

5" to 6"	5/8"

c. Trapeze Suspension: Sch-10 or Sch-40 steel pipe trapeze member in accordance with NFPA 13- published load ratings.

d. Pipe Clamps and Straps: B-Line B2000 or B2400, Tolco, Fig. 200 or Fig. 1, or equal. Where used for seismic support systems, provide B-line B2400, Tolco fig. 69 series retainer pipe straps, or equal.

e. Concrete Inserts: B-line B221 continuous insert or B2500 spot insert, or equal. Do not use actuated fasteners for support of overhead piping unless approved by Architect.

f. Steel Connectors: Tolco Fig. 65 beam clamps with Fig. 69 retainer straps, or equal.

g. Deck Connectors: Afcon Fig. 610 steel ceiling plate, or equal, where approved by structural Engineer.

4. Support to Structure:

a. Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or through bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required.

1) Do not install Lag screws in tension without written review and acceptance by Structural Engineer.

Side Beam Angle Clip	B-Line B3062	MSS Type 34
Side Beam Angle Clip	B-Line B3060	
Ceiling Flange	B-Line B3199	

2) Blocking for support of piping shall be not less than 2 inch thick for piping up to 2 inch size. Provide 3 inch blocking for piping up through 5 inch size, and 4 inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.

3) Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill starter holes for each lag screw.

b. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of structural components. Burning or welding on structural member may only be done if approved by Architect.

5. Pipe hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced per NFPA 13, and per pipe manufacturer's listing, except as noted below.

6. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.

7. Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.

8. Insulate copper piping from ferrous materials and hangers with two layers of 3 inch wide, 10 mil polyvinyl tape wrapped around pipe.

9. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.

10. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

3.7 UNIONS AND FLANGES

A. Install Watts, Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel pipe or material. Bushings or couplings shall not be used.

B. Install unions in piping NPS 2” and smaller and flanges in piping NPS 2-1/2” and larger whether shown or not at each connection to equipment and tanks, and at connections to automatic valves.

C. Locate unions for easy removal of equipment, tanks, or valves.

3.8 ACCESS DOOR

A. Furnish and install access doors wherever required whether shown or not for easy maintenance of fire protection systems. Access doors shall provide for complete removal and replacement of equipment.

3.9 CONCRETE WORK

A. Concrete work required for Work of this Section shall be included under another section of the Specification, unless otherwise noted, including reinforced concrete bases for pumps, tanks, compressors unless the work is specifically indicated on Drawings to be furnished under this Section.

B. Thrust blocks, underground anchors, and pads for cleanouts, valve access boxes and washer boxes are included under this Section of the Specifications. Concrete shall be 3000 psi test minimum. Refer to Division 03 for concrete types.

3.10 PIPE IDENTIFICATION

A. Provide temporary identification of each pipe installed, at time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the Work.

B. Apply legend and flow arrow at valve locations; at points where piping enters or leaves a wall, partition, cluster of piping or similar obstruction, at each change of direction, and at approximately 20'-0" intervals on pipe runs. Variations or changes in locations and spacing may be made with approval of Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.

1. Apply legend and flow arrow at approximately 10’-0” intervals in science classrooms and science prep rooms.

C. Wherever two or more pipes run parallel, markings shall be supplied in the same relative location on each.

D. Apply markings after painting and cleaning of piping and insulation is completed.

3.11 EXPANSION ANCHORS IN HARDENED CONCRETE:

A. Refer to Structural Drawings.

B. Qualification Tests: The specific anchor shall have a current ICC-ES report and have been evaluated in cracked concrete in accordance with Acceptance Criteria AC193. The design shear and withdrawal load shall not be more than 80% of allowable load listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor.

C. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.

D. Testing: Fifty percent of anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of the project inspector.

E. The load may be applied by any method that will effectively measure tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor, or calibrated spring-loading devices. Anchors in which torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

3.12 TESTS AND ADJUSTMENTS

A. Test installations in accordance with the following requirements and all applicable codes:

1. Project Inspector should witness tests of piping systems.
2. Notify Architect at least seven days in advance of tests.
3. Notify local fire department of time and date of fire systems testing.
4. Piping shall be tested at completion of roughing-in, or at other times as directed by Architect.
5. Furnish necessary materials, test pumps, gases, instruments and labor required for testing.
6. Isolate from system equipment that may be damaged by test pressure.

B. Test Schedule: No loss in pressure or visible leaks shall show after four hours at pressures indicated:

C. System Tested	D. Test Pressure PSI	E. Test With
F. Fire Sprinkler Piping	G. 200	H. Water

I.	Compressed Air	J.	200	K.	Air & Non-corrosive Leak Test Fluid
L.	Dry Standpipes	M.	300	N.	Water
O.	Wet Standpipes	P.	200	Q.	Water

1. Piping, including underground piping, connected to fire sprinkler system shall be tested and certified in accordance with NFPA requirements, except where requirements listed in this Section exceed requirements of NFPA.
2. Non-corrosive leak test fluid shall be suitable for use with piping material specified, and with type of gas conveyed by piping system.

R. Should material or work fail in any of these tests, it shall be immediately removed and replaced with new material, and portion of work replaced shall again be tested by Contractor at his own expense.

S. Lubricate each item of equipment, including motors, before operation.

3.13 TRACER WIRES

A. Provide tracer wire for non-metallic water pipe in ground outside of buildings. Use AWG #12 tracer wire with blue colored low density high molecular weight polyethylene insulation, and lay continuously on pipe so that it is not broken or stressed by backfilling operations. Secure wire to the piping with tape at 18 inch intervals. Solder all joints.

B. Terminals: Precast concrete box and cast iron locking traffic cover, Brooks 3TL, or equal; cover marked with name of service; 6 inches of loose gravel below box. Plastic terminal board with brass bolts; identify line direction with plastic tags. Test for continuity between terminals, after backfilling, in presence of Inspector.

C. Alternate: (use of this alternate material requires approval of authority having jurisdiction): Use electronically detectable plastic tape with metallic core, Terra Tape D, manufactured by Reef Industries, Inc., Seton, Inc., Marking Services, Inc., or equal; tape 2 inches wide, continuously imprinted "CAUTION WATER LINE BELOW". Install, with printed side up, directly over pipe, 18 inches below finish grade. Backfill material shall be as previously specified for the particular condition where pipe is installed, but avoid use of crushed rock or of earth with particles larger than l/2 inch within the top 12 inches of backfill. Take precautions to insure that tape is not damaged or misplaced during backfill operations. Terminal boxes not required.

3.14 CHECK, TEST AND START REQUIREMENTS

A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of fire protection equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.

1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
4. When work has been completed, provide copies of reports for review, prior to final observation of work.

B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.

C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each operating and maintenance manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

3.15 COMMISSIONING AND PRELIMINARY OPERATIONAL TESTS

A. Prior to observation to determine final acceptance, put fire protection systems into service and check that work required has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of tests.

1. Equipment has been started, checked, lubricated and adjusted in accordance with manufacturer's recommendations.
2. Correct rotation of motors and ratings of overload heaters are verified.
3. All manufacturers' certificates of start-up specified have been delivered to Owner.
4. All equipment has been cleaned, and damaged painted finishes touched up.
5. Missing or damaged parts have been replaced.
6. Flushing of piping systems has been completed and water treatment equipment, where specified, is completed.
7. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
8. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
9. Maintenance manuals have been delivered and Owner training has been completed.

B. Review of Contractor's Tests:

1. Tests made by Contractor or manufacturers' representatives are subject to observation and review by Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon completion of tests, provide letter to confirm that testing has been successful.

C. Test Logs:

1. Maintain test logs listing the tests on mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of tests.

END OF SECTION 21 00 50

SECTION 21 10 00 – FIRE PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sprinkler heads.

B. Pipe and Fittings.

C. Valves.

D. Water flow alarm switch.

E. Fire Department connection.

F. Post indicator valve.

G. Integrated Pre-Action Systems

H. Packaged Fire Pump Systems

1.2 RELATED DOCUMENTS

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

B. Section 21 00 50 Basic Fire Sprinkler Materials and Methods.

1.3 REFERENCES

A. It is the intent of these Specifications to provide for complete and operating fire protection automatic sprinkler system in full compliance with the following standards:

1. National Fire Protection Association (NFPA) Standard No. 13, 2010, as amended by the CBC.
2. National Fire Protection Association (NFPA) Standard No. 13, 2013, as amended by the CBC.
3. CBC Chapter 9 (as amended).
4. NFPA No. 20, 2013
5. NFPA No. 24, 2013 (as amended).
6. NFPA No. 25, 2011 (California Edition).

B. The work shall also be in accordance with all local or state requirements that apply.

1.4 DESCRIPTION OF WORK

A. Work of this section includes, but is not necessarily limited to, the following:

B. Furnish all labor, design drawings, calculations, materials, tools, and equipment to install the wet pipe automatic fire sprinkler system as described in this Specification Section. System shall be hydraulically calculated and designed for the building occupancy classification as determined by NFPA 13.

1. This work includes, but is not limited to the following:

a. Complete automatic fire risers, including valves, fire department connections, flow switches, pressure switch and service mains as indicated.

b. Complete interior wet type automatic fire protection spray type sprinkler distribution system, including overhead service and branch mains, lateral supply piping, supports, hangers, seismic bracing, and heads

c. Required tests and inspections.

d. Provide electrical work required to complete the system. Contractor shall be responsible for providing complete and operable systems, including electrical wiring. Install wiring in conduit, in accordance with Division 26.

e. Protected areas shall include areas above and below the finished ceilings, exterior exposure, canopies, stairways, rooms, areaways, entry, etc, and other areas requiring sprinklers. Thoroughly examine architectural and other drawings as required to satisfy this requirement.

f. Tags, identification labels and instruction manuals for proper operation and maintenance.

C. Provide fire sprinklers to protect combustible building overhangs greater than 4 feet wide, as required by local authority.

D. Determine the static and residual pressure for the site as required for accurate determination of system requirements. Base system calculations on the lowest expected static and residual pressure for the area.

1. Test data for static and residual pressure shall be obtained from water district or local fire department; test shall be made within the last six months prior to start of work.

2. Provide calculations based on 10 percent minimum safety factor. For hydraulically calculated fire sprinkler systems the maximum velocity in the building and the fire main piping shall not exceed 15 feet per second.

1.5 DRAWINGS

A. Contractor shall thoroughly examine architectural, structural, and other Drawings provided as part of this Contract.

B. Number of sprinkler heads indicated on Contract Drawings shall not be reduced. Provide additional heads required for coordination and to obtain approvals. Coordinate suitable head locations and spacing with Architect.

1.6 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of fire protection products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least five years of successful installation experience on projects with fire sprinkler piping systems similar to that required for this Project.

1. A State of California Fire Protection Contractor's license (C-16) is required.

C. Design Criteria: Provide complete fire protection systems as indicated and as required by authority having jurisdiction.

1. When there is conflict between requirements of authority having jurisdiction or requirements of other standards agencies and these Drawings and Specifications, requirements of authority having jurisdiction and recommendations of standards agencies shall govern.

2. Design and install entire system in accord with applicable codes, standards, and regulations.

3. The automatic sprinkler system shall conform to requirements of the 2007 edition of the National Fire Protection Association, Standard No. 13, as amended by the CBC. Contractor shall hydraulically calculate sprinkler system in accordance with NFPA 13.

4. Drawings are diagrammatic only to indicate rooms/areas of sprinkler protection and piping clearances when appropriate. Rerouting of pipe and addition, deletion or relocation of heads may be necessary. Submit proposed layout for approval prior to start of installation.

5. FM Compliance: Comply with Factory Mutual "Approval Guide."

6. Supply equipment and accessories in accordance with requirements of all applicable national, state and local codes.

7. Items of a given type shall be the products of the same manufacturer.

8. Scheduled equipment performance is minimum capacity required.

9. Scheduled electrical capacity shall be considered as maximum available.

1.7 COORDINATION

A. Coordinate Work in this Section with trades covered in other Sections of Specifications to provide a complete and operable installation of highest quality workmanship.

B. Coordinate location of fire protection piping, mains and branches, to avoid interference with work by other trades. Plumbing drainage piping and ductwork shall have right-of-way over fire protection piping. Wherever conflicts exist, fire protection piping shall be offset or rerouted at no additional cost to Owner. Provide locations of piping for use in Coordinated Layout called for in Specification Section 23 80 00.

C. Piping shall be concealed, except where so indicated or where absolutely necessary to be exposed. Exposed piping shall be placed as approved by Architect prior to installation. Heads shall be fully coordinated with architectural reflected ceiling plan and placed in center of ceiling tiles.

D. On-site measurement of pipe will be required. Offsets, pipe, fittings, drains, etc., required to meet job conditions shall be furnished and installed at no extra cost to Owner.

E. Additional heads required by NFPA 13 regulations shall be provided at no extra cost, if required as a result of Contractors' coordination. Location of heads and mains shall not be changed unless approved by Architect.

F. Coordinate layout and installation of sprinklers with other construction penetrating ceilings, including light fixtures, HVAC equipment, and partition assemblies.

G. The Architect shall decide any differences or disputes concerning coordination, interference or extent of work, and his decision shall be final.

1.8 SUBMITTALS

A. Samples: Provide one sample of each sprinkler head type.

B. Shop Drawings: Submit in accordance with Division 01, and as follows:

1. Prepare Drawings, calculations, and product data of fire protection systems indicating pipe sized, pipe locations, fittings, shutoffs, equipment, etc. Note, in bold type, any piping which will project beyond finished surfaces of normally occupied rooms, exterior of the building or other locations which will expose the system to view.
2. Manufacturer's data on each item of material or equipment used.
3. Layout drawings and flow calculations approved by agencies having jurisdiction.
4. Drawings and calculations shall be stamped and signed by a State of California licensed professional engineer prior to submission to the Architect. Engineer shall be qualified for this work.

C. Test Reports: As indicated in paragraph "Tests".

1. Sprinkler pressure test.
2. Standpipe pressure test.
3. Alarm system test.
4. Underground piping test.

D. Operation and Maintenance Manual:

1. Operation and Maintenance Manual in accordance with Section 21 00 50. Include an original manual of NFPA 25, California edition, in Operation and Maintenance Manual for fire sprinkler system.
2. Guarantees in accordance with Division 01.

E. Deferred Approval Documents: Do not proceed with fabrication or installation of fire sprinkler system until deferred approval documents have been approved by regulatory agencies.

1. General: Provide detailed drawings, specifications, and calculations prepared by a State of California licensed professional engineer.

2. Architect Review: Make additions, changes and corrections as directed by Architect and resubmit.

3. Agency Review: Architect will submit documents to Agency or Authority Having Jurisdiction. Make additions, changes and corrections required by Agency / Authority at no cost to Owner and resubmit to Architect.

4. Agency Approval: Architect will submit documents to Agency / Authority for final approval.

1.9 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification:

1. ANSI - American National Standards Institute.

2. ASME - American Society of Mechanical Engineers.

3. UL - Underwriters' Laboratories, Inc. Fire Resistance Directory.

4. CBC - California Building Code.

5. NFPA National Fire Protection Standards as amended by the CBC.

6. CFC - California Fire Code.

7. CPC - California Plumbing Code.

1.10 SUPERVISION

A. Keep a competent superintendent on the job that shall coordinate the activities of the crafts and maintain the progress of the work to the satisfaction of the Architect.

1.11 SITE CONDITIONS

A. Verify all dimensions at the building site and check existing conditions before beginning work. Make changes that are necessary to coordinate the work with other trades, after review by the Architect.

1.12 REGULATIONS

A. All work shall be installed in strict conformity with California Building Code (CBC), California Plumbing Code (CPC), and California Electric Codes (CEC), Industrial Safety Orders, California Mechanical Code (CMC), California Fire Code (CFC), and other laws and regulations of authorities having jurisdiction.

1.13 FEES AND PERMITS

A. Take out permits and pay fees and charges required in connection with the Work.

1.14 TEMPORARY CONNECTIONS

A. Temporary connections required to maintain services during the course of the Contract shall be made without additional cost to Owner. The normal function of the building must not be interrupted; notify Owner minimum seven days in advance before interrupting any service.

PART 2 - PRODUCTS

2.1 GENERAL

A. The equipment to be furnished under this Specification shall be standard product of manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, component parts of system need not be products of the same manufacturer.

2.2 MATERIALS AND EQUIPMENT

A. Unless otherwise shown on Drawings, specified, or directed by Architect, materials and equipment used in installation of sprinkler systems shall be listed as approved by FM or UL for fire protection systems, and shall be the latest design of the manufacturer.

2.3 SPRINKLER HEADS

A. Sprinklers must be quick response type and have a temperature classification per NFPA 13. Fire sprinklers must be of one manufacturer throughout the building. No mixing of sprinkler brands must be permitted. Sprinklers must be of all brass body construction with a metal Belleville spring seal, coated on both sides with Teflon film. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Institutional sprinklers must have a quick response solder link. Commercial sprinklers must have a quick response frangible bulb type fusible element. Sprinklers to be installed in areas with no ceilings must be of a brass finish and must be of adequate temperature for the hazard. Sprinklers must have a standard or large orifice and a 5.6 or 8.0 nominal K Factor. Sprinklers must be UL Listed or FM Approved. Quick response sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy.

B. Sprinkler head types are indicated on the Fire Protection Plans. Contractor must review types of heads with the County Representative prior to drawing submittal. The Contractor must submit in writing to the County Representative the types of heads for each room in each building based on the meeting.

C. Institutional Style Sprinklers:

1. Quick Response Institutional Style Flush Pendent Sprinkler: Quick response institutional pendent sprinklers must have a standard orifice with a nominal K Factor of 5.6. Sprinkler must have a quick response solder link. Quick response institutional pendent sprinklers must incorporate a lock ring and chrome finish escutcheon that mount to the threaded sprinkler body at the finished ceiling. Quick response institutional pendent sprinklers must have a maximum adjustment of 1/4-inch. Quick response institutional pendent sprinklers must be UL Listed. Quick response institutional flush pendent sprinklers must be listed for installation in an Ordinary Hazard occupancy, if installed in an Ordinary Hazard occupancy. Quick Response Institutional Flush Pendent Sprinklers must be Viking SIN: VK410 (Base Part Number 10554), or equal as approved by State Fire Marshal and County Representative.

2. Quick Response EC Institutional Style Flush Pendent Sprinkler: Quick response institutional extended coverage pendent sprinklers must have a standard orifice with a nominal K Factor of 5.6. Sprinkler must have a quick response solder link. Quick

response institutional extended coverage pendent sprinklers must incorporate a lock ring and chrome finish escutcheon that mount to the threaded body at the finished ceiling. Quick response institutional extended coverage pendent sprinklers must have a maximum adjustment of 1/4-inch. Quick response institutional extended coverage pendent sprinklers must be UL Listed for coverage of 16-feet by 16-feet in Light Hazard occupancies. Quick Response Institutional Extended Coverage Flush Pendent Sprinklers must be Viking SIN: VK410 (Base Part Number 10554), or equal as approved by State Fire Marshal and County Representative.

3. Quick Response Institutional Style Flush Sidewall Sprinkler: Quick response institutional sidewall sprinklers must have a standard orifice with a nominal K Factor of 5.6. Sprinkler must have a quick response solder link. Quick response institutional sidewall sprinklers must incorporate a lock ring and chrome finish escutcheon that mount to the threaded sprinkler body at the finished wall. Sidewall institutional sprinklers must be equipped with a brass retaining flange that is to be installed on the sprinkler head supply pipe to prevent forward movement of sprinkler head. Quick response institutional sidewall sprinklers must be installed so that the body of the sprinkler does not protrude past the sprinkler escutcheon. Quick response institutional sidewall sprinklers must be UL Listed for use in Light Hazard occupancies. Quick Response Institutional Flush Sidewall Sprinklers must be Viking SIN: VK412 (Base Part Number 10579), or equal as approved by State Fire Marshal and County Representative.

D. Commercial Quick Response Sprinklers:

1. Quick Response Pendent Sprinkler: Sprinklers to be installed through a ceiling must be chrome finish pendent sprinklers (or finish as specified elsewhere) with an adjustable semi-recessed escutcheon of same specified finish. Sprinklers must have a quick response frangible bulb type fusible element. Sprinklers must have a standard or large orifice and a 5.6 or 8.0 nominal K Factor. Sprinklers must be UL Listed or FM Approved. Quick response sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Quick Response Sprinklers must be Viking SIN: VK302 (5.6K Standard Orifice Pendent) or SIN: VK352 (8.0K Large Orifice Pendent), or equal as approved by State Fire Marshal and County Representative.

2. Microfast Quick Response Upright Sprinkler: Sprinklers to be installed through a ceiling must be chrome finish pendent sprinklers (or finish as specified elsewhere) with a Viking model “E-1 or F-1” adjustable semi-recessed escutcheon of same specified finish. Sprinklers must have a quick response frangible bulb type fusible element. Sprinklers must have a standard or large orifice and a 5.6 or 8.0 nominal K Factor. Sprinklers must be UL Listed or FM Approved. Quick response sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Quick Response Sprinklers must be Viking SIN: VK300 (5.6K Standard Orifice Upright) or SIN: VK350 (8.0K Large Orifice Upright), or equal as approved by State Fire Marshal and County Representative.

3. Quick Response Concealed Horizontal Sidewall Sprinkler: Quick response concealed horizontal sidewall sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Sprinklers must have a quick response frangible bulb type fusible element. Concealed horizontal sidewall sprinklers must have a white finish (or painted to match enclosure finish) cover plate that is a push-on, pull-off assembly with a cover diameter no greater than 2-3/4-inch. Concealed sprinklers must have a 1/2-inch NPT, a standard orifice, and a nominal K Factor of 5.6.

Quick response horizontal sidewall sprinklers must be UL Listed for Light Hazard and Ordinary Hazard occupancies. Concealed Horizontal Sidewall Sprinklers must be Viking SIN: VK408 (Base Part Number 11451), or equal as approved by State Fire Marshal and County Representative.

4. Specific Application Window Sprinklers: Quick response horizontal or pendant vertical sidewall sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Sprinklers must have a quick response frangible bulb type fusible element. Sprinklers must have a 1/2-inch NPT, a standard orifice, and a nominal K Factor of 5.6. Quick response window sprinklers sprinklers must be UL Listed for Light Hazard and Ordinary Hazard occupancies, and listed to provide complete wetting and coverage for heat strengthened, tempered, or ceramic glass windows using closed sprinklers. Specific Application Window Sprinklers must be Tyco model WS, or equal as approved by State Fire Marshal and County Representative.

   a. "Open" heads intended for outdoor protection of windows or roofs are not an acceptable alternative for this application.

E. Sprinkler Guards: Wire cage type, including fastening device for attaching to sprinkler. Provide sprinkler guards for all sprinkler heads located in water heater room.

F. Spare Heads: Furnish spare heads equal to one percent of total number of heads installed under Contract, but not less than twelve. Spare head types furnished shall be representative of types and temperature ratings of heads installed, and in proportion to number of each type and temperature rating of heads installed. Furnish not less than two sprinkler head wrenches, with at least one wrench for each type of sprinkler head installed. Place spare heads and wrenches in wall mounted box manufactured for this purpose.

2.4 PIPE AND FITTINGS

A. For Installation Aboveground: 150 PSI, Schedule 40 black steel, ASTM A-135 or A-53 with UL approved ductile or cast iron screwed fittings.

1. Schedule 10 UL approved pipe with UL approved grooved fittings and associated couplings may be used for pipe sizes 2 inches and greater. Threading of piping will not be accepted.

B. For Installation Underground to 12 inches Above Ground: Ductile cast iron AWWA C111 and C151. Outside the building, J.M. Blue Brute Class 200 UL, P.W. Pipe, or equal, C900, PVC pressure pipe, approved for fire protection use. Install in accordance with NFPA 24 and AWWA standards. Provide concrete thrust blocks at each change or direction. Fittings shall be ductile iron, ASME B16.1, Class 125 inside building; PVC Class 200 Ring-Tite outside building. Pipe shall be approved for fire protection use.

C. Standpipes: Schedule 40 galvanized steel with 300 psi galvanized fittings.

D. Mechanical tees, saddle fittings, bushings and mechanical sprinkler head fittings shall not be used.

2.5 VALVES

A. Angle, Check, and Globe Valves: Fed. Spec WW-V-51; Class A, type as suitable for application.

1. Select check valves for installation in vertical lines recommended by manufacturer as suitable for vertical installation. Install in vertical lines only where flow is upward.

B. Gate Valves:

1. Sizes 1-1/2 inches or less: Fed. Spec WW-V-54, Class A.

2. Sizes above 1-1/2 inches: Fed. Spec WW-V-58, Class A, designation OS or OF, as required. Provide OS&Y type, 175 pound rated working pressure.

3. Furnish and deliver to Owner one wrench of each size required for operating underground valves.

C. Drain Valves: angle, or globe. Fed. Spec WW-V-51; Class A, type as suitable for application.

1. UL listed and FM approved combination test and drain fittings may be used.

D. Zone Control Valves: UL listed, outside screw and yoke or butterfly. Valves shall be sealed open with approved seal. Provide weatherproof actuator housing, with two single pole, double throw switches.

1. Supervisory Switch: Fit the control valves on the fire sprinkler risers with supervisory switch, with single pole double throw switch actuator installed to change switch position when valve is being closed.

2.6 WATER FLOW ALARM SWITCH

A. UL listed water flow alarm switch suitable for variable pressure, complete with instantaneous recycling retard and two single pole double throw electrical contacts. Provide continuously monitored water flow alarm switch and trouble sensor, automatically transmitted to an approved control alarm station.

2.7 FIRE DEPARTMENT CONNECTION

A. Post mounted, complying with Local Fire Marshal standards cast brass two-way inlet body with drop clappers. Two brass double female snoots with rigid end N.P.T.X. pin lug house thread swivels, plugs and chain.

B. Provide check valve in the piping between the inlet connection and the fire protection system. Provide ball drip at low point of piping, below grade on the Siamese side of the check valve, and drain to gravel sump. Provide gravel sump with minimum 3 cubic feet of course gravel.

2.8 POST INDICATOR VALVE

A. Mueller, American Cast Iron Pipe Co., or equal, UL-listed; provide handle lock and water flow alarm switch.

2.9 UNION AND FLANGES

A. Size and Type:

1. Steel 2 inches and smaller: 150 pound screwed black or galvanized malleable iron, match pipe, ground joint, brass to iron seat.
2. Steel 2-1/ inches and larger: 150 pound black flange union, flat faced, full gasket.

B. Gaskets: 1/16 inch thick rubber Garlock #122, Johns-Manville, or equal.

C. Flange Bolts: Open hearth bolt steel, square heads, with cold pressed hexagonal nuts, cadmium plated in ground. Provide copper plated steel bolts and nuts or brass bolts and nuts for brass flanges.

2.10 GAUGES

A. Marsh "Quality Gage", U.S. Gage, Danton 800, or equal, with bronze bushed movement and front recalibration. Dials shall be white with black numerals, 3-1/2 inch dial face. Normal reading shall be at midscale. Provide a three-way valve on each gauge connection.

2.11 SEISMIC SEPARATION ASSEMBLY

A. Provide seismic separation assembly as defined in NFPA 13 at locations where piping crosses building seismic joints and at locations where required to prevent pipe breakage due to building movement.

1. At Contractors option, provide Metraflex “Fireloop” UL listed assembly, or equal at each seismic joint location, in lieu of seismic separation assembly.

2.12 INTEGRATED PRE-ACTION SYSTEM

A. System Description and Approval Requirements

1. System shall be Viking TotalPac3, or equal. All part numbers and system nomenclature indicated below reference Viking product data.
2. The cabinet assembly shall contain a self contained preaction double interlock system, SUREFIRE® release, pre-assembled, pre-wired and factory tested under ISO-9001 manufacturing and quality control procedures.
3. The integrated unit shall be c-UL-us Listed and FM Approved as an assembled unit. All system components shall be compatible, cULus listed or FM approved.
4. System shall have unique serial number for easy traceability

B. TOTALPAC®3 Cabinet

1. Cabinet shall be a self-contained type and integrate a preaction double interlock system, containing all hydraulic, pneumatic, devices, and electrical components required for the control of a preaction system. System shall include the following:

a. Sturdy free-standing 14 gauge steel cabinet measuring:

1) 23" x 25" x 77" (58.4 x 63.5 x 195.5 cm) for 1-1/2” and 2” systems
2) 36” x 25” x 77” (91.4 x 63.5 x 195.5 cm) for 3” and 4” systems
3) 46” x 25” x 77” (116.8 x 63.5 x 195.5 cm) for 6” systems
4) 54” x 31” x 81” (137.2 x 78.7 x 205.7 cm) for 8” systems

2. Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base (powder coated).
3. One or two locked access door(s), depending on cabinet size, to reduce frontal clearance required for opening.
4. Individual access doors for the hydraulic section and the emergency release.
5. Integrated Preaction System
    a. Viking deluge valves model F-1 for 1-1/2" (40 mm) through 8” (200mm) diameter c/w supervised butterfly control valve, releasing trim rated at 250 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoid. Systems provided with solenoid only, without this mechanical latching device, shall not be accepted. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.
    b. Pressure gauges to indicate water supply, priming water and air pressures of the system. Each pressure gauge must be provided with its own three-way valve.
    c. Release trim with solenoid valves, pneumatic actuator and every supervisory and alarm device required shall be Schedule 40 galvanized steel. Black pipe will not be accepted.
    d. Schedule 40 steel pipe header painted fire red, with grooved ends to be connected to supply water from either side.
    e. Schedule 40 steel pipe drain manifold of 2" diameter painted fire red, with grooved ends for drain connections from either side.
    f. Trim shall include properly identified contractor test ports factory mounted into the trim piping to facilitate system testing and commissioning.
    g. Viking VFR-400 integrated releasing control panel with emergency batteries factory-assembled inside the TotalPac®3 cabinet.
    h. The system shall have an integrated releasing circuit disconnect switch to allow the system to be tested without actuating the fire suppression system as required per NFPA 72, 2010 Edition. Operation of the disconnect switch shall cause a supervisory signal at the releasing service fire alarm control unit. The disconnect switch shall be a physical switch and not be accomplished by using software.
    i. Field wiring terminal block and junction box integrated with the cabinet for connection of field wiring. Standard factory-wired terminal strips to accept field installation of ARM-44 Relay Module, CA2Z Class initiating circuit module, RA-4410RC remote annunciator.
    j. The cabinet assembly must be pre-assembled, pre-wired and factory tested under ISO-9001 conditions, as a Viking TOTALPAC®3 system, by FireFlex Systems Inc. System shall be Approved for seismic requirements. c-UL-us Listed and FM Approved as an assembled unit.

C. System Required Options

1. Shut-off valve – Provide a Listed and Approved supervised butterfly valve installed on the system riser inside the cabinet for full flow test purposes. An integrated sight glass

shall be part of this arrangement for visually confirming water flow through the main drain upon system actuation.

2. Galvanized Option – Water supply inlet manifold and riser outlet with galvanized pipe, cap and couplings.

D. Integrated releasing control panel – Viking VFR-400

1. The releasing control panel shall be fully integrated to the TotalPac®3 cabinet enclosure. It shall be pre-assembled, pre-wired, programmed and tested at the factory. It shall be FM Approved and cULus listed to UL 864-9 standard. The panel shall include four programmable Class B, Style B initiating zones, two class B supervisory zones, and four programmable output circuits. Onboard, menu-driven programming with e pre-installed programs for ease of set-up must also be provided. Batteries shall be sized to provide emergency power as per UL (24 hours) or FM (90 hours) requirements. The control panel shall include both an LCD Annunciator and a set of yellow & red LED lamps identifying alarm, trouble, supervisory and flow conditions. Easy to operate control buttons shall also be included for the operation of the panel functions.

E. Releasing control panel options (select as required by State Fire Marshal)

1. Class A, Style D initiating device module: Provide a CA2Z module to allow the installation of Class A, Style D wiring on the initiating circuit.

2. Class A, Style Z indicating appliance module: Provide a CAM module to allow the installation of Class A, Style Z wiring on the indicating appliance circuit.

3. Relay module: Provide an ARM-44 relay module to allow eight (8) additional relays. The ARM-44 shall connect via RS-485 and 24 VDC power and shall be rated for 3 amps at 24 VDC resistive load. There shall also be a disable switch to allow for maintenance and testing.

4. Remote Annunciator: Provide a model RA-4410RC remote annunciator module and install it on-site following the instructions provided by the manufacturer. The remote annunciator shall be mounted on a standard four gang wall box provided by the contractor.

F. Automatic & manual detection devices

1. Supply and install a complete electrical detection system including conduit, wiring, Helios Air sampling detectors, manual pull stations, and connections to auxiliary functions.

2. Helios Air sampling system shall be wired on zones 1. Helios Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit. Spacing and type of detectors shall meet the requirements of the applicable standards and the manufacturer's recommendations for the application protected.

3. The detection and alarm indicating devices (24 Vdc bell, horn or strobe) must be compatible with the release control panel.

4. A bell or a horn should be installed near the TotalPac3 cabinet.

5. Supervisory tamper and pressure switches mounted inside the cabinet by the factory should be wired to two separate zones and provide separate indications for tamper and air supervisory.

    a. Note: Refer to the applicable compatible device list provided in the panel Installation, Operation & Instruction Manual to determine which compatible initiating and signaling devices model number to use.

G. Notification devices and signs

1. Supply and install a complete notification system including conduit, wiring, and notification devices.

2. The NAC devices (24 Vdc bell, horn or strobe) must be compatible with the release control panel.

H. System operation

1. The integrated VFR-400 releasing control panel sequence of operation shall be factory-programmed to perform the following:

    a. The activation of the electric detection AND the opening of an automatic sprinkler is necessary to cause the deluge valve actuation.

    b. The activation of the electric detection alone will not cause water to enter the system piping.

    c. The opening of an automatic sprinkler OR damage to system piping without the detection condition satisfied will activate the "very low air" alarm pressure switch but water will not enter the system piping.

    d. Activation of the electric detection AND the "very low air" alarm pressure switch will activate the solenoid valve open, causing the deluge valve to open and allowing water to enter the system piping. The alarm pressure switch will activate. Water will flow out of any open sprinklers and/or any openings on the system.

    e. Operation of the emergency manual release will depressurize the priming chamber, causing the deluge valve to open and allowing water to enter the system piping. The alarm pressure switch will activate, Water will flow out of any open sprinklers and/or any openings on the system.

    f. When AC Power and DC power supplied by the back up batteries is lost, the system shall “fail-safe” and function as a dry pipe system. The normally open solenoid will remain open, and the pneumatic actuator is the only device holding the priming water in the priming chamber. When a sprinkler operates, air pressure is lost and the pneumatic actuator opens. Priming water is drained from the priming chamber, causing the deluge valve to open and allowing water to enter the system piping. The alarm pressure switch will activate. Water will flow out of any open sprinklers and/or any openings on the system.

    g. Trouble condition on detection zones, or "very low air" alarm zone, or the normally closed solenoid output will disable the normally open solenoid and the pneumatic actuator is the only device holding the priming water in the priming chamber. When a sprinkler operates, air pressure is lost and the pneumatic actuator opens. Priming water is drained from the priming chamber, causing the deluge

valve to open and allowing water to enter the system piping. The alarm pressure switch will activate. Water will flow out of any open sprinklers and/or any openings on the system.

I. Air

1. Air compressor and supervisory trim (Air Supply Style "A") shall be provided inside the cabinet and its pressure factory adjusted for the selected configuration. The air supply must be regulated and of the proper size to restore normal system air pressure within 30 minutes as per NFPA 13.

2. Air Supply options (select as required by CA State Fire Marshal)

a. If required by the size of the piping network, an accelerator device, Viking model E-1 shall be factory installed in the air trim with its own pressure gauge and bypass valve, designed to increase the operating speed of the system.

b. Where dry air is desired, a dehydrator assembly shall be factory installed in the air trim, with bowl guard, supply control and drain valves. Dehydrator shall be Viking manually generated desiccant-type air dryer, the desiccant acting as a moisture indicator by changing color from dark blue to pink.

J. System drain

1. The single drain collector of the TotalPac®3 system shall be connected to an open drain consisting of a vertical pipe with an air gap around the drain collector pipe.

2. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.

3. Multiple drain collectors and open drain cups inside the cabinet will not be accepted.

2.13 PACKAGED FIRE PUMP SYSTEMS

A. The contractor shall provide a factory assembled and tested Packaged Fire Pump System designed in accordance with NFPA 20. The system shall be rated for operating flow and pressure as indicated in the equipment schedules. The system shall be mounted on a common base plate and include all necessary components such that the installer only needs to run piping to and from the system and connect incoming power. The packaged fire pump system shall include the following equipment:

B. Fire Pump

1. The pump shall be an vertical in-line centrifugal pump, A-C Fire Pump model 1580 or approved equal. The pump shall be listed by the Underwriters Laboratory and/or be approved by Factory Mutual. The pump shall have a bronze impeller, bronze case wear ring, packing gland and shaft sleeve. The pump shall deliver no less than 65% of rated pressure at 150% of rated flow. The shut-off pressure shall not exceed 140% of rated pressure.

C. Electric Driver

1. The motor shall be listed by Underwriters’ Laboratories and have the voltage and horsepower rating as indicated in the equipment schedules. It shall be open drip proof

with a 1.15 service factor and shall comply with the provisions of NFPA 70, National Electric Code as described in NFPA 20.

D. Controller

1. The motor controller shall be listed by Underwriters Laboratories and approved by Factory Mutual for fire pump service. It shall be compatible with the motor horsepower and voltage. It shall be of the full voltage type. The controller enclosure shall be of NEMA 2 type. The controller shall be completely assembled, wired and tested prior to shipment.

E. Jockey Pump

1. The Packaged Fire Pump System shall be provided with an integral jockey pump. The jockey pump will be close coupled to a TEFC motor. The motor will operate the voltage and motor horsepower rating as indicated in the equipment schedules.

F. Jockey Pump Controller

1. A UL listed jockey pump controller shall be supplied. The jockey pump controller shall come complete with a fusible disconnect, pre-piped pressure switch, front-mounted,hand-off-auto selector switch and overload relays. The controller enclosure shall be of NEMA 2 type.

G. Accessories

1. Systems shall include:

a. Suction and discharge pressure gauges on fire pump.

b. Isolating gate valve at suction for both fire pump and jockey pump.

c. Isolation valve at discharge for both fire pump and jockey pump.

d. Discharge check valve for fire pump and jockey pump.

H. Factory Prefabrication and Testing

1. All of the above equipment (except the test header and hose valves) shall be mounted on a common base. All pipes, piping components, and the pressure sensing lines shall be firmly anchored to the steel base by means of structural steel supports. All electrical wiring between controllers and motors shall be completed and tested at the factory. The entire packaged system will be hydrostatically tested at the factory prior to shipment. Additionally, all equipment will be tested in accordance with the requirements of NFPA 20, U.L. and F.M.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation of the sprinkler system shall not be started until complete plans and specifications (including water supply information and type of existing sprinkler system, if any) have been approved by the State Fire Marshal.

1. Piping shall be concealed unless shown or otherwise directed.

2. Where piping is left exposed within a room, it shall be run true to vertical, horizontal or intended planes. Where possible, uniform margins shall be maintained between parallel lines and/or adjacent wall, floor or ceiling surfaces.

3. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for maximum headroom clearance. This clearance shall not be less than 7'-6" without written approval from Architect.

4. Minor changes in locations of equipment, piping, etc., from locations shown shall be made when directed by Architect at no additional cost to Owner, providing such change is ordered before such items of work, or work directly connected to same, are installed and providing no additional material is required.

5. Grade all piping as required by NFPA 13.

6. Close ends of pipe immediately after installation; leave closure in place until removal is necessary for completion of installation.

7. Piping systems shall be thoroughly flushed and proved clean before connection to equipment.

8. Pipe discharge of each drain valve to floor sink or drain.

3.2 HANGERS AND SUPPORTS

A. General: Support piping so that it is firmly held in place by approved iron hangers and supports and by special hangers as required in accordance with NFPA 13. Hangers shall support loads specified in NFPA 13, and, in addition, shall support weight of pipe, fluid and pipe insulation, based on spacing between supports with a minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments, or hangers, shall be of same size as pipe or tubing on which used, or nearest larger size available. Materials, design, and type numbers per Manufacturers' Standardization Society (MSS) Standard Practice SP-58, provide branch line restraints where hangers exceed 6 inches long, in accordance with NFPA 13. Install concrete anchors required. Hanger material shall be approved by Architect before installation. Do not support piping by plumbers' tape, wire, rope, wood or other makeshift devices.

B. Suspend rods from angle clips, in accordance with Section 21 00 50.

3.3 SEISMIC REQUIREMENTS

A. Comply with CBC, Volume 2, Chapter 16A and CBC Chapter 9 and NFPA 13.

B. Seismic bracing system shall be a complete pre-engineered bracing system. Pre-engineered bracing system shall include plan layout, brace selection, specification, and calculations. Complete system shall be submitted to Architect for review. See Delegated Design Submittal paragraph in article, Submittals, in Section 21 00 50.

C. Anchorage for various manufactured and fabricated items is detailed and scheduled on the drawings or specified.

1. For proposed changes to anchorage shown, or specified, submit proposed methods of anchorage with calculations prepared by a California Registered Structural Engineer.

Design of anchorage shall comply with the above regulations using minimum coefficients, CP, listed CBC Chapter 16A.

D. It is not intended that prototype or non-standard equipment or equipment frames be provided. However, items of equipment shown or specified to be anchored shall maintain integrity at point of anchor after being subjected to accelerations equivalent to those established herein.

E. Anchors: Piping shall be provided with anchors for protection of piping against damage due to earthquakes, as required by CBC Chapter 16A, NFPA 13, and other sections of this specification.

3.4 TESTS

A. At various stages and upon completion, the system must be tested in the presence of the enforcing agency.

B. Upon completion and prior to acceptance of the installation, subject the entire new system to the tests required in NFPA 13, and shall furnish the Owner with certificates as appropriate.

3.5 IDENTIFICATION

A. Coordinate requirements with the authority having jurisdiction.

B. Provide brass valve tags at each system valve, indicating valve service.

C. Provide signage at each sprinkler valve, with sign indicating specific portion of system controlled by valve.

D. Provide signage at each outdoor alarm device, with sign indicating which authority to call if device is activated.

E. Prior to final acceptance, Contractor shall provide accurate color-coded Building Plan at riser location, clearly depicting fire protection system area of coverage, location of inspectors' test/drain connection and auxiliary drain connections. Provide this information at each system or building at riser location for building. Plan(s) shall be ½ size and plastic laminated.

F. Provide hydraulic data signage permanently attached to risers, indicating location, basis of design, water supply and pressure requirements of system.

3.6 ELECTRICAL WIRING

A. Coordination of wiring systems is part of this work. Contractor shall ensure that the following is completed.

1. Work provided in other Specification Sections:

a. Supervised wiring to fire alarm control panel.

b. Supervised wiring from main waterflow indicator to fire alarm panel.

c. Supervised wiring from sprinkler flow switches to fire alarm panel.

d. Supervised wiring from valve water flow alarm switches to fire alarm panel.

2. Work provided in this Specification Section:

a. Wiring diagrams for devices.

b. Other wiring not specified to provide an operating system.

3.7 SPRINKLER HEADS

A. Heads shall be placed upright where on exposed piping, unless otherwise noted, and in pendant position on concealed piping, unless noted otherwise, with deflectors parallel to the ceiling or roof slope. Clearance between deflectors and ceilings, electric, or heating equipment, or other obstruction shall be in accordance with the requirements of NFPA 13. Provide sprinkler head guards where heads are subject to mechanical damage, for example, at mechanical rooms, and storage rooms and gymnasiums.

B. Mount box containing spare sprinkler heads and wrenches on wall in location selected by Owner.

C. Do not install pendant sprinkler heads until flushing of the piping has been completed.

D. Provide return bend as illustrated in NFPA 13 (NFPA exceptions do not apply) for each sprinkler head installed in finished ceiling.

3.8 PIPING JOINTS AND CONNECTIONS

A. Pipe shall be assembled in accordance with the requirements of NFPA 13.

B. Flange and spigot piece at the base of sprinkler riser shall be secured to the underground elbow at the base of riser with tie-rods which are properly coated, or stainless steel to protect against corrosion. Set-screw type flange adapters and mechanical joint retainer glands are not an acceptable substitute for tie-rods. Provide concrete thrust blocks in accordance with NFPA 24 and CBC.

3.9 VALVES

A. All valves shall be identified by permanent metal tags or other approved means.

3.10 DRAINS

A. Auxiliary drains shall be installed on low points in each system.

1. Five or fewer trapped gallons will not require a drain valve but may be drained through a plugged fitting. Drain valves shall be in accordance with the requirements of NFPA 13.

B. Install one inspector's test drain on sprinkler system. Extend drain to outside in location approved by Architect. Water discharge shall be positioned such that landscaping will not be damaged.

C. Drain valves shall be piped to a safe place of discharge and discharge shall be visible either by open-end drainpipe or sight drain fitting.

D. Provide flushing connections at ends of cross-mains.

3.11 PRE-ACTION SYSTEM INSTALLATION

A. The installation must meet all established standards and be according to all applicable laws, regulations and codes.

B. The proper operation and coordination for the system's installation, including the automatic sprinkler system, detection system, signaling system and initial start-up are all under the responsibility of the fire protection contractor.

C. Water supply for the cabinet shall allow a grooved connection to supply manifold from the left or right-hand side of the unit.

D. Drain output for the cabinet shall be connected through the bottom center of the unit.

3.12 SLEEVES

A. Install AMI Products, Adjus-to-Crete, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.

B. At walls below grade Link-Seal casing seals, or equal, may be used in lieu of caulking. Pipes penetrating walls below grade shall be anchored at wall.

3.13 FLOOR, WALL, AND CEILING PLATES

A. Fit pipes with or without insulation passing through walls, floors, or ceilings and hanger rods penetrating finished ceilings with chrome plated or stainless steel plates.

3.14 FIRESAFING

A. The annular space between pipe sleeves and pipe passing through all floors and walls shall be packed with incombustible mastic or other suitable material, in accordance with U.L. Fire Resistance Directory.

B. Penetrations in fire rated assemblies shall also be protected in accordance with CBC Chapter 7, Section 712, and UL Fire Resistance Directory.

3.15 UNION AND FLANGES

A. Install unions whether shown or not at each connection to equipment and at one connection to each valve or cock.

B. Locate the unions for easy removal of the equipment or valve.

3.16 CLEANING

A. Upon completion of tests, clean equipment, piping, etc., installed under this Section of the Specifications.

3.17 FLUSH

A. Entire system shall be flushed out and cleaned after completion of piping, and prior to installation of sprinkler heads. Flush shall be continued until water runs clear at drain connections.

END OF SECTION 21 10 00

DIVISION 22
PLUMBING

SECTION 220513

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Electronically commutated.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 220516

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Flexible-hose packless expansion joints.
2. Alignment guides and anchors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex Pression Ltd.
b. Flex-Hose Co., Inc.

c. Flexicraft Industries.
d. Mason Industries, Inc.
e. Metraflex Company (The).
f. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.

3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adsco Manufacturing LLC.
b. Advanced Thermal Systems, Inc.
c. Flex-Hose Co., Inc.
d. Flexicraft Industries.
e. Flex-Weld, Inc.
f. Mason Industries, Inc.
g. Metraflex Company (The).
h. Unisource Manufacturing, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, stainless steel.
b. Expansion Plug: Stainless steel.
c. Washer and Nut: Stainless steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Industries, LLC.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

1. Sleeves are not required for core-drilled holes.

B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.

2. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

4. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 220518

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220519

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flo Fab inc.

b. Miljoco Corporation.
c. Palmer Wahl Instrumentation Group.
d. Tel-Tru Manufacturing Company.
e. Trerice, H. O. Co.
f. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMETEK, Inc.
   b. Ashcroft Inc.

c. Flo Fab inc.
d. Marsh Bellofram.
e. Miljoco Corporation.
f. Noshok.
g. Palmer Wahl Instrumentation Group.
h. Tel-Tru Manufacturing Company.
i. Trerice, H. O. Co.
j. Watts; a Watts Water Technologies company.
k. Weiss Instruments, Inc.

2. Standard: ASME B40.100.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Trerice, H. O. Co.
6. Watts; a Watts Water Technologies company.
7. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:

1. Inlets and outlets of each domestic water heat exchanger.
2. Inlet and outlet of each domestic hot-water storage tank.

J. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlets and outlets of each domestic water heat exchanger shall be the following:

1. Industrial-style, liquid-in-glass type.

B. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:

1. Test plug with EPDM self-sealing rubber inserts.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:

1. Liquid-filled, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:

1. Liquid-filled, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:

1. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi.

B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Bronze swing check valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221113 "Facility Water Distribution Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Grooved: With grooves according to AWWA C606.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.

c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.

3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Pipe stands.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from the California Board of State and Community Corrections.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. B-line, an Eaton business.
   b. Thomas & Betts Corporation, A Member of the ABB Group.
   c. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.

3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. 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.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touchup: 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.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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.
2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
9. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
10. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system 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. C-Clamps (MSS Type 23): For structural shapes.
6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system 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 in writing by manufacturer to prevent crushing insulation.

K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 220548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Seismic-restraint accessories.
3. Mechanical anchor bolts.

B. Related Requirements:

1. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and

values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III (Housing units), and II (Administration.)

a. Component Importance Factor: 1.5.

b. Component Response Modification Factor: As required per Table 13.6.1 of ASCE 7-10.
c. Component Amplification Factor: As required per Table 13.6.1 of ASCE 7-10.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 1.5.
4. Design Spectral Response Acceleration at 1.0-Second Period: 0.60.
5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Unistrut; Part of Atkore International

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.4 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in stainless steel for interior and exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

D. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install stainless steel anchors for interior and exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from

the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

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

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 ACTION SUBMITTALS

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

B. Valve numbering scheme.

C. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Champion America.
   d. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

3. Letter Color: White.

4. Background Color: Red.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Champion America.
4. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Champion America.
4. Seton Identification Products.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain, or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.

2. Valve-Tag Colors:

   a. Cold Water: Natural.
   b. Hot Water: Natural.

END OF SECTION

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic hot-water piping.
2. Domestic recirculating hot-water piping.
3. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Mineral-Fiber, Preformed Pipe Insulation:

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

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Engineered Brass Company.
   b. Insul-Tect Products Co.
   c. McGuire Manufacturing.
   d. Plumberex Specialty Products, Inc.
   e. Truebro.
   f. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/2 Insert pipe size and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

C. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

END OF SECTION

SECTION 220800

COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Related Sections:

1. Section 017823 “Operations and Maintenance Data.”
2. Section 017900 “Demonstration and Training.”
3. Section 018100 "General Commissioning Requirements" for general commissioning process requirements.
4. Section 230800 “Commissioning of HVAC.”

1.3 DEFINITIONS

A. Commissioning: The systematic process of ensuring that the building’s systems are operating in accordance with the Contract Documents that the systems perform interactively in accordance with the Contract Documents, and that facility personnel are prepared to operate and maintain the building and its systems. This includes, but may not be limited to, pre-functional testing of equipment, functional testing of systems, system interoperability testing, training of facility personnel, delivering Operation and Maintenance (O&M) documentation, and the turnover of completed systems.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

F. Contractor: As used in this section, Contractor refers to the General Contractor, subcontractors of all tiers, or vendors, based on usage.

G. Pre-functional Tests: PFTs are primarily static inspections and procedures to prepare the equipment or system for initial startup and operation (e.g. oil levels satisfactory, fan belt

tension appropriate, labels affixed, gages installed, sensor calibrated, etc.) However, some PFT check list items require simple testing of the function of a component, piece of equipment, or system. PFT check-lists are intended to augment, and be combined with, the manufacturer's start-up check-lists, and procedures.

H. Functional Performance Tests: FPT is the dynamic testing of complete systems under full operation. The FPTs will be developed directly from the approved Sequence of Operations for each system, and are intended to dynamically test component and system operations, as well as demonstrate full compliance with the specifications, contract documents, and the design intent. Systems, subsystems, assemblies, components, and equipment" where these terms are used together or separately, they shall mean "installed" systems, subsystems, and equipment.

I. Systems Manual: The Systems Manual is the final deliverable from the Commissioning process, and provides the information needed to understand, operate, and maintain the facility and its systems. It should be the repository of all updates and corrections as they occur, including those through occupancy. The Systems Manual expands the scope of the standard Operation and Maintenance documentation to include additional information developed through commissioning, and is prepared by the CxA.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual plumbing systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

E. Organize and lead the Commissioning Team.

F. Develop the Commissioning Schedule.

G. Script project specific Commissioning Specifications.

H. Review the Design and Construction Documents.

I. Prepare a construction-phase Commissioning Plan.

J. Identify Commissioning Team member roles and responsibilities.

K. Review the owner's project requirements, and the basis of design for completeness and consistency.

L. Coordinate and convene Commissioning Team meetings.

M. Prepare and distribute minutes to the Commissioning Team Members and attendees.

N. Conduct an initial construction-phase Commissioning Meeting for the purpose of reviewing the Commissioning Activities, establishing preliminary schedules for Operation and Maintenance submittals, Owner Training sessions, and Project Completion.

O. Observe and inspect construction, and report progress and deficiencies.

P. Review and assist sub-contractors with development of equipment specific pre-functional tests.

Q. Develop and script project-specific functional performance tests in collaboration with the sub-contractors, and in accordance with the approved Sequence of Operations.

R. Schedule, direct, witness, and document functional performance testing.

S. Document and track the status of all testing deficiencies in a FPT Observations and Exceptions Log.

T. Compile test data, inspection reports, and certificates for inclusion in the Systems Manual and the Commissioning Report.

U. Review project records for accuracy.

V. Review and comment on the Operations and Maintenance documentation, and Systems Manual outlines for compliance with the owner's project requirements, basis of design, and contract documents.

W. Prepare and distribute the final Commissioning Report.

1.7 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for plumbing systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that plumbing systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that plumbing control system (water management system) has been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Inspect and verify the position of each device and interlock identified on checklists.

E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of plumbing testing shall include entire plumbing installation, from central equipment for heat generation through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the Plumbing Contractor shall prepare detailed testing plans, procedures, and checklists for plumbing systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.3 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Domestic Water Heat Exchanger Testing and Acceptance Procedures: Testing requirements are specified in domestic water heat exchanger Section. Provide submittals, test data, inspector record, and heat exchanger certification to the CxA.

B. Domestic Water Pumps Testing and Acceptance Procedures: Testing requirements are specified in domestic water pumps Section. Provide submittals, test data, inspector record, and pump certification to the CxA.

C. Plumbing Control System (Water Management System) Testing: Field testing plans and testing requirements are specified in Section 224600 "Security Plumbing Fixtures." Assist the CxA with preparation of testing plans.

END OF SECTION

SECTION 221116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

D. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries, Inc.
e. Smith, Jay R. Mfg. Co.
f. Viking Johnson.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Central Plastics Company.
b. Jomar Valve.
c. Watts; a Watts Water Technologies company.
d. Wilkins.
e. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install domestic water piping level without pitch and plumb.

F. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

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

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

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

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

P. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

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

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

C. 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.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. 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.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day 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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. 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 a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures 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. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Hose bibbs.
8. Drain valves.
9. Water-hammer arresters.
10. Trap-seal primer valves.
11. Flexible connectors.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. Legend Valve & Fitting, Inc.
    d. MIFAB, Inc.
    e. Watts; a Watts Water Technologies company.
    f. Woodford Manufacturing Company.
    g. Zurn Industries, LLC.

2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

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

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO.
    d. Flomatic Corporation.
    e. Watts; a Watts Water Technologies company.
    f. Zurn Industries, LLC.

2. Standard: ASSE 1013.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Flo Fab inc.
    c. ITT Corporation.
    d. NIBCO INC.
    e. Watts; a Watts Water Technologies company.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.

3. Body: Bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Station (Tempering Valves):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Powers.

2. Tempering station shall be a lead-free digital water temperature control and monitoring system. System shall include full-color touchscreen interface which is configurable on site, and does not require factory pre-programming, nor proprietary tools to adjust settings. System shall control water temperature to ±2°F at all times, including periods of low or zero flow. Unit shall include a user programmable high-temperature alarm. Unit shall use predictive control to anticipate changes in system demand, and to adjust valve pre-emptively to maintain mixed water set point. Controllers shall be password protected, and have a user-adjustable outlet temperature range of 80°F to 180°F, and an approach temperature of 2°F.

System shall digitally monitor inlet pressure and temperature, mixed outlet temperature, pressure and setpoint, and return water temperature. System shall control recirculation pump specified in the project schedule drawings based on specified return temperature limits.

Unit shall have the ability to be integrated with the building's BACnet building management system to display high temperature alarms.

System shall include the ability provide a user initiated and controlled high-temperature sanitation mode as of the Owner's thermal bacteria eradication protocol.

In the event of a power failure, or loss of cold water, the system shall close the hot water supply.

System shall be listed or approved to ASSE1017, cUPC, NSF, CSA24/UL873, and BTL standards.

Unit shall be mounted on a heavy-duty, corrosion resistant, welded strut frame. Unit shall be factory tested as a complete unit.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 3 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 4 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.033 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.8 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. IPS Corporation.
    c. Oatey.

2. Mounting: Recessed.

3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.9 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMTROL, Inc.

b. Josam Company.
c. MIFAB, Inc.
d. Precision Plumbing Products.
e. Sioux Chief Manufacturing Company, Inc.
f. Smith, Jay R. Mfg. Co.
g. Tyler Pipe; a subsidiary of McWane Inc.
h. Watts; a Watts Water Technologies company.
i. Zurn Industries, LLC.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MIFAB, Inc.
b. Precision Plumbing Products.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.
e. Watts; a Watts Water Technologies company.
f. Zurn Industries, LLC.

2. Standard: ASSE 1018.

3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

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

a. Smith, Jay R. Mfg. Co.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.

3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Metraflex Company (The).
4. Unaflex.
5. Universal Metal Hose.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Install Y-pattern strainers for water on supply side of each solenoid valve and pump.

E. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

F. Install water-hammer arresters in water piping according to PDI-WH 201.

G. Install supply-type, 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.

H. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

I. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Reduced-pressure-principle backflow preventers.
2. Calibrated balancing valves.
3. Primary, thermostatic, water mixing valves.
4. Outlet boxes.
5. Supply-type, trap-seal primer valves.
6. Trap-seal primer systems.

B. 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. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

SECTION 221123

DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. In-line, sealless centrifugal pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; a Xylem brand.
3. Grundfos Pumps Corp.

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Casing: Bronze, with threaded or companion-flange connections.
3. Motor: Single speed, unless otherwise indicated.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 50 to 125 deg F.
3. Enclosure: NEMA 250, Type 4X.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V, ac.
7. Settings: Start pump at 105 deg F and stop pump at 120 deg F.
8. Include a well for a BMS temperature sensor to monitor the temperature of the water.

B. Timers: Electric, for control of hot-water circulation pump.

1. Type: Programmable, seven-day clock with manual override on-off switch.
2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: 120-V ac.
6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.
7. Include an auxiliary relay for the BMS system to start and stop the pumps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install thermostats in hot-water return piping.

D. Install timers on wall in Mechanical Equipment room, adjacent to water heater.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping.

E. Connect thermostats, and timers to pumps that they control.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats, and timers for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

END OF SECTION

SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. MIFAB, Inc.
e. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. MIFAB, Inc.
e. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

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

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

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

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

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

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

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. 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 two 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 degrees. 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.

J. 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.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. 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."

M. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. 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.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. 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.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

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.

3.9 PIPING SCHEDULE

A. Aboveground, soil and waste piping shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

B. Aboveground, vent piping shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

C. Underground, soil, waste, and vent piping shall be the following:

1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

END OF SECTION

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Channel drainage systems.
4. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Section 334100 "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Josam Company.
2) MIFAB, Inc.
3) Smith, Jay R. Mfg. Co.
4) Tyler Pipe; a subsidiary of McWane Inc.
5) Watts; a Watts Water Technologies company.
6) Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Josam Company.
2) Smith, Jay R. Mfg. Co.
3) Watts; a Watts Water Technologies company.
4) Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Closure: Brass plug with tapered threads.
5. Adjustable Housing Material: Cast iron with threads.
6. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.

7. Frame and Cover Shape: Round.
8. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. Watts; a Watts Water Technologies company.
   f. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Watts; a Watts Water Technologies company.
   e. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
3. Body Material: Gray iron.
4. Outlet: Bottom.
5. Top or Strainer Material: Nickel bronze.
6. Top of Body and Strainer Finish: Nickel bronze.
7. Top Shape: Round.
8. Trap Material: Cast iron.
9. Trap Pattern: Standard P-trap.
10. Trap Features: Trap-seal primer valve drain connection.

2.3 CHANNEL DRAINAGE SYSTEMS

A. FRP Channel Drainage Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ACO USA.
    b. Josam Company.
    c. Smith, Jay R. Mfg. Co.
    d. Zurn Industries, LLC.

2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

    a. Channel Sections: Interlocking-joint, sloped-invert, FRP modular units, with end caps. Include flat, rounded, or inclined inside bottom, with outlets in number, sizes, and locations indicated.

        1) Dimensions: 6 inches wide. Include number of units required to form total lengths indicated.
        2) Frame: Manufacturer's standard metal for grates.

    b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.

        1) Material: Fiberglass.
        2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

    c. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
    d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 degrees.
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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. 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.

E. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

F. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221413

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

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

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. MIFAB, Inc.
e. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. MIFAB, Inc.
e. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

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

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

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

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

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

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. 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.

J. Lay buried building storm 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.

K. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

L. 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."

M. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Vertical Piping: MSS Type 8 or Type 42, clamps.
3. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

4. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
5. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. 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.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. 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.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. 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.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 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.

3.9 PIPING SCHEDULE

A. Aboveground storm drainage piping NPS 6 and smaller shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

B. Underground storm drainage piping NPS 6 and smaller shall be the following:

1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.

C. Underground, storm drainage piping NPS 8 and larger shall be the following:

1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.

END OF SECTION

SECTION 221423

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Watts; a Watts Water Technologies company.
e. Zurn Industries, LLC.

2. Standard: ASME A112.6.4, for general-purpose roof drains.

3. Body Material: Cast iron.
4. Dimension of Body: Nominal 8- to12-inch diameter.
5. Outlet: Bottom.
6. Dome Material: Cast iron.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. Watts; a Watts Water Technologies company.
   f. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.

3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe; a subsidiary of McWane Inc.
   e. Watts; a Watts Water Technologies company.
   f. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.

3. Size: Same as connected drainage piping.

4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install test tees in vertical conductors and near floor.

F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 223100

DOMESTIC WATER SOFTENERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Commercial water softeners.
2. Chemicals.
3. Water-testing sets.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Water softeners shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water softeners.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For water softeners, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control reports.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application.

B. UL Compliance: Fabricate and label water softeners to comply with UL 979, "Water Treatment Appliances."

1.8 COORDINATION

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

1.9 WARRANTY

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

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

a. Structural failures of mineral and brine tanks.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.
d. Attrition loss of resin exceeding 3 percent per year.
e. Mineral washed out of system during service run or backwashing period.
f. Effluent turbidity greater and color darker than incoming water.

g. Fouling of underdrain system, gravel, and resin with turbidity or by dirt, rust, or scale from water softener or soft water, while operating according to manufacturer's written operating instructions.

2. Commercial Water Softeners, Warranty Period: From date of Substantial Completion.

a. Mineral Tanks: Five years.
b. Brine Tanks: 10 years.
c. Control Valve: One year(s).

1.10 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of water softener Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper water softener operation at rated capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 COMMERCIAL WATER SOFTENERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Culligan International Company.
2. Diamond Water Systems, Inc.
3. Ecodyne Water Treatment, Inc.
4. WaterSoft.

B. Description: Factory-assembled, pressure-type water softener.

1. Standard: Comply with NSF 61 Annex, "Drinking Water System Components - Health Effects."
2. Configuration: Twin unit with two mineral tanks and one brine tank.
3. Mounting: On housekeeping pad.
4. Wetted Components: Suitable for water temperatures from 40 to at least 120 deg F.
5. Mineral Tanks: Steel, electric welded; pressure-vessel quality.

a. Seismic Requirements: Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
b. Construction: Non-ASME code.
c. Pressure Rating: 100 psig minimum.
d. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
e. Handholes: 4 inches round or 4 by 6 inches elliptical, in top head and lower sidewall of tanks 30 inches and smaller in diameter.
f. Support Legs or Skirt: Constructed of structural steel, welded to tank before testing and labeling.
g. Finish: Exterior of tank spray-painted with rust-resistant prime coat, 2- to 3-mil dry film thickness. Interior sandblasted and lined with epoxy-phenolic coating, 8- to 10-mil dry film thickness.
h. Upper Distribution System: Single, point type, fabricated from PVC pipe and fittings.
i. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, nonclogging PE strainers, and arranged for even flow distribution through resin bed.
j. Liner: PE, ABS, or other material suitable for potable water.

6. Controls: Fully automatic; factory wired and factory mounted on unit.

a. Adjustable duration of various regeneration steps.
b. Automatic start and complete automatic operation.
c. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
d. Sequence of Operation: Multiport pilot-control valve automatically pressure-actuates main operating valve through steps of regeneration and return to service.
e. Pointer on pilot-control valve shall indicate cycle of operation.
f. Includes means of manual operation of pilot-control valve if power fails.

7. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:

a. Slow opening and closing, nonslam operation.
b. Diaphragm guiding on full perimeter from fully open to fully closed.
c. Isolated, dissimilar metals within valve.
d. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
e. Sampling cocks for soft water.
f. Special tools are not required for service.

8. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressure; does not require field adjustments.

a. Demand-Initiated Control: Each twin mineral-tank unit is equipped with automatic-reset-head water meter, in common outlet header, that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tank. Automatically repeats with other tank. Electrical lockout prevents simultaneous regeneration of both tanks.

9. Brine Tank: Combination measuring and wet-salt storing system.

a. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawal and freshwater refill.
c. Size: Large enough for at least four regenerations at full salting.

10. Brine Reclaim:

a. System controller shall be programmed to permit the proper amount of brine for subsequent regenerations to be diverted back to the brine system. The entire brine reclaim process shall be fully automatic and require no adjustment from one regeneration to the next. The system shall include all necessary diaphragm and solenoid valves needed to support the reclaim function. These valves shall be operated by the system controller. The use of a separate controller to perform the steps of brine reclaim is not permitted.
b. The brine tank shall be equipped with a float operated, non-corrosive, field serviceable brine float valve for automatic control of brine withdrawal and brine reclaim water refill.
c. The brine valve shall automatically open to admit brine to the resin tank during eduction, and close automatically, providing positive shut-off to prevent air from entering the system during the reclaim process. The brine valve shall work with the brine reclaim feature of the main operating valve controls to admit the correct volume of reclaimed water to the brine tank in accordance with the reclaim time setting in the control program.
d. The brine valve shall include a float operated safety shut-off valve as a back up to the timed reclaim from the main operating valve control to prevent brine tank overflow.

11. Factory-Installed Accessories:

a. Piping, valves, tubing, and drains.
b. Sampling cocks.
c. Main-operating-valve position indicators.
d. Water meters.

C. Capacities and Characteristics:

1. Water Analysis:

a. Hardness: 30 grains/gal.

b. Iron: 0 ppm.
c. Dissolved Solids: N/A.
d. Concentration: 7 pH.

2. Continuous Service Flow Rate: 94 gpm at 2.5-psig pressure drop.
3. Peak Service Flow Rate: 420 gpm for sustained periods of 90 minutes at 25-psig pressure drop.
4. Backwash-to-Drain Flow Rate: 20 gpm.
5. Water Consumption: 10,000 gallons/day.
6. Water Demand: 24 hours/day.
7. Number of Mineral Tanks: Two.
8. Electrical Characteristics:

a. Volts: 24 VAC.
b. Phases: 1 phase.
c. Hertz: 60 Hz.
d. Minimum Circuit Ampacity: 20 A.

9. Salt Capacity: 866 lbs.
10. Minimum Number of Regenerations per Refill: 8.7.
11. Floor Area Required: 114 inches by 44 inches.
12. Height Required: 85 inches.

2.2 CHEMICALS

A. Mineral: High-capacity, sulfonated-polystyrene, ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.

1. Exchange Capacity: 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.

B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are unacceptable.

1. Form: Processed, food-grade salt pellets.

2.3 WATER-TESTING SETS

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

2.4 SOURCE QUALITY CONTROL

A. Hydrostatically test mineral tanks before shipment to a minimum of one and one-half times the pressure rating.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WATER SOFTENER INSTALLATION

A. Equipment Mounting:

1. Install commercial water softeners on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure.

C. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.

D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

E. Install water-testing sets mounted on wall, unless otherwise indicated, and near water softeners.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to equipment, allow space for service and maintenance of equipment.

C. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.

1. Metal general-duty valves are specified in Section 220523 "General Duty Valves for Plumbing Piping."
2. Plastic valves are specified in Section 221116 "Domestic Water Piping."

D. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."

E. Install valved bypass in water piping around water softeners.

1. Metal general-duty valves are specified in Section 220523 "General Duty Valves for Plumbing Piping."
2. Plastic valves are specified in Section 221116 "Domestic Water Piping."
3. Water piping is specified in Section 221116 "Domestic Water Piping."

F. Install drains as indirect wastes to spill into open drains or over floor drains.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Water softeners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

B. Add water to brine tanks and fill with the following form of salt:

1. Commercial Water Softeners: Processed, food-grade salt pellets.

C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:

1. ASTM D 859, "Test Method for Silica in Water."
2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1068, "Test Methods for Iron in Water."
4. ASTM D 1126, "Test Method for Hardness in Water."
5. ASTM D 1129, "Terminology Relating to Water."
6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water softeners.

END OF SECTION

SECTION 223500

DOMESTIC-WATER HEAT EXCHANGERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Circulating, storage, domestic-water heat exchangers.
2. Domestic-water, heat-exchanger accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic-water heat exchangers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heat exchanger indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For domestic-water heat exchangers, accessories, and components, from manufacturer.

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of circulating, domestic-water heat exchanger, from manufacturer.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic-water heat exchangers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.8 COORDINATION

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

1.9 WARRANTY

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

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

   a. Structural failures including heat exchanger, storage tank, and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

   a. Circulating, Storage, Domestic-Water Heat Exchangers:

1) Storage Tank: Five years.
2) Tube Coil: Five years.
3) Controls and Other Components: Three years.

b. Compression Tanks: One year(s).

PART 2 - PRODUCTS

2.1 CIRCULATING, DOMESTIC-WATER HEAT EXCHANGERS

A. Circulating, Storage, Domestic-Water Heat Exchangers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. HTP Superstor Ultra.
b. Patterson-Kelley.
c. Smith, A. O. Corporation.

2. Description: Packaged, large-capacity, hot-water storage tank with heat-exchanger coil; circulator; controls; and specialties for heating domestic water with heating hot water in coil.

3. Flow Pattern: Standard-flow arrangement, with water from bottom of storage tank circulated across heat-exchanger coil and returned to tank. Include hot-water outlet located at top of tank and temperature sensor in tank.
4. Storage-Tank Construction: Stainless-steel with 125-psig working-pressure rating. Include nozzle and head for heat-exchanger tube coil.

a. Configuration: Vertical.
b. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.

1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

c. Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire storage tank and nozzle except connections and controls.

5. Heat-Exchanger Coil: NPS 1 diameter, cupronickel tubes with tube sheet and supporting baffles. Include heat-exchanger pressure rating equal to or greater than heating-fluid supply pressure.
6. Temperature Control: Adjustable temperature aquastat, mounted in storage-tank shell head unless otherwise indicated.
7. Safety Control: Automatic, high-temperature-limit cutoff device or system. Include automatic low-water cutoff device or system.
8. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of

heat exchanger. Select one relief valve with sensing element that extends into storage tank.

9. Gages: Factory-mounted thermometer and pressure gage.
10. Circulating Pump: As specified on project schedules.

    a. Pump Control: Sensor for operating pump and control valve.

11. Energy Management System Interface: Normally closed dry contacts for enabling and disabling heat exchanger.

2.2 DOMESTIC-WATER, HEAT-EXCHANGER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Flexcon Industries.
    c. Pentair Pump Group.
    d. Smith, A. O. Corporation.
    e. State Industries.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

3. Construction:

    a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics:

    a. Working-Pressure Rating: 150 psig.
    b. Acceptance Capacity: 4 gal. minimum.
    c. Air Precharge Pressure: 12 psig.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than heat-exchanger working-pressure rating. Select relief valves with sensing element that extends into storage tank.

D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than heat-exchanger working-pressure rating.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heat exchangers specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heat exchangers to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heat exchangers will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER, HEAT-EXCHANGER INSTALLATION

A. Domestic-Water, Heat-Exchanger Mounting: Install domestic-water heat exchangers on concrete base. Comply with requirements for concrete bases specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor heat exchangers to substrate.

B. Install domestic-water heat exchangers level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to heat exchangers and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General Duty Valves for Plumbing Piping."
2. Install shutoff valves on heating hot-water piping to heat exchangers. Comply with requirements for shutoff valves specified in Section 230523 "General Duty Valves for HVAC Piping."

C. Install domestic-water heat exchangers with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install temperature and pressure relief valves in top portion of storage-tank shells of domestic-water heat exchangers with domestic-water storage. Use relief valves with sensing elements

that extend into shells. Extend relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature-and-pressure relief valves in water piping for domestic-water heat exchangers without storage. Extend relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install heat-exchanger drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heat exchangers that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometer on each domestic-water, heat-exchanger, outlet piping, and install thermometer on each domestic-water, heat-exchanger, heating-fluid inlet and outlet piping. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install pressure gages on domestic-water, heat-exchanger, heating-fluid piping. Comply with requirements for pressure gages specified in Section 220519 "Meters and Gages for Plumbing Piping."

I. Fill domestic-water heat exchangers with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for heating hot-water piping specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to domestic-water heat exchangers, allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of domestic-water heat exchangers.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heat exchangers will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain circulating domestic-water heat exchangers.

END OF SECTION

SECTION 224213.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

B. Related Requirements:

1. Section 224600 "Security Plumbing Fixtures" for security water closets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, bottom outlet, top spud.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.
b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. Zurn Industries, LLC.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Spud Size and Location: NPS 1-1/2; top.
h. Color: White.

3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Delany Products.
b. Sloan Valve Company.
c. Zurn Industries, LLC.

2. Standard: ASSE 1037.

3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Consumption: 1.28 gal. per flush.
9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.
b. Bemis Manufacturing Company.
c. Centoco Manufacturing Corporation.
d. Church Seats; Bemis Manufacturing Company.

e. Kohler Co.
f. Olsonite Seat Co.
g. Zurn Industries, LLC.

2. Standard: IAPMO/ANSI Z124.5.

3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

C. Install toilet seats on water closets.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224213.16

COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, washout.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.
b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. Zurn Industries, LLC.

2. Fixture:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Washout with extended shields.
   d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
   e. Water Consumption: Water saving.
   f. Spud Size and Location: NPS 3/4, top.
   g. Outlet Size and Location: NPS 2, back.
   h. Color: White.

3. Waste Fitting:

   a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
   b. Size: NPS 2.

4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Standard: ASSE 1037.
2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Style: Exposed.
7. Consumption: 0.125 gal. per flush.
8. Minimum Inlet: NPS 3/4.
9. Minimum Outlet: NPS 3/4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

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

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

B. Related Requirements:

1. Section 224600 "Security Plumbing Fixtures" for security lavatories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Oval, vitreous china, undercounter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America.
   b. Crane Plumbing, L.L.C.
   c. Kohler Co.
   d. Zurn Industries, LLC.

2. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: For undercounter mounting.
   c. Faucet-Hole Punching: No holes.
   d. Faucet-Hole Location: On countertop.
   e. Color: White.
   f. Mounting Material: Sealant and undercounter mounting kit.

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Ledge back, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America.
   b. Crane Plumbing, L.L.C.
   c. Kohler Co.
   d. Zurn Industries, LLC.

2. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: For wall hanging.
   c. Faucet-Hole Location: Top.
   d. Color: White.

3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.

2.3 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, single-control mixing, commercial, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America.
   b. Chicago Faucets; Geberit Company.
   c. Delta Faucet Company.
   d. Kohler Co.
   e. Moen Incorporated.
   f. T & S Brass and Bronze Works, Inc.

2. Standard: ASME A112.18.1/CSA B125.1.

3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Material: Commercial, solid brass.

2.4 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, hard-wired, electronic-sensor-operated, mixing, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard America.
   b. Chicago Faucets; Geberit Company.
   c. Kohler Co.
   d. Moen Incorporated.
   e. Sloan Valve Company.
   f. T & S Brass and Bronze Works, Inc.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.

3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.

2.5 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 1/2.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.6 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material: Chrome-plated, one-piece, cast-brass trap with swivel 0.029-inch-thick tubular brass wall bend; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

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

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.16

COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Service basins.
2. Utility sinks.
3. Sink faucets.
4. Supply fittings.
5. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Terrazzo, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. Crane Plumbing, L.L.C.
    c. Florestone Products Co., Inc.

2. Fixture:

    a. Standard: IAPMO PS 99.
    b. Shape: Square.
    c. Tiling Flange: On two sides.
    d. Rim Guard: On front top surfaces.
    e. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.

2.2 UTILITY SINKS

A. Utility Sinks: Stainless steel, counter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard America.
    b. Elkay Manufacturing Co.
    c. Just Manufacturing.
    d. Kohler Co.

2. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4.

3. Mounting: On counter with sealant.

2.3 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, single-control mixing valve.

1. Commercial, Solid-Brass Faucets.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) American Standard America.
        2) Chicago Faucets; Geberit Company.
        3) Elkay Manufacturing Co.
        4) Just Manufacturing.

5) Kohler Co.
6) Moen Incorporated.
7) T & S Brass and Bronze Works, Inc.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Material: Commercial, solid brass.
5. Finish: Chrome plated.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 1/2
2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.6 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

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

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Set floor-mounted sinks in leveling bed of cement grout.

D. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 “General Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

G. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224223

COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. Shower faucets.

B. Related Requirements:

1. Section 224600 "Security Plumbing Fixtures" for security showers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shower faucets to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.
b. Chicago Faucets; Geberit Company.

c. Kohler Co.
d. Lawler Manufacturing Company, Inc.
e. Leonard Valve Company.
f. Moen Incorporated.
g. Powers.
h. Speakman Company.
i. Zurn Industries, LLC.

2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.

3. Faucet:

a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
b. Body Material: Solid brass.
c. Finish: Polished chrome plate.
d. Maximum Flow Rate: 1.5 gpm unless otherwise indicated.
e. Mounting: Concealed.
f. Operation: Single-handle, push-pull or twist or rotate control.
g. Antiscald Device: Integral with mixing valve.
h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

4. Supply Connections: NPS 1/2.
5. Shower Head:

a. Standard: ASME A112.18.1/CSA B125.1.
b. Shower Head Material: Metallic with chrome-plated finish.
c. Spray Pattern: Adjustable
d. Shower-Arm, Flow-Control Fitting: 1.5 gpm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

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

3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.

1. Exception: Use ball valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of showers, inspect and repair damaged finishes.

B. Clean showers, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of showers for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224600

SECURITY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Combination units.
2. Showers.
3. Water management system.

B. Related Requirements:

1. Section 224213.13 "Commercial Water Closets."
2. Section 224213.16 "Commercial Urinals."
3. Section 224216.13 "Commercial Lavatories."
4. Section 224216.16 "Commercial Sinks."
5. Section 224223 "Commercial Showers."
6. Section 224713 "Drinking Fountains" for standard drinking fountains.

1.3 DEFINITIONS

A. Accessible Service Space: Service area in secure space behind wall-mounted fixtures.

B. Back-Access Fixture: Security plumbing fixture designed to mount on wall sleeve built into wall or on wall, so installation and removal of fixture, piping, and other components are accessible only from service space behind wall.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for security plumbing fixtures.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Wiring diagrams, system network diagrams, and screen shots of the graphical user interface for the water management system.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For security plumbing fixtures and components to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Combination Units: Back access, on floor, cabinet, with water closet and lavatory.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company.
b. Metcraft Industries, Inc.
c. Willoughby Industries.

2. Material: 14-gauge--minimum-thick stainless steel; corrosion-resistant metal for internal piping and bracing.

3. Finish: ASTM A 480/A 480M, No. 4 polished finish on exposed surfaces.
4. Cabinet: Five-sided apron with two angled sides, with backsplash.

a. Water-Closet Bowl Location: Centered on front of apron.
b. Toilet-Paper Holder: Recessed; stainless steel located above water closet and centered in front of apron.

5. Accessories:

a. Toothbrush Holders: One on each side of backsplash.
b. Bubbler: On backsplash.
c. Pinned Cleanout: 4” pinned clean out with brass plug.

6. Mounting: Bolts through wall sleeve into accessible service space.
7. Water Closet:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Bowl:

1) Type: Elongated, with back inlet, integral trap, and siphon-jet design with back outlet and contoured seat.
2) Seat Surface: ASTM A 480/A 480M, No. 7 polished finish.
3) Outlet Connection: NPS 4, horizontal with cleanout and slip joint.

8. Lavatory:

a. Standard: ASME A 112.19.3/CSA B45.4.
b. Location: In top of cabinet.
c. Receptor: Oval bowl with integral soap depression.

d. Hot- and Cold-Water and Bubbler Supply Valves: Mechanical-metering type with push-button actuation and individual check stops complying with ASME A112.18.1/CSA B125.1.
e. Filler Spout: Backsplash mounted.
f. Drain: Integral punched grid with NPS 1-1/4 minimum waste and trap complying with ASME A112.18.2/CSA B125.2. Drains through water closet bowl.

9. Wall Sleeve: Galvanized-steel frame of dimensions required to match fixture. Include steel bars or other design to prevent escape if fixture is removed.

10. Cleanout Hook Assembly: Provide clean-out hook assembly at each combination unit installed at the upper tier of the second floor. Cleanout hook assembly shall consist of a line size tee with a 4" brass plug, stainless steel pin, 30 foot long stainless steel cable, and stainless steel hook. Cleanout hook assembly shall be installed in the sanitary waste riser, 12 inches above the combination unit waste discharge connection.

2.2 FLUSHOMETER VALVES

A. Flushometer Valves: Hydraulic activated diaphragm flush valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Delany Products.
b. Sloan Valve Company.
c. Zurn Industries, LLC.

2. Standard: ASSE 1037.

3. Minimum Pressure Rating: 125 psig.
4. Features: Integral check stops and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Concealed.
8. Consumption: 1.28 gal. per flush.
9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

2.3 SHOWERS

A. Showers: Back access, recessed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company.
b. Metcraft Industries, Inc.
c. Willoughby Industries.

2. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Material: 0.078-inch- (2.0-mm-) minimum-thick stainless steel; corrosion-resistant metal for internal piping and bracing.
c. Finish: ASTM A 480/A 480M, No. 4 polished finish on exposed surfaces.
d. Type and Configuration: Wall, with showerhead and soap dish.
e. Tempered-Water Supply Valves: Mechanical-metering type with individual check stops complying with ASME A112.18.1/CSA B125.1.
f. Shower: Vandal-resistant, fixed-type head.
g. Soap Dish: Recessed, stainless steel.

3. Mounting: Bolts through wall sleeve into accessible service space.
4. Wall Sleeve: Galvanized-steel frame of dimensions required to match fixture.

2.4 WATER MANAGEMENT SYSTEM

A. Electronic Water Management System.

1. Manufacturers: Basis of design shall be Willoughby Industries Model WMS II. Subject to compliance with requirements, provide products by the basis of design manufacturer or one of the following:

a. Acorn Engineering Company.
b. Metcraft Industries, Inc.
c. Willoughby Industries.

2. Water management system shall be PC based and run on a Windows 7 or newer operating system. Software shall be installed on work station located in the mechanical room. Water management system shall be integrated with the security electronics system to allow control through the security electronics work stations at the housing unit. Installing contractor shall coordinate software installation and interface with security electronics vendor.
3. Individual cell valve controllers (CVCs) shall be located in the plumbing chase and shall control operation of electronic lavatory valves, electronic-hydraulic flush valves, and electronic shower valves.
4. CVCs shall operate on 24 volts AC and shall retain all memory of setting in the event of power interruption. System manufacturer shall supply 120/24 VAC step down transformers. Each CVC shall be capable of controlling up to two lavatory/toilet combination units (one hot valve, one cold valve and one flush valve for each unit) or combinations of up to six low voltage solenoid valves. CVCs shall be modular, and capable of operating in a fully networked or stand-alone configuration.
5. A diagnostic light shall be provided on each CVC to indicate the presence of control power. A flashing light shall indicate the computer in the CVC is operational. A second flashing light shall indicate network communication activity. Valve output lights on the CVC shall provide status of all outputs to valves. Additional status lights shall indicate the presence and type of any lockout condition in force on valve function.
6. Diagnostic pushbuttons on the CVC shall also be provided to enable maintenance personnel to activate valves and overflow functions from the plumbing chase.
7. Valve activation shall come from vandal resistant stainless steel internally sealed pizeo buttons. Buttons shall require less than 5 pounds of force to activate. Button housing shall be isolated from low voltage wiring.

8. All solenoid valves shall be non-hold open type and all metering times shall be independently adjustable. Metering time for each valve shall be adjustable from 1 to 60 seconds for each lavatory valve, 1 to 10 seconds for each flush valve and 1 second to 9 minutes and 59 second for each shower valve. Metering cycles shall be interruptible with a second push of the button. All the settings can either be set for a single fixture or a mass selection of all fixtures of the same type on the PC screen. Initial metering times shall be set as follows:

    a. Lavatories – 12 seconds.
    b. Flush valves – 2 seconds.
    c. Showers – 5 minutes.

9. Overuse limits can be set to control the use of any given valve function to the number of uses a toilet or actual accumulated time for all other fixture types with a set time period up to 24 hours. Overuse is configurable to trigger a screen notification of the overuse condition, lock out a fixture requiring staff intervention to enable again, or lock out fixture until enough time has passed to bring use under the preset threshold that has been defined.

10. Excessive use of toilets can be limited by setting of a reinitiate delay time period after a given number (adjustable) of actuations in a given amount (adjustable) of time.

11. The PC workstation shall display all fixtures and indicate their operations on a graphical representation of the facility floor plan. Architect shall provide a copy of the floor plan in an AutoCAD format to the water management system supplier.

12. Workstation software shall be capable of managing networks of up to 500 CVC nodes, and up to 3,048 valves. A twisted-pair cable with a minimum of four (4) conductors of CAT3 or better rating shall be used to provide network communication links from the work station to the first CVC, and continue to each subsequent CVC in an individual network trunk line of up to 4,000 feet.

13. In the event of the loss of network communications or a loss of power, system timing parameters shall be retained in each CVC to allow fixtures to operate in the same way that they operated prior to the loss of power or the loss of network communications.

14. Provide a minimum of 8 feet of wiring to connect each supplied valve to the control board.

15. The networked system shall be capable of the following:

    a. Enabling or disabling an individual fixture or an entire group of fixtures from the control station.
    b. Controlling the maximum number of simultaneous flushes (adjustable from 1 to 999) that can occur within a given time period (adjustable from 1 to 60 seconds.)
    c. Automatically flushing a toilet after an adjustable period of non-use has passed to prevent trap from drying out and creating stagnant water.
    d. Allowing remote actuation of fixtures from the control station.
    e. Providing scheduled permitted or lockout time periods per day for selected fixtures.
    f. Providing indication and reset capability of overflow alarms.
    g. Logging all valve activity chronologically including overuse and overflow occurrences.

16. The system shall provide four levels of security: view only, operator, supervisor, and administrator.

    a. View Only Security Level shall allow the following access:

        1) Move between display screens
        2) Observe fixture activity on screens
        3) Log into a higher-user level
        4) Indication of loss of communication to fixture controls

    b. Operator Security Level shall allow the following access:

        1) All of the View Only Level access
        2) Remote valve actuation
        3) Lockout of fixtures
        4) Reset of fixtures
        5) Monitor and reset of alarms for overflow and overuse

    c. Supervisor Security Level shall allow the following access:

        1) All of the Operator Security Level access
        2) Adjust valve timing
        3) Set scheduled lockout/permit times
        4) Set overuse limits and responses
        5) Turn on and set simultaneous flush guard
        6) Access log files to analyze water consumption history (if enabled by administrator)
        7) Enable and disable sound effects
        8) Optional selection of a 24 hour point at which all overuse counters will be reset

    d. Administrator Security Level shall allow the following access:

        1) All of the Supervisor Security Level access
        2) Set Operator, Supervisor, and Administrator passwords
        3) Set and adjust network communication settings
        4) Set controls for remote clients connecting to the system server
        5) Set sound files to be used when feature is enabled
        6) Enable and configure log files of valve and user activity

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Install security plumbing fixtures level and plumb according to roughing-in drawings.

B. Install back-access, stainless-steel fixtures as follows:

1. Install wall sleeve in wall if indicated.
2. Install fixture on wall sleeve or wall, as indicated, with access from accessible service space.
3. Extend supply piping from service space to fixture.
4. Install soil and waste piping from fixture and extend into service space.
5. Install fixture trap in service space instead of below fixture drain.

C. Install fixture outlets with gasket seals.

D. Install fixtures designated "accessible" according to ICC A117.1 for heights, dimensions, and clearances.

E. Seal joints between fixtures, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."

C. Comply with requirements for soil and waste drainage piping specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust water management controls.
3. Test software and hardware interlocks.

C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Operate and adjust flushometer valves and flow-control valves on fixtures.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water management system. Refer to Section 017900 "Demonstration and Training."

3.7 CLEANING AND PROTECTION

A. After installing fixtures, inspect and repair damaged finishes.

B. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

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 224713

DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes drinking fountains and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains: Stainless steel, wall mounted.

1. Stainless-Steel Drinking Fountains:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elkay Manufacturing Co.
2) Halsey Taylor.
3) Haws Corporation.
4) Oasis International; a Lynn Tilton company.

2. Standards:

a. Comply with ASME A112.19.3/CSA B45.4.
b. Comply with NSF 61 Annex G.

3. Type Receptor: With back.
4. Receptor Shape: Rectangular.
5. Back Panel: Stainless-steel wall plate behind drinking fountain.
6. Bubblers: Two, with adjustable stream regulator, located on deck.
7. Control: Push button.
8. Drain: Grid type with NPS 1-1/4 tailpiece.
9. Supply: NPS 3/8 with shutoff valve.
10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
11. Support: ASME A112.6.1M, Type III lavatory carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set pedestal drinking fountains on floor.

C. Install recessed drinking fountains secured to wood blocking in wall construction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General Duty Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 226113

COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Dental compressed-air piping, designated "dental air."

B. Related Requirements:
   1. Section 226119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities" for air compressors and specialties.

1.3 DEFINITIONS

A. Medical compressed-air piping systems include medical air, dental air, instrument air, and medical laboratory air.

B. Nonmedical compressed-air piping systems include laboratory air piping systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Material Certificates: Signed by Installer certifying that medical compressed-air piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.

C. Brazing certificates.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Medical Air Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Dental air operating at 80 to 100 psig.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99 for medical air piping materials.

B. Copper Medical Gas Tube: ASTM B 819, Type K, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.

C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.

D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
   1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, full-face type.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

F. Flexible Pipe Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Hyspan Precision Products, Inc.
   d. Mercer Rubber Co.
   e. Metraflex Company (The).
   f. Universal Metal Hose.
2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   a. Working-Pressure Rating: 200 psig minimum.
   b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

2.4 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

B. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Healthcare Products Inc.
   b. Amico Corporation.
   c. BeaconMedaes.
   d. Conbraco Industries, Inc.
   e. NIBCO INC.
   f. Ohio Medical Corporation.
   g. Tri-Tech Medical.
2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever.
8. Stem: Blowout proof with PTFE or TFE seal.

C. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Healthcare Products Inc.
   b. Amico Corporation.
   c. BeaconMedaes.
   d. Conbraco Industries, Inc.

e. Ohio Medical Corporation.
f. Tri-Tech Medical.

2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

D. Safety Valves:
1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
a. Scrub to ensure complete cleaning.
b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of compressed-air piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

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

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install compressed-air piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

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

O. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 226313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.

P. Piping Restraint Installation: Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

Q. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

R. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.

S. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.

B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

C. Install flexible pipe connectors in discharge piping of each air compressor.

3.4 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

B. Threaded Joints: Apply appropriate tape to external pipe threads.

C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Vertical Piping: MSS Type 8 or Type 42, clamps.

C. Individual, Straight, Horizontal Piping Runs:
1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

E. Base of Vertical Piping: MSS Type 52, spring hangers.

F. Support horizontal piping within 12 inches of each fitting and coupling.

G. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch-minimum rods.

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.

I. Install supports for vertical copper tubing every 10 feet.

3.6 IDENTIFICATION

A. Install identifying labels and devices for nonmedical laboratory compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for medical compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
   1. Dental Air: Black letters on yellow background.

3.7 FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical compressed-air piping in healthcare facilities and to prepare test and inspection reports.

B. Tests and Inspections:
   1. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of dental air piping and dental vacuum piping systems.
   2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
      a. Initial blowdown.
      b. Initial pressure test.
      c. Cross-connection test.
      d. Piping purge test.
      e. Standing pressure test for positive-pressure medical compressed-air piping.
      f. Repair leaks and retest until no leaks exist.
   3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
      a. Standing pressure test.
      b. Individual-pressurization cross-connection test.
      c. Valve test.
      d. Piping purge test.
      e. Piping particulate test.
      f. Piping purity test.
      g. Final tie-in test.
      h. Operational pressure test.
      i. Dental air purity test.
      j. Verify correct labeling of equipment and components.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.9 PIPING SCHEDULE

A. Connect new tubing to existing tubing with memory-metal couplings.

B. Dental Air Piping except Instrument Air Piping SmallerThan NPS 3 and Operating at less Than 185 psig: Type K, copper medical gas tube; wrought-copper fittings; and brazed joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

END OF SECTION

SECTION 226119

COMPRESSED-AIR EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Inlet-air filters.
2. Dental air compressors.
3. Dental air-compressor control panels.

1.3 DEFINITIONS

A. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in acfm.

B. Medical air equipment includes dental air compressors and accessories for healthcare facilities.

C. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air compressors.

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air equipment to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Air Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed-air equipment testing indicated, that is an NRTL and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR AIR COMPRESSORS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 99, "Health Care Facilities," for compressed-air equipment and accessories for medical compressed-air systems.

C. Comply with UL 544, "Medical and Dental Equipment," for medical compressed-air equipment.

D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

E. Mounting Frame: Fabricate base and attachment to air compressor and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.2 INLET-AIR FILTERS

A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.3 DENTAL AIR COMPRESSORS

A. Dental Air Compressors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CustomAir, Ramvac.
    b. Midmark Corp.

2. Description: Factory-assembled, -tested, and -packaged; automatic, dental compressed-air system that will deliver air of quality at least equal to intake air; suitable for dental applications and capable of producing air at 80 psig.

3. Air Compressor(s): Oilless reciprocating type.
4. Compressor Controls: Adjustable, tank-mounted, pressure switches and alternator for duplex air compressors.
5. Check Valves: In discharge piping of each air compressor.
6. Air Filter: Integral with air compressor or separate unit for field installation in compressed-air piping.
7. Dryer: Desiccant type integral with air compressor or separate unit for field installation in compressed-air piping.
8. Receiver: Steel tank rated for at least 100 psig with rubber isolators on feet.

    a. Pressure Regulator: Adjustable.
    b. Safety Valve: ASME relief valve with setting of 100 psig or less.
    c. Drain: Automatic valve.

2.4 DENTAL AIR-COMPRESSOR CONTROL PANELS

A. Dental Air-Compressor Control Panels:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CustomAir.
    b. Midmark Corp.

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.
4. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.
5. Description: Wall-mounted type with visual indicators to indicate equipment in operation and to perform the following:

    a. Shut off dental air equipment.
    b. Shut off water supply to dental air equipment. Include solenoid-operated valve for installation in water piping.

B. Control panels may be combined with dental vacuum pump control panels in single dental equipment control panels.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean compressed-air equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for medical air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 COMPRESSED-AIR EQUIPMENT INSTALLATION

A. General Requirements for Compressed-Air Equipment Installation:

1. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.
2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.
3. 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.
4. Install equipment to allow right of way for piping installed at required slope.
5. Install the following devices on compressed-air equipment:

a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
b. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
c. Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

B. Dental Air System Equipment Installation:

1. Install according to ASSE 6010 and NFPA 99.
2. Install dental air system units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
3. Maintain manufacturer's recommended clearances for service and maintenance.
4. Install control panels for dental compressed-air equipment on wall near equipment.

3.3 CONNECTIONS

A. Comply with requirements for water-supply piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Comply with requirements for compressed-air piping specified in Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Connect compressed-air piping to compressed-air equipment, accessories, and specialties with shutoff valve and union or flanged connection.

3.4 IDENTIFICATION

A. Identify nonmedical laboratory compressed-air equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Identify medical compressed-air equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment." and with NFPA 99.

3.5 FIELD QUALITY CONTROL FOR HEALTHCARE-FACILITY MEDICAL COMPRESSED-AIR EQUIPMENT

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Medical Compressed-Air Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air equipment concurrently with tests, inspections, and certification of medical vacuum equipment, medical vacuum piping, and medical compressed-air piping systems.
2. Preparation: Perform medical compressed-air equipment tests according to requirements in NFPA 99 for the following:

    a. Air-quality purity test.
    b. System operation test.

3. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical compressed-air equipment.
4. Replace damaged and malfunctioning controls and equipment.
5. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures, materials, and gases used.
    c. Test methods used.
    d. Results of tests.

D. Components will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that air-compressor inlet filters and piping are clear.
5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.

7. Drain receiver tank(s).
8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
9. Test and adjust controls and safeties.

B. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors.

END OF SECTION

SECTION 226213

VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Dental vacuum piping, designated "dental vacuum."

B. Related Requirements:
   1. Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities" for vacuum producers and accessories.

1.3 DEFINITIONS

A. HVE: High-volume (oral) evacuation.

B. WAGD: Waste anesthetic gas disposal.

C. Medical vacuum piping systems include medical vacuum, WAGD, dental vacuum, HVE, and medical laboratory vacuum piping systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Material Certificates: Signed by Installer certifying that medical vacuum piping materials comply with requirements in NFPA 99.

C. Brazing certificates.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Medical Vacuum Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Dental vacuum operating at 12 in. Hg.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99 for medical vacuum piping materials.

B. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.

C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.

D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

E. Flexible Pipe Connectors:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flex-Hose Co., Inc.
      b. Flexicraft Industries.
      c. Metraflex Company (The).

d. Universal Metal Hose.

2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   a. Working-Pressure Rating: 200 psig minimum.
   b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

2.4 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
   1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.

B. Copper-Alloy Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Healthcare Products Inc.
      b. Amico Corporation.
      c. BeaconMedaes.
      d. Conbraco Industries, Inc.
      e. NIBCO INC.
      f. Ohio Medical Corporation.
      g. Tri-Tech Medical.
   2. Standard: MSS SP-110.
   3. Description: Three-piece body, brass or bronze.
   4. Pressure Rating: 300 psig minimum.
   5. Ball: Full-port, chrome-plated brass.
   6. Seats: PTFE or TFE.
   7. Handle: Lever.
   8. Stem: Blowout proof with PTFE or TFE seal.
   9. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

C. Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Healthcare Products Inc.
      b. Amico Corporation.
      c. BeaconMedaes.
      d. Conbraco Industries, Inc.
      e. Ohio Medical Corporation.
      f. Tri-Tech Medical.
   2. Description: In-line pattern, bronze.
   3. Pressure Rating: 300 psig minimum.
   4. Operation: Spring loaded.
   5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
   1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
   2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
      a. Scrub to ensure complete cleaning.
      b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of vacuum piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

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

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install vacuum piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.

O. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.

P. Piping Restraint Installation: Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

Q. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

R. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.

S. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.

T. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from vacuum equipment and specialties.

B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

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

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:
   1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
   2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch-minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1/4: 60 inches with 3/8-inch rod.
   2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
   3. NPS 3/4: 84 inches with 3/8-inch rod.
   4. NPS 1: 96 inches with 3/8-inch rod.
   5. NPS 1-1/4: 108 inches with 3/8-inch rod.
   6. NPS 1-1/2: 10 feet with 3/8-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

3.6 IDENTIFICATION

A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
   1. Dental Vacuum: Black boxed letters on white-and-black diagonal stripe background.

3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical vacuum piping systems in healthcare facilities and to prepare test and inspection reports.

B. Tests and Inspections:
   1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping systems.
   2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
      a. Initial blowdown.
      b. Initial pressure test.
      c. Cross-connection test.
      d. Piping purge test.
      e. Standing pressure test for vacuum systems.
      f. Repair leaks and retest until no leaks exist.
   3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
      a. Standing pressure test.
      b. Individual-pressurization cross-connection test.
      c. Valve test.
      d. Master and area alarm tests.
      e. Piping purge test.
      f. Final tie-in test.
      g. Operational vacuum test.
      h. Verify correct labeling of equipment and components.
   4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
      a. Inspections performed.
      b. Procedures, materials, and gases used.
      c. Test methods used.
      d. Results of tests.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.9 PIPING SCHEDULE

A. Flanges may be used where connection to flanged equipment is required.

B. Dental Vacuum Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves:
   1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

END OF SECTION

SECTION 226219

VACUUM EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Dental vacuum pumps.
   2. Dental vacuum pump control panels.

1.3 DEFINITIONS

A. Actual Air: Air delivered at vacuum producer inlet. Flow rate is air measured in acfm.

B. HVE: High-volume oral evacuation for dental applications in healthcare facilities.

C. Medical Vacuum Equipment: Includes dental vacuum producers and accessories for healthcare facilities.

D. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For vacuum producers.
   1. Include plans, elevations, sections, anddetails.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Seismic Qualification Certificates: For vacuum producers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum equipment to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Medical Vacuum Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum equipment testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vacuum equipment mounting.

2.2 GENERAL REQUIREMENTS FOR VACUUM PUMPS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.

C. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.

D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty vacuum pumps and receivers.

E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
2. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Instrumentation: Include vacuum pump inlet and receiver vacuum gages, hour meter, vacuum pump discharge-air and coolant temperature gages, and control transformer.
7. Alarm Signal Devices: For connection to alarm system to indicate when backup vacuum pump is operating.

F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols.
1. Interior Finish: Corrosion-resistant coating.
2. Accessories: Include vacuum relief valve, vacuum gage, and drain.

G. Mounting Frames: Fabricate base and attachment to vacuum pump and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.3 DENTAL VACUUM PUMPS

A. Dental Vacuum Pumps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CustomAir.
b. Midmark Corp.
2. Description: Factory-assembled, -tested, and -packaged; duplex; automatic, dental vacuum system; suitable for dental applications and capable of producing not less than 12 in. Hg.
3. Duplex Vacuum Pumps: For mounting on base or on floor.
a. Vacuum Pumps: Brass water-injection or liquid-ring type with rubber isolators on feet. Include fitting and tubing for circulation of approximately 80 percent of water through vacuum pump.
b. Check Valves: For installation in each vacuum pump suction.
c. Vacuum Relief Valves: For installation in each vacuum pump suction.
d. Waste Mufflers: For installation in each vacuum pump waste piping.

2.4 DENTAL VACUUM PUMP CONTROL PANELS

A. Dental Vacuum Pump Control Panels:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CustomAir.
   b. Midmark Corp.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.
4. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.
5. Description: Wall-mounted type with visual indicators to indicate equipment in operation and to perform the following:
   a. Shut off dental vacuum equipment.
   b. Shut off water supply to dental vacuum equipment. Include solenoid-operated valve for installation in water piping.

B. Control panels may be combined with dental air compressor control panels in single dental equipment control panels.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for medical vacuum applications, according to CGA G4.1, "Cleaning Equipment for Oxygen Service."

3.2 VACUUM EQUIPMENT INSTALLATION

A. Install vacuum equipment for healthcare facilities according to ASSE 6010 and NFPA 99.

B. Equipment Mounting:
1. Install vacuum producers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"

C. Install vacuum equipment anchored to substrate.

D. Orient equipment so controls and devices are accessible for servicing.

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Install the following devices on vacuum equipment:
   1. Thermometer, Vacuum Gage, and Pressure Relief Valve: Install on each vacuum pump receiver.
   2. Drain Valves: Install on receivers. Discharge receiver condensate over nearest floor drain. Discharge separator oral evacuation fluids by direct connection into sanitary waste piping system.

G. Dental Vacuum System Equipment Installation:
   1. Install according to ASSE 6010 and NFPA 99.
   2. Install dental vacuum system units on concrete bases with restrained elastomeric mounts with a minimum deflection of 1/2 inch. Vibration isolation devices and installation requirements are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
   3. Maintain manufacturer's recommended clearances for service and maintenance.
   4. Install control panels for dental vacuum equipment on wall near equipment.

3.3 CONNECTIONS

A. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for vacuum piping specified in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Where installing piping adjacent to equipment, allow space for service and maintenance.

D. Connect vacuum piping to vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.

3.4 IDENTIFICATION

A. Identify medical vacuum equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment." and with NFPA 99.

3.5 FIELD QUALITY CONTROL FOR HEALTHCARE-FACILITY MEDICAL VACUUM EQUIPMENT

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Medical Vacuum Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum equipment concurrently with tests, inspections, and certification of medical compressed-air equipment, medical compressed-air piping, and medical vacuum piping systems.
2. Preparation: Perform medical vacuum equipment tests according to requirements in NFPA 99 for the following:
   a. System operation test.
3. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical vacuum equipment.
4. Replace damaged and malfunctioning controls and equipment.
5. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
   a. Inspections performed.
   b. Procedures and materials used.
   c. Test methods used.
   d. Results of tests.

D. Components will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that vacuum producer outlet piping is clear.
5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings.
7. Drain receiver and separator tank(s).
8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
9. Test and adjust controls and safeties.

B. Verify that vacuum equipment is installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in electrical Sections.

D. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain vacuum producers.

END OF SECTION

DIVISION 23
HEATING, VENTILATING, AND AIR-CONDITIONING

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Electronically commutated.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 230516

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Flexible-hose packless expansion joints.
2. Alignment guides and anchors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex Pression Ltd.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Mason Industries, Inc.
e. Metraflex Company (The).
f. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.

3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advanced Thermal Systems, Inc.
   b. Flex-Hose Co., Inc.
   c. Flexicraft Industries.
   d. Flex-Weld, Inc.
   e. Hyspan Precision Products, Inc.
   f. Mason Industries, Inc.
   g. Metraflex Company (The).
   h. U.S. Bellows, Inc.
   i. Unisource Manufacturing, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

   a. Stud: Threaded, stainless steel.
   b. Expansion Plug: Stainless steel.
   c. Washer and Nut: Stainless steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

SECTION 230517

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Industries, LLC.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

2. Interior Partitions:

    a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 230518

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 230519

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

B. Related Sections:

1. Section 231123 "Facility Natural-Gas Piping" for gas meters.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flo Fab inc.
    b. Miljoco Corporation.
    c. Palmer Wahl Instrumentation Group.
    d. Tel-Tru Manufacturing Company.
    e. Trerice, H. O. Co.
    f. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMETEK, Inc.
   b. Ashcroft Inc.
   c. Flo Fab inc.
   d. Marsh Bellofram.
   e. Miljoco Corporation.
   f. Palmer Wahl Instrumentation Group.
   g. Tel-Tru Manufacturing Company.
   h. Trerice, H. O. Co.
   i. Watts; a Watts Water Technologies company.
   j. Weiss Instruments, Inc.

2. Standard: ASME B40.100.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.

5. Trerice, H. O. Co.
6. Watts; a Watts Water Technologies company.
7. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids (except steam).

I. Install test plugs in piping tees.

J. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Inlet and outlet of each hydronic coil in air-handling units.
4. Two inlets and two outlets of each hydronic heat exchanger.

K. Install pressure gages in the following locations:

1. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:

1. Test plug with EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:

1. Industrial-style, liquid-in-glass type.

C. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:

1. Test plug with EPDM self-sealing rubber inserts.

D. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:

1. Industrial-style, liquid-in-glass type.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

3.5 PRESSURE-GAGE SCHEDULE

A. Pressure gages at suction and discharge of each pump shall be the following:

1. Liquid-filled, direct-mounted, metal case.

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

END OF SECTION

SECTION 230523

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron ball valves.
3. Iron, single-flange butterfly valves.
4. Iron, grooved-end butterfly valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron, grooved-end swing-check valves.
8. Bronze globe valves.
9. Iron globe valves.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.

b. Kitz Corporation.
c. Sure Flow Equipment Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig.
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. DeZurik Water Controls.
e. Flo Fab Inc.
f. Hammond Valve.
g. Kitz Corporation.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Kennedy Valve; a division of McWane, Inc.
   b. Shurjoint Piping Products.
   c. Victaulic Company.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 175 psig.
   c. Body Material: Coated, ductile iron.
   d. Stem: Two-piece stainless steel.
   e. Disc: Coated, ductile iron.
   f. Seal: EPDM.

2.6 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Red-White Valve Corporation.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Composition.
h. Seat Ring: Bronze.
i. Disc Holder: Bronze.
j. Disc: PTFE or TFE.
k. Gasket: Asbestos free.

2.8 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Shurjoint Piping Products.
c. Victaulic Company.

2. Description:

a. CWP Rating: 300 psig.
b. Body Material: ASTM A 536, ductile iron.
c. Seal: EPDM.
d. Disc: Spring operated, ductile iron or stainless steel.

2.9 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.10 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Powell Valves.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Globe valves.
4. Pump-Discharge Check Valves:

    a. NPS 2-1/2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 3 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
4. For Steel Piping, NPS 5 and Larger: Flanged ends.
5. For Grooved-End Steel Piping: Valve ends may be grooved.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Globe Valves: Class 150, non-metallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 125.
3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
4. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
5. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
6. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
7. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from the California Bureau of State and Community Corrections.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. B-line, an Eaton business.
   b. Thomas & Betts Corporation, A Member of the ABB Group.
   c. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.

3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. National Pipe Hanger Corporation.
4. PHS Industries, Inc.
5. Pipe Shields Inc.
6. Piping Technology & Products, Inc.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. 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.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger 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.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

3. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: 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.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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.
2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
9. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
10. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system 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. C-Clamps (MSS Type 23): For structural shapes.
6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system 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 in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Housed-restrained-spring isolators.
3. Pipe-riser resilient supports.
4. Resilient pipe guides.
5. Elastomeric hangers.
6. Snubbers.
7. Restraint channel bracings.
8. Seismic-restraint accessories.
9. Mechanical anchor bolts.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III (Housing units), and II (Administration.)

a. Component Importance Factor: 1.5.
b. Component Response Modification Factor: As required per Table 13.6.1 of ASCE 7-10.
c. Component Amplification Factor: As required per Table 13.6.1 of ASCE 7-10.
d. Design Spectral Response Acceleration at Short Periods (0.2 Second): 1.5.

3. Design Spectral Response Acceleration at 1.0-Second Period: 0.60.
4. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.

3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.

2.3 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.

b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.4 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.5 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.6 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.7 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.8 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.9 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.10 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install stainless steel anchors for interior and exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system 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

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Valve numbering scheme.

C. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Champion America.
d. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

3. Letter Color: White.
4. Background Color: Red.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Champion America.
4. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Champion America.
4. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Blue.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Champion America.
4. Seton Identification Products.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain, or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Heating Water Piping: Black letters on a safety-orange background.
2. Refrigerant Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

A. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Refrigerant: 1-1/2 inches, round.
b. Hot Water: 1-1/2 inches, round.
c. Gas: 1-1/2 inches, round.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 018100 "General Commissioning Requirements" for general commissioning process requirements.
2. Section 230800 “Commissioning of HVAC.”

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

a. Variable-flow hydronic systems.
b. Primary-secondary hydronic systems.

3. Balancing steam systems.
4. Testing, Adjusting, and Balancing Equipment:

a. Heat exchangers.
b. Motors.
c. Condensing units.
d. Boilers.
e. Heat-transfer coils.

5. Testing, adjusting, and balancing existing systems and equipment.
6. Control system verification.

1.3 DEFINITIONS

A. BAS: Building automation systems.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

E. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.

C. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by NEBB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. 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.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.3 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.4 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.5 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.

f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
   b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
   c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
   d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
   e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
   b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.7 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

    a. Measure total water flow.

        1) Position valves for full flow through coils.
        2) Measure flow by main flow meter, if installed.
        3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

    b. Measure pump TDH as follows:

        1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        3) Convert pressure to head and correct for differences in gage heights.
        4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
        5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

    c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

    a. Measure flow in main and branch pipes.
    b. Adjust main and branch balance valves for design flow.
    c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

    a. Measure flow at terminals.
    b. Adjust each terminal to design flow.
    c. Re-measure each terminal after it is adjusted.
    d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

    a. Measure differential pressure, and verify that it is within manufacturer's specified range.
    b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

13. Verify that memory stops have been set.

3.8 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.9 PROCEDURES FOR HEAT EXCHANGERS

A. Adjust water flow to within specified tolerances.

B. Measure inlet and outlet water temperatures.

C. Measure inlet steam pressure.

D. Check settings and operation of safety and relief valves. Record settings.

3.10 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.

3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.11 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.12 PROCEDURES FOR BOILERS

A. Hydronic Boilers:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Record relief valve pressure setting.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.14 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.15 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.16 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.17 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.18 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.

6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, 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. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.

i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.

c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.

g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.

o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.19 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 230713

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.

B. Related Sections:

1. Section 230719 "HVAC Piping Insulation."
2. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Knauf Insulation.

c. Manson Insulation Inc.
d. Owens Corning.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Keep insulation materials dry during application and finishing.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with least number of joints practical.

H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

J. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping"irestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.7 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

END OF SECTION

SECTION 230719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Heating hot-water piping, indoors.
3. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:

1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to

authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex USA.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.

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

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. Foster Brand; H. B. Fuller Construction Products.
d. K-Flex USA.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.4 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

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

    a. Childers Brand; H. B. Fuller Construction Products.
    b. ITW Insulation Systems; Illinois Tool Works, Inc.
    c. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating

cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 3/4 inch thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 1 and Smaller: Insulation shall be the following:

    a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

    a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

C. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

    a. Flexible Elastomeric: 1 inch thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Flexible Elastomeric: 2 inches thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. Aluminum, Stucco Embossed: 0.020 inch thick.

END OF SECTION

SECTION 230800

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Section 017823 “Operations and Maintenance Data.”
2. Section 017900 “Demonstration and Training.”
3. Section 018100 "General Commissioning Requirements" for general commissioning process requirements.
4. Section 220800 “Commissioning of Plumbing Systems.”

1.3 DEFINITIONS

A. Commissioning: The systematic process of ensuring that the building’s systems are operating in accordance with the Contract Documents that the systems perform interactively in accordance with the Contract Documents, and that facility personnel are prepared to operate and maintain the building and its systems. This includes, but may not be limited to, pre-functional testing of equipment, functional testing of systems, system interoperability testing, training of facility personnel, delivering Operation and Maintenance (O&M) documentation, and the turnover of completed systems.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

F. Contractor: As used in this section, Contractor refers to the General Contractor, subcontractors of all tiers, or vendors, based on usage.

G. Pre-functional Tests: PFTs are primarily static inspections and procedures to prepare the equipment or system for initial startup and operation (e.g. oil levels satisfactory, fan belt tension appropriate, labels affixed, gages installed, sensor calibrated, etc.) However, some PFT check list items require simple testing of the function of a component, piece of equipment, or system. PFT check-lists are intended to augment, and be combined with, the manufacturer's start-up check-lists, and procedures.

H. Functional Performance Tests: FPT is the dynamic testing of complete systems under full operation. The FPTs will be developed directly from the approved Sequence of Operations for each system, and are intended to dynamically test component and system operations, as well as demonstrate full compliance with the specifications, contract documents, and the design intent. Systems, subsystems, assemblies, components, and equipment" where these terms are used together or separately, they shall mean "installed" systems, subsystems, and equipment.

I. Systems Manual: The Systems Manual is the final deliverable from the Commissioning process, and provides the information needed to understand, operate, and maintain the facility and its systems. It should be the repository of all updates and corrections as they occur, including those through occupancy. The Systems Manual expands the scope of the standard Operation and Maintenance documentation to include additional information developed through commissioning, and is prepared by the CxA.

J. TAB: Testing, adjusting and balancing.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

G. Commission the mechanical systems listed in the Commissioning Plan.

H. Provide submittals as required by the Architect and Engineer, and those listed on the pre-functional test sheets.

I. Provide start-up for all HVAC equipment. Clearly document all completed start-up and system operation check-out procedures, providing a copy to the CxA.

J. Provide all test equipment necessary to fulfill specified requirements.

K. Assist and cooperate with the TAB contractor and CxA by:

1. Placing all HVAC equipment and systems into operation during each working day of TAB and commissioning, as required.
2. Providing all sheaves and belts that may be required by TAB.
3. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug for all test holes.
4. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

L. Install P/T plug at each water sensor which is an input point to the control system.

M. Prepare a preliminary schedule for Division 23; duct system testing, flushing and cleaning, equipment start-up, and TAB start and completion for use by the CxA. Update the schedule as appropriate.

N. Notify the CxA when pipe and duct system testing, flushing, cleaning, start-up of each piece of equipment, and TAB will occur. Contractor is responsible for notifying CxA in advance, when commissioning activities not yet performed, or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

O. Refer to Section 01 91 13 fore specific details on non-conformance issues relating to pre-functional testing check-lists and tests, and for issues relating to functional performance tests.

P. The training shall consist of a review of the O & M Manuals, and hands-on training. Training shall be conducted by the Contractor, or equipment manufacturer’s experts, as indicated in the equipment specifications. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down, emergency procedures, and preventative maintenance for all pieces of equipment. The Contractor shall fully explain and demonstrate the operation, function, and overrides of any local controls, not controlled by the central control system. Training shall occur after functional testing is complete.

1.6 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

E. Organize and lead the Commissioning Team.

F. Develop the Commissioning Schedule.

G. Script project specific Commissioning Specifications.

H. Review the Design and Construction Documents.

I. Prepare a construction-phase Commissioning Plan.

J. Identify Commissioning Team member roles and responsibilities.

K. Review the owner's project requirements, and the basis of design for completeness and consistency.

L. Coordinate and convene Commissioning Team meetings.

M. Verify TAB activities for accuracy and alignment with Contract Documents.

N. Prepare and distribute minutes to the Commissioning Team Members and attendees.

O. Conduct an initial construction-phase Commissioning Meeting for the purpose of reviewing the Commissioning Activities, establishing preliminary schedules for Operation and Maintenance submittals, Owner Training sessions, TAB work, and Project Completion.

P. Observe and inspect construction, and report progress and deficiencies.

Q. Review and assist sub-contractors with development of equipment specific pre-functional tests.

R. Develop and script project-specific functional performance tests in collaboration with the sub-contractors, and in accordance with the approved Sequence of Operations.

S. Schedule, direct, witness, and document functional performance testing.

T. Document and track the status of all testing deficiencies in a FPT Observations and Exceptions Log.

U. Compile test data, inspection reports, and certificates for inclusion in the Systems Manual and the Commissioning Report.

V. Review project records for accuracy.

W. Review and comment on the Operations and Maintenance documentation, and Systems Manual outlines for compliance with the owner's project requirements, basis of design, and contract documents.

X. Prepare and distribute the final Commissioning Report.

1.7 CONTROLS CONTRACTOR RESPONSIBILITY

A. Sequences of Operation Submittals: The contractor's submittal of control drawings shall include complete, detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences on the drawings. They shall include:
   1. An overview narrative of system (one or two paragraphs) generally describing its purpose, components, and function.
   2. All interactions and interlocks with other systems.
   3. Detailed delineation of control between packaged controls and the building automation system (BAS), listing what points the BAS monitors only, and what BAS points are control points, and are adjustable.
   4. Written sequences of operation for packaged controlled equipment. (Equipment manufacturer's stock sequences may be included, but will generally require additional narrative.)
   5. Start-up sequences.
   6. Warm-up mode sequences.
   7. Normal operating mode sequences.
   8. Unoccupied mode sequences.
   9. Shut-down sequences.
   10. Capacity control sequences and equipment staging.
   11. Temperature and pressure control: setbacks, set ups, resets, etc.
   12. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
   13. Effects of power or equipment failure with all standby component functions.
   14. Sequences of alarms and emergency shut downs.
   15. Seasonal operational differences and recommendations.
   16. Initial and recommended values for all adjustable settings, setpoints, and parameters that are typically set, or adjusted by operating staff; any other control settings, or fixed values, delays, etc. that will be useful during testing and operating the equipment.
   17. Schedules.
   18. To facility referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference.

B. Control Drawings Submittal:

   1. The controls drawings shall have a key to all abbreviations.
   2. The control drawings shall contain graphic schematic depictions of the systems and each component.
   3. The schematics shall include the system and component layout of any equipment that the control system monitors, enables, or controls, even if the equipment is primarily controlled by packaged or integral controls.
   4. Provide a full points list with at least the following points:

      a. Controlled system
      b. Point abbreviation
      c. Point description (DB temp, airflow, etc.)
      d. Display unit
      e. Control point or setpoint (yes/no)
      f. Monitoring point (yes/no)
      g. Intermediate point (yes/no)
      h. Calculated point (yes/no)

i. Control or setpoint: Point that controls equipment or can have its setpoint changed (OSA, SAT, etc.)
j. Intermediate point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset.)
k. Monitoring point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
l. Calculated point: "Virtual" point generated from calculations of other point values.
m. The Contractor shall keep CxA informed of all changes to this list during programming and setup.

C. An updated as-built version of the control drawings and sequences of operations shall be included in the final controls O&M manual submittal.

D. Assist and cooperate with the TAB contractor in the following manner:

1. Meet the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB contractor with any unique instruments needed and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.)
2. For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed prior to TAB.
3. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

E. Assist and cooperate with the CxA in the following manner:

1. Using a skilled technician who is familiar with the installed system, execute the functional testing of the controls system. Assist in the functional testing of all equipment. Provide two-way radios during the testing.

F. Execute all control system trend logs.

G. The contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout, and adjust the control system prior to functional performance testing. At a minimum the plan shall include for each type of equipment controlled by automatic controls:

1. System name.
2. List of all devices.
3. Step-by-step procedures for testing each controller after installation.
4. Procedure for verifying proper hardware and wiring installation.
5. Process for downloading programs to local controllers, and verifying that they are addressed correctly.
6. Process of performing operational checks of each controlled component.
7. Plan and process for calibrating valve and damper actuators, and all sensors.
8. A description of the expected field adjustments for transmitters, controllers, and control actuators, should control responses fall outside of expected values.

H. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point, and clearly indicate when a sensor or controller has “passed” and is operating within correct parameters.

I. A description of the instrumentation required for testing.

J. Indicate what tests on what system should be completed prior to TAB using the control system for TAB work. Coordinate with the CxA and TAB contractor for this determination.

K. Provide a signed and dated certification to the Contractor upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.

L. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control, and virtual points.

M. List and clearly identify on the as-built duct and piping drawings the locations of all monitoring and control sensors.

N. Provide all test equipment necessary to fulfill specified testing requirements.

1.8 TEST AND BALANCE (TAB)

A. Submit the outline of the TAB plan an approach for each system and component to the CxA six weeks prior to starting TAB.

B. The submitted plan shall include:

1. Certification that the TAB contractor has reviewed the construction documents to sufficiently understand the design intent of each system.
2. An explanation of the intended us of the building control system. The Contractor shall comment on the feasibility of the plan.
3. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted, and balanced with the data cells to be gathered for each.
4. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
5. Final test report forms to be used.
6. Detailed step-by-step procedures for the TAB work for each system and issue; terminal flow calibration for each terminal type, diffuser proportioning, branch / sub-main proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc.
7. List of all flow, system capacity, and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
8. Details of how total flow will be determined.
9. The identification and types of measurement instruments to be used, and their most recent calibration date.
10. Specific procedures that will ensure that both air and water side are operating at their lowest possible pressures and provide methods to verify this.
11. Confirmation that TAB Contractor understands the outside air ventilation criteria under all operating conditions.

12. Details of where and how minimum outside air cfm will be verified and set and for what level (total building, zone, etc.)
13. Details of how building static and exhaust fan / relief damper capacity will be checked.
14. Details of methods for making any specified coil or other system capacity measurements.
15. Details of any TAB work to be done in phases.
16. Details regarding specified deferred or seasonal TAB work.
17. Details of any specified false loading of systems to complete TAB work.
18. Details of all exhaust fan balancing and capacity verification, including any required room pressure differentials.
19. Plan for hand-written field technician logs of discrepancies, deficient, or uncompleted work by others, contract interpretation requests, and lists of completed tests (scope and frequency.)
20. Plan for formal progress reports (scope and frequency.)
21. Plan for formal deficiency reports (scope, frequency, and distribution.)

C. The Contractor shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests at least twice a week.

D. Communicate in writing to the controls operator all setpoint and parameter changes made, or problems and discrepancies identified during TAB which affect the controls system setup and operation.

E. CxA or IOR to witness the TAB to verify that the systems are being balanced per specifications.

F. Provide a draft copy of the TAB report to the CxA within two weeks of completion. The report shall contain a full explanation of the methodology, assumptions, and the results in a clear format with designations of all uncommon abbreviations and column headings. The report shall follow the latest reporting recommendations by TABB.

G. Provide the CxA with any updates as a result of the Engineer’s review.

H. Provide all test equipment necessary to fulfill the specified testing requirements.

1.9 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.

7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. Hydronic Pumps Testing and Acceptance Procedures: Testing requirements are specified in hydronic pumps Section. Provide submittals, test data, inspector record, and pump certification to the CxA.

C. Air Handling Unit Testing and Acceptance Procedures: Testing requirements are specified in packaged, outdoor, central-station air-handling unit Section. Provide submittals, test data, inspector record, and air handling unit certification to the CxA.

D. Exhaust Testing and Acceptance Procedures: Testing requirements in HVAC power ventilator Section. Provide submittals, test data, inspector record, and fan certification to the CxA.

E. Split System Air Conditioning Unit Testing and Acceptance Procedures: Testing requirements are specified in split system air conditioners Section. Provide submittals, test data, inspector record, and split system air conditioner certification to the CxA.

F. Computer Room Air Conditioning Unit Testing and Acceptance Procedures: Testing requirements are specified in computer room air conditioners, ceiling mounted unit Section. Provide submittals, test data, inspector record, and air conditioner certification to the CxA.

G. Air Terminal Unit Testing and Acceptance Procedures: Testing requirements in air terminal units Section. Provide submittals, test data, inspector record, and terminal unit certification to the CxA.

H. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control for HVAC." Assist the CxA with preparation of testing plans.

I. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

J. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

K. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

END OF SECTION

SECTION 230900

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 018100 "General Commissioning Requirements" for general commissioning process requirements.
2. Section 230800 “Commissioning of HVAC.”

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. BAS Design Criteria: Expansion of the existing County of Monterey Honeywell Building Automation System (BAS) the includes the following:

1. HVAC Control System
2. Energy Management System
3. Integration of the BACnet Data from the air handling units, boiler system, computer room air conditioning units, and split systems.
4. UL Listed Smoke Control for the AHU, smoke control exhaust fans, and devices.

1.3 DEFINITIONS

A. BACnet: A control network technology platform for designing and implementing interoperable control devices and networks.

B. DDC: Direct digital control.

C. I/O: Input/output.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, transformers, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

1.5 INFORMATIONAL SUBMITTALS

A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135 (BACnet.)

B. Qualification Data: For Installer.

C. Enterprise Buildings Integrator Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions for monitoring and control revisions. The server and workstation software shall be upgraded just before the completion of this project.

D. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

E. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. All AHU DDC Controllers and Exhaust Fan Controllers along with smoke control digital inputs from the fire alarm system used for smoke control shall be UUKL Listed.

D. Comply with ASHRAE 135 (BACnet) for DDC system components.

1.8 DELIVERY, STORAGE, AND HANDLING

A. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

A. Coordinate location of thermostats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of electrical branch circuits for control units and operator workstation.

C. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.

D. Coordinate equipment with Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

A. This project is an expansion of the existing Honeywell R430 Enterprise Buildings Integrator (EBI) County of Monterey System. The products and services of this specification shall provide the integration of the:

1. BACnet Data from the Section 238123.13 “Computer-room Air-Conditioners, Ceiling-mounted Units”, Section 238126 “Split-system Air-conditioners”, Section 237413 “Packaged, Outdoor, Central-station Air-handling Units,” and Section 235233 “Water-tube Boilers” into the Honeywell EBI Frontend Server for the Operation of the facility including trending, events, alarms, status and commanding per the points list.
2. EBI Graphics of each building and the mechanical equipment.
3. EBI Startup graphic of the Jail complex with temperatures in a tabular format.
4. EBI Trending of the analog and digital points.
5. PC-6A Control system for the VAV boxes, Boiler Plant, Exhaust Fans, etc.
6. CPO-IPC Control system for smoke control.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manufacturers:

a. Use Honeywell Building Solutions control system hardware and software that meet the requirements of this specification and Building standards.
b. Approved Product provided by: Honeywell Building Solutions, Inc. Foster City, CA.
c. Contact: Mac.Parfet@honeywell.com cell phone 510-715-7311

d. Equipment shall be furnished, installed, and tested by Honeywell Building Solutions, Inc. to be fully compatible with the existing EBI R430 System serving the County of Monterey. The new and existing products shall maintain the operation within the EBI and operate an integrated system in its entirety.
e. All new and existing points on the EBI System shall be displayable on the same graphics.
f. All existing EBI workstations on the County LAN shall have access to the jail data, graphics, and reports stored in the Enterprise Buildings Integrator R430 Database.
g. Bids by Wholesalers, Contractors, Franchised Dealers or any firm whose principal business is not that of manufacturing and installing automatic temperature control, fire alarm, security, and access control systems shall not be acceptable.
h. The system shall be furnished by competent mechanics, regularly employed by the BMCS manufacturer with full responsibility for proper operation of the BMCS including debugging and proper calibration of each component in the entire system. Supplier shall have an in-place support facility within 75 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
i. The final checkout and verification of proper operation shall further be conducted by a technician who is an employee of the company named on the UL Listing card for the existing BMS server and software, existing DDC Controllers, existing fire control panel equipment and smoke control equipment. This insures the panel and field devices have been installed in accordance with the manufacturer's installation instructions, which are included in the UL Listing process. Quality assurance and Agency Listing compliance, for both manufacture and installation, is thus the responsibility of this single company.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

E. Control system shall be BACnet based, and shall be connected to Monterey County's existing Honeywell EBI energy management system located at the Corporation Yard on Laurel Drive. Connection will be via the County's Ethernet system.

2.2 SYSTEM ARCHITECTURE

A. The Existing DDC system shall include system servers, operator work stations, a data server, and field level devices installed in an architecture that consists of two layers, the TCP/IP layer and the field bus layer. The existing DDC System utilizes the County of Monterey LAN.

B. The TCP/IP layer connects all of the buildings to the LAN and then interconnects all the buildings on a WAN or wide area network. Fixed IP addresses for connections to the LAN or local area network shall be used for each device (except workstations) that connects to the LAN or local area network.

C. Provide a new UUKL EBI Supervisory work station in the central control room. This will provide workstation functionality and connectivity to the existing Honeywell EBI sever. This supervisory workstation will connect via Ethernet to the County LAN.

2.3 NETWORKING

A. All required software for fully functional systems shall be installed and configured with connectivity to the existing Honeywell Enterprise Buildings Integrator R430 Server on the County of Monterey LAN. The owner shall provide the IP connections and identify the specific rooms in each building where the new BACnet Plant controller.

B. IP Network: All new devices that connect to the LAN shall be capable of operating at 100 megabits per second or 1000 megabits per second. A legacy device connection speed of 10 megabits shall be accommodated on a case-by-case basis.

2.4 Graphics – Enterprise buildings integrator frontend R430 Modifications

A. Provide floor plan graphics with the background from AutoCAD with the controlled equipment locations (air handling units, VAV terminal units, pumps, boilers, fans, etc.) and thermostats shown.

1. Provide a separate EBI floor plan graphic with the color to match the building standard in the EBI based on the space temperature of the temperature sensor.
2. Provide a separate heads up display in tabular format with the key points, name, status, temperature.
3. Provide trending of all temperatures and fan status, start/stop, setpoints.
4. Update the County Global Schedules on the EBI R430 Scheduling system for the start/stop scheduling of all buildings and systems.
5. Add to the EBI existing EBI system graphics
   a. Add to the County Buildings main penetration to the Jail Addition.
   b. Add a summary tabular HVAC graphic showing all AHUs, exhaust fans with status and start/stop, discharge temperature, discharge static pressure, temperature set point, static pressure set point, damper position, occupancy mode. The tabular graphic shall be setup by Zone. Include the boiler system and pump status.
   c. Add a detailed AHU graphic with a sectional view of the AHU and all points associated. A parameter page shall be located behind the detailed view. Provide a link to the actual AHU O&M pdf provided by others.
   d. Add a sectional view of the Jail with Fan status and CFM totals. Provide links to each floor plan.
   e. Add a floor plan graphic with all VAV boxes, FSD Damper status, room temperatures, and duct discharge temperature. Allow for a summary control of all VAVs to off, min, auto, maximum CFM setpoint. Totalize the CFM from the VAVs for each floor plan and include the smoke control status. Clicking on each VAV box will connect to an individual VAV box Graphic.
   f. Add an individual VAV box graphic with all parameters, set points, and input/output points.
   g. Add a smoke control summary graphic with each zone, all associated smoke control fans and status and input points from the fire alarm system.
   h. Add a boiler plant graphic showing all the reheat and AHU control valves positions along with the differential pressure sensor, and differential pressure set points.

i. Behind each AHU, boiler plant, and VAV graphic shall be a sequence of operation graphic with the data for each set point and value from the controller.

B. Trends:

1. Real Time Trends:

a. Trends shall be setup for each AHU, Boiler Plan, VAV terminal unit on a building by building basis.
b. Provide History storage on each point with standard and extended history.

C. The Honeywell PC-6A Network Controller (NC) and Honeywell CPO-IPC (UUKL) shall be a Native BACnet controller based on 32 bit technology to provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NC. The NC shall conform to BACnet Building Controller (B-BC) profile and be provided with appropriate PIC statement defining BACnet services and objects supported. BACnet Data Sharing BIBBs supported shall include at a minimum: RP, RPM, WP, WPM, COV. Alarm and Event, Trending, and scheduling including SCHED-A BIBBs support shall also be supported in BACnet native communications. The NC shall support Master Communication control on the BACnet communication bus. The NC shall physically connect to the LAN without the need for additional Router hardware. The NC shall support transmitting and receiving segmented messages as well as BACnet Broadcast Messages over IP. It should be possible to define any NC in an IP subnet as a BBMD device. The NC shall also support both Secure (https://) and non-secure (http://) remote web server access using commonly used web browsers. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending and Trending Backfill
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of BACnet devices and BACnet controller data
7. Integration of MODBUS devices and serial MODBUS RTU controller data
8. The Network Controller must provide the following hardware features as a minimum:
9. One Ethernet Port -10 / 100 Mbps RJ45
10. One RS-232 port
11. One RS 485 port
12. Three independent BACnet MS/TP Channel capable of supporting up to 90 total Unitary controllers
13. A minimum of 24 On-board I/O, expandable up to 128 hardware points; external expansion I/O on dedicated controller I/O bus is also accepted for up to 256 (alternate maximum of 128 physical points for UUKL applications) physical I/O points where on-board I/O is not supported
14. Battery Backup using Gold Capacitor to avoid low battery alarms and subsequent replacement during service life of the controller.
15. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
16. A Reset Button
17. The NC must be capable of operation over a temperature range of 0 to 50°C

18. The NC must be capable of withstanding storage temperatures of between 5 and 70°C
19. The NC must be capable of operation over a humidity range of 5 to 93% RH, non-condensing

2.5 Input and Output Interface

A. General. Hard-wire input and output points to Honeywell Comfortpoint Open Network Floor Controller.
B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
F. Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.6 BACnet VAV Box controls CPO-VAV2

A. Controller shall be 32 bit microprocessor based BACnet Advanced Application Controller in accordance with the ANSI/ASHRAE Standard 135-2004. Advanced Application Controllers shall be provided for Air Handling Units, Variable Air Volume (VAV) Terminals and other applications as shown on the drawings. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. The system supplier must provide a PICS document showing the installed systems compliance level to the ANSI/ASHRAE Standard 135-2004.

1. All Advanced Application Controller shall be fully programmable with the help of Windows based software programming tool and shall at all times maintain their BACnet compliance. Controllers offering application selection only (non-programmable) require a 15% spare point capacity to be provided for all applications. All control sequences within or programmed into the B-AAC shall be stored

in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

2. Stand-alone, Native BACnet, UL Listed Application Controllers shall be used to provide direct digital control of HVAC equipment. In addition to their standalone capabilities, they shall also provide the ability networked in a peer-to-peer, BACnet MS/TP field network to other MS/TP controllers, and VAV/SPC zone controllers on the single MS/TP channel. These controllers may be used to optimize the energy consumption by implementing various control strategies such as temperature set-up/setback etc.
3. Standard features for all Advanced Application Controllers shall include:
   a) 32 bit microprocessor based controllers
   b) Stand-alone or networked peer-to-peer capabilities on single MS/TP channel, Masters to slave devices are not acceptable
   c) Should have on-board Real Time Clock
   d) Should support BACnet intrinsic alarm reporting
   e) Should support calendar objects for scheduling
   f) Should comply to BACnet B-AAC device profile
   g) Flexibility to be used and connected to Network Controller to expand the I/O capacity of network controller
   h) BACnet MS/TP LAN with configurable baud rate from 9600 to 76.8k baud
   i) All Inputs to be Universal Inputs with 12 bit resolution- software selectable as analog or digital with standard and custom ranges.
   j) Pulse counting shall be available for any one of binary inputs up to 15Hz frequency
   k) Standard P, PI, or PID BACnet Loop Objects
   l) Minimum of one Loop Object for each output
   m) In the particular case of Programmable VAV Controllers (VAV), the following shall apply in addition to the standard features listed above:

      1. Standard VAV control sequences are incorporated to provide pressure independent control of a single duct VAV unit
      2. Each VAV Controller shall be with an actuator to provide flexibility to choose suitable for a floating actuator.
      3. Each controller shall have an onboard flow-thru sensor for use with a single or multi-point differential pressure measuring station or pitot tube. Programmable controller to allow customizing of the standard sequences for temperature setback, overrides, proportional wet reheat and other user defined sequences to adapt to changing building conditions. The ability to only change operating parameters or substitute between configurable applications shall not be considered acceptable.
      4. Should be easily programmable using Microsoft Windows based programming utility.
      5. The VAV controller shall communicate with the main network controller at a baud rate of not less than 38.4K baud. The VAV controller shall provide LED indication of communication and controller performance to the technician, without cover removal.

   n) In the particular case of Programmable Small Point Control (SPC) Application Controllers, the following shall apply in addition to the standard features listed above:

1. Programmable control basic to allow customizing of the standard sequences for temperature setback, overrides, proportional wet reheat and other user defined sequences to adapt to changing building conditions. The ability to only change operating parameters or substitute between configurable applications shall not be considered acceptable
2. Should be easily programmable using Microsoft Windows based programming utility.
3. The SPC shall communicate with the main network controller at a baud rate of not less than 38.4K baud.
4. The SPC shall provide LED indication of communication and controller performance to the technician, without cover removal.

B. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

C. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.7 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Accuracy: Plus or minus 0.5 deg F at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Exposed.
    b. Set-Point Indication: Exposed.
    c. Thermometer: Concealed.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
4. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Building Static-Pressure Range: 0- to 0.25-inch wg.
    d. Duct Static-Pressure Range: 0- to 5-inch wg.

2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.8 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.9 THERMOSTATS

A. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on weekday, Saturday, and Sunday.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

    a. Time of day.
    b. Actual room temperature.
    c. Programmed temperature.
    d. Programmed time.
    e. Duration of timed override.
    f. Day of week.
    g. System mode indications include "heating," "off," "fan auto," and "fan on."

B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

C. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

D. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

2.10 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:

    a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
    d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements (Two-Position Spring Return): 24-V ac.
7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: 40 to 104 deg F.
10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
11. Run Time: 90 seconds.

2.11 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.

4. Sizing: 5-psig maximum pressure drop at design flow rate or the following:

a. Two Position: Line size.
b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

C. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

1. Body Style: Lug.
2. Disc Type: Nickel-plated ductile iron.
3. Sizing: 1-psig maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.12 DAMPERS

A. Dampers: AMCA-rated, parallel-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

2.13 CONTROL CABLE

A. All control cabling installed above accessible ceilings shall either be plenum rated cable or shall be installed in conduit.

B. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

E. Install automatic dampers according to Section 233300 "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."

H. Install hydronic instrument wells, valves, and other accessories according to Section 232116 Hydronic Piping Specialties."

I. Install duct volume-control dampers according to Section 233113 "Metal Ducts."

J. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."

B. All smoke control system wiring shall be in conduit.

C. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

E. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
b. Manually operate flow switches to verify that they make or break contact.

6. Temperature:

a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
b. Calibrate temperature switches to make or break contacts.

7. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
8. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
9. Provide diagnostic and test instruments for calibration and adjustment of system.
10. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 231123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Gas Meters.

1.3 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.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Gas meters. Indicate pressure ratings and capacities.
6. Dielectric fittings.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

1.11 COORDINATION

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

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.
b. End Connections: Threaded or butt welding to match pipe.
c. Lapped Face: Not permitted underground.
d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
    c. Aboveground Portion: PE transition fitting.
    d. Outlet shall be threaded or flanged or suitable for welded connection.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

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

        1) Dresser Piping Specialties.
        2) Smith-Blair, Inc.

    b. Stainless-steel flanges and tube with epoxy finish.
    c. Buna-nitrile seals.
    d. Stainless-steel bolts, washers, and nuts.
    e. Factory-installed anode for steel-body couplings installed underground.

2.2 PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. BrassCraft Manufacturing Co.; a Masco company.
   c. Conbraco Industries, Inc.
   d. Lyall, R. W. & Company, Inc.
   e. Perfection Corporation.

2. Body: Bronze, complying with ASTM B 584.

3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Bronze Plug Valves: MSS SP-78.

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

   a. A.Y. McDonald Mfg. Co.
   b. Lee Brass Company.

2. Body: Bronze, complying with ASTM B 584.

3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Meter Company.
   b. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
   c. Invensys.
   d. Maxitrol Company.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 2 psig.

2.6 SERVICE METERS

A. Turbine Meters: Comply with ASME MFC-4M.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Elster American Meter.

2. Housing: Cast iron or welded steel.

3. Connection Threads or Flanges: Steel.
4. Turbine: Aluminum or plastic.
5. Turbine Bearings: Self-lubricating.
6. Compensation: Continuous temperature.
7. Meter Index: Cubic feet.
8. Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig.
11. Accuracy: Maximum plus or minus 2.0 percent.

2.7 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Replace pipe having damaged PE coating with new pipe.

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

F. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

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

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

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

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

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

G. Locate valves for easy access.

H. Install piping free of sags and bends.

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

J. Verify final equipment locations for roughing-in.

K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

O. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

a. Exception: Tubing passing through partitions or walls does not require striker barriers.

3. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

S. Do not use natural-gas piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.6 GAS-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from meters. Install dielectric fittings downstream from meters.

F. Install meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

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

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.9 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.11 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

B. Aboveground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping NPS 1-1/4 and larger shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

C. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

D. Valves in branch piping for single appliance shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION

SECTION 232113

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Air-vent piping.
5. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Chemical treatment.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 150 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Blowdown-Drain Piping: 200 deg F.
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. DWV Copper Tubing: ASTM B 306, Type DWV.

C. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.
b. Nexus Valve, Inc.
c. Smith-Cooper International.
d. Victaulic Company.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. Capitol Manufacturing Company.
   c. Central Plastics Company.
   d. Jomar Valve.
   e. Matco-Norca.
   f. Watts; a Watts Water Technologies company.
   g. Wilkins.
   h. Zurn Industries, LLC.

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 150 psig.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Matco-Norca.
   d. Watts; a Watts Water Technologies company.
   e. Wilkins.
   f. Zurn Industries, LLC.

2. Description:

   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.

c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

2.6 BYPASS CHEMICAL FEEDER

A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Makeup-water piping installed aboveground shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

F. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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

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

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

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

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

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping level and plumb.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523 "General-duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

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

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

C. 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.

D. 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/A5.8M.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

F. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH: 9.0 to 10.5.
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.
4. Chemical Oxygen Demand: Maximum of 100 ppm. Revise this value if closed system contains glycol.
5. Corrosion Inhibitor:

    a. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.

6. Soluble Copper: Maximum of 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum of 10 ppm.
8. Total Suspended Solids: Maximum of 10 ppm.
9. Ammonia: Maximum of 20 ppm.
10. Free Caustic Alkalinity: Maximum of 20 ppm.
11. Microbiological Limits:

    a. Total Aerobic Plate Count: Maximum of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maximum of 100 organisms/mL.
    c. Nitrate Reducers: 100 organisms/mL.
    d. Sulfate Reducers: Maximum of zero organisms/mL.
    e. Iron Bacteria: Maximum of zero organisms/mL.

B. Install bypass chemical feeders in each hydronic system where indicated.

1. Install in upright position with top of funnel not more than 48 inches above the floor.
2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.

C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect 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. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 232116

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Blowdown-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 150 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Blowdown-Drain Piping: 200 deg F.
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-duty Valves for HVAC Piping."

B. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.
b. Bell & Gossett; a Xylem brand.
c. Flow Design, Inc.
d. Griswold Controls.
e. HCI; Hydronics Components Inc.
f. Nexus Valve, Inc.
g. Tour & Andersson; available through Victaulic Company.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

C. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.

b. Bell & Gossett; a Xylem brand.
c. Flow Design, Inc.
d. Griswold Controls.
e. HCI; Hydronics Components Inc.
f. Nexus Valve, Inc.
g. Tour & Andersson; available through Victaulic Company.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

D. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; a Xylem brand.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.
f. Watts; a Watts Water Technologies company.

2. Body: Bronze or brass.

3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Stainless-steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; a Xylem brand.
d. Nexus Valve, Inc.

2. Body: Bronze.

3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; a Xylem brand.
d. Nexus Valve, Inc.

2. Body: Bronze or cast iron.

3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

C. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; a Xylem brand.

2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett; a Xylem brand.

2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F maximum operating temperature.

3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

C. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

D. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, or air separator, to expansion tank with a 2 percent upward slope toward tank.

D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION

SECTION 232123

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Separately coupled, horizontally mounted, in-line centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Aurora Pump; Pentair Ltd.
3. Grundfos Pumps Corporation.
4. ITT Corporation.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Oil lubricated; bronze-journal or thrust type.

D. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Totally enclosed, fan cooled.
b. Enclosure Materials: Rolled steel.
c. Motor Bearings: Permanently lubricated ball bearings.
d. Efficiency: Premium efficient.

2.2 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Aurora Pump; Pentair Ltd.
3. Grundfos Pumps Corporation.
4. ITT Corporation.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Oil lubricated; bronze-journal or thrust type.

D. Shaft Coupling: Molded-rubber insert with interlocking spider capable of absorbing vibration.

E. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Totally enclosed, fan cooled.
b. Enclosure Materials: Rolled steel.
c. Motor Bearings: Grease-lubricated ball bearings.
d. Efficiency: Premium efficient.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

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

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Where installing piping adjacent to pump, allow space for service and maintenance.

B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install check, shutoff, and throttling valves on discharge side of pumps.

E. Install Y-type strainer and shutoff valve on suction side of pumps.

F. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.

    a. Component Importance Factor: 1.5.
    b. Component Response Modification Factor: As required per Table 13.6.1 of ASCE 7-05.
    c. Component Amplification Factor: As required per Table 13.6.1 of ASCE 7-05.
    d. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.92.

3. Design Spectral Response Acceleration at 1.0-Second Period: 0.63.
4. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ductmate Industries, Inc.
    b. Lindab Inc.
    c. McGill AirFlow LLC.
    d. SEMCO LLC.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.
b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Ductmate Industries, Inc.
3. Mason Industries, Inc.
4. TOLCO.
5. Unistrut; Part of Atkore International.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design

considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
3. Unconditioned Space, Exhaust Ducts: Seal Class C.
4. Unconditioned Space, Return-Air Ducts: Seal Class B.
5. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
6. Conditioned Space, Exhaust Ducts: Seal Class B.
7. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 1-inch wg.

2. Ducts Connected to Variable-Air-Volume Air-Handling Units:

    a. Pressure Class: Positive 3-inch wg.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive 2-inch wg.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive or negative 1-inch wg.

2. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 2-inch wg.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 2-inch wg.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

    a. Pressure Class: Negative 1-inch wg.

2. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 2-inch wg.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

        1) Radius-to Diameter Ratio: 1.5.

    b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm: Conical tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Combination fire and smoke dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct security bars.
11. Duct accessory hardware.

B. Related Requirements:

1. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
2. Section 283112 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.

c. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
d. Duct security bars.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a divsion of MESTEK, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.
7. Vent Products Co., Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 3-inch wg.

E. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum, with welded corners or mechanically attached.

F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Nonferrous metal.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.

2.4 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a divsion of MESTEK, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.
7. Vent Products Co., Inc.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 3-inch wg.

E. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum, with welded corners or mechanically attached.

F. Blades:

1. Multiple, 0.050-inch-thick aluminum sheet.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Neoprene.

H. Blade Axles: Nonferrous metal.

I. Tie Bars and Brackets:

1. Material: Galvanized steel.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Stainless steel.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Warming and Ventilating; a Mestek Architectural Group company.
    b. Flexmaster U.S.A., Inc.
    c. Flex-Tek Group.
    d. McGill AirFlow LLC.
    e. Nailor Industries Inc.
    f. Pottorff.
    g. Ruskin Company.
    h. Vent Products Co., Inc.

2. Standard leakage rating.

3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Frame: Hat-shaped, 0.05-inch-thick stainless steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Nonferrous metal.
7. Bearings:

    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a divsion of MESTEK, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded interlocking, gusseted or mechanically attached corners and mounting flange.

F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel.

I. Leakage: Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.05-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

L. Master control panel for use in dynamic smoke-management systems.

M. Damper Motors: two-position action.

N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

O. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, damper mounted.

2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Hardcast, Inc.
3. Nexus PDQ.
4. Ward Industries; a brand of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Hardcast, Inc.
5. METALAIRE, Inc.
6. SEMCO LLC.
7. Ward Industries; a brand of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. Nailor Industries Inc.
7. Pottorff.
8. Ruskin.
9. Ward Industries; a brand of Hart & Cooley, Inc.

B. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at +3.0-inch wg.for supply ducts, and factory set at -2.0-inch wg. for return and exhaust ducts.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Hardcast, Inc.
5. JP Lamborn Co.
6. Ventfabrics, Inc.
7. Ward Industries; a brand of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

6. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. Flex-Tek Group.
3. McGill AirFlow LLC.
4. Ward Industries; a brand of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: R-8 minimum.

C. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.12 DUCT SECURITY BARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Kees, Inc.
3. Krueger.
4. Lloyd Industries, Inc.
5. Metal Form Manufacturing, Inc.
6. Price Industries.

B. Description: Field- or factory-fabricated and field-installed duct security bars.

C. Configuration:

1. Frame: 2-1/2 by 2-1/2 by 1/4 inch angle.
2. Sleeve: 3/16-inch, continuously welded steel frames with 1-1/2-by-1-1/2-by-1/8-inch angle frame furnished loose for field welding on other end. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
3. Horizontal Bars: 1/2 inch.
4. Vertical Bars: 1/2 inch.
5. Bar Spacing: 6 inches.
6. Mounting: Bolted or welded.

2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install 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.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct security bars. Construct duct security bars from 0.164-inchsteel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.

3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
4. Control devices requiring inspection.
5. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

P. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

Q. Connect flexible ducts to metal ducts with draw bands.

R. Install duct test holes where required for testing and balancing purposes.

S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 233423

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.
2. Ceiling-mounted ventilators.
3. In-line centrifugal fans.

B. Related Sections:

1. Section 077213 “Manufactured Curbs” for roof curbs.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Review: Review and approve roof curb shop drawings prepared by Division 07 contractor.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

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

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Greenheck Fan Corporation.
3. Loren Cook Company.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
6. Burglar Bars: 1/2-inch- thick steel bars welded in place to form 6-inch squares.
7. Other accessories as listed on the drawings.

2.2 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Broan-NuTone LLC.
2. Carnes Company.
3. Greenheck Fan Corporation.
4. Loren Cook Company.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Painted steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:

1. As listed on the drawings.

2.3 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Greenheck Fan Corporation.
3. Loren Cook Company.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
6. Other accessories as listed on the drawings.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.5 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

C. Roof Curb: Coordinate roof curb installation with Division 07 contractor. Attach supply and return air ductwork to roof curb. Install RTUs on curb, and secure to upper rail per the manufacturer’s instructions, and per the mechanical drawings.

D. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 233600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-duct air terminal units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For air terminal units.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Size and location of initial access modules for acoustic tile.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Instructions for resetting minimum and maximum air volumes.
b. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Krueger.
3. Nailor Industries Inc.
4. Price Industries.
5. Titus.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal cabinet.

C. Casing: 0.040-inch- thick galvanized steel, single wall.

1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from

zero to 140 deg F, shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.

E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Fail in position.

F. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

G. Control devices shall be provided to the factory for mounting of the VAV box controller with integral damper motor and airflow sensor. The temperature controls system manufacturer as specified in Section 230923 "Direct Digital Control (DDC) System for HVAC", shall ship the controller to the VAV box factory for mounting.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.2 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7. Comply with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on air terminal units that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.3 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.4 CONNECTIONS

A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.5 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.

5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Modular core supply grilles.
3. Security registers and grilles.

B. Related Sections:

1. Section 089116 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carnes Company.
    b. Krueger.
    c. Nailor Industries Inc.
    d. Price Industries.
    e. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.

2.2 REGISTERS AND GRILLES

A. Security Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anemostat Products; a Mestek company.
    b. Carnes Company.
    c. Krueger.
    d. Nailor Industries Inc.
    e. Price Industries.
    f. Titus.

2. Security Level: Maximum and suicide deterrent.
3. Material: Steel.
4. Material Thickness: 0.19 inch.
5. Finish: Baked enamel, white.
6. Wall Sleeve: 3/16 inch welded to face.
7. Mounting: 1-by-1-by-3/16-inch retaining angle frame.

B. Security Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anemostat Products; a Mestek company.
    b. Carnes Company.

c. Krueger.
d. Nailor Industries Inc.
e. Price Industries.
f. Titus.

2. Security Level: Maximum and suicide deterrent.
3. Material: Steel.
4. Material Thickness: 0.19 inch.
5. Finish: Baked enamel, white.
6. Wall Sleeve: 3/16 inch welded to face.
7. Mounting: 1-by-1-by-3/16-inch retaining angle frame.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 235233

WATER-TUBE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes packaged, factory-fabricated and -assembled, gas-fired, finned water-tube boilers for generating hot water.

B. Section includes packaged, factory- assembled, water-tube boilers for generating hot water.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, include the following:

1. Construction details, material descriptions, dimensions, and weights of individual components, profiles, and finishes for boilers.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Predicted boiler efficiency while operating at design capacity and at varying part loads with basis indicated.
4. Predicted emissions levels while operating at design capacity and at varying part loads with basis indicated. Indicate operation that produces worst-case emissions.
5. Technical data for refractory and insulation, including temperature rating, thermal performance, attachment, and arrangement.
6. Calculations showing predicted surface temperature of boiler jacket with basis indicated.
7. Force and moment capacity of each piping and flue connection.
8. Dimensioned location of low, high, and normal water level, showing operating set point and each alarm set point.
9. Temperature and pressure rating, size, and materials of construction for boiler trim components, including piping, fittings, flanges, unions, and valves. Provide valve manufacturer's product data for each valve furnished. For safety valves, include trip and reset settings and flow capacity.
10. Manufacturer's product data showing size, scale range, and accuracy of thermometers and pressure gages.
11. Pressure rating, size, and materials of construction for boiler fuel train components, including piping, fittings, flanges, unions, switches, and valves. Provide manufacturer's product data for each valve and switch furnished.
12. Detailed information of controls, including product data with technical performance, operating characteristics, and sequence of operation.

13. Product data for each motor, including performance, operating characteristics, and materials of construction.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring. Differentiate between factory and field installation.
4. Include piping diagrams of factory-furnished piping that indicate size and each piping component.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For boilers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Installation instructions.

C. Source quality-control reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.

B. Spare Parts List: Recommended spare parts list with quantity for each.

C. Touch-up Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.

D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship boilers from the factory free of water. Drain water and blow dry with compressed air if required to remove all water before shipping.

B. Cover and protect flue, electrical controls, and piping connections before shipping. Protect and seal openings and connections with blinds, caps, plugs, and other materials during delivery, storage, and handling.

C. Protect boiler components with removable temporary enclosures to prevent damage during shipping, storage, and installation.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace heat exchangers damaged by thermal shock and vent dampers of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Exchangers: 20 years from date of Substantial Completion.
2. Warranty Period for Vent Dampers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Gas-Fired Boiler Emissions: Not to exceed allowable ambient-air quality standards in governing jurisdiction and indicated values.

1. Carbon monoxide:

a. 50 parts per million at any point from 100 percent to 50 percent fire.
b. 150 parts per million at any point below 50percent fire.

2. Nitrogen compounds: 20 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
3. Sulfur compounds: One part per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
4. Hydrocarbon and Volatile Organic Compounds: 10 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
5. Particulate Matter: 0.01 lb/MMBtu.
6. Smoke: Not visible and not to exceed No. 1 on the Bacharach smoke scale.

B. Multiple Boiler Operation: Equip individual boilers in multiple boiler applications with integral controls to provide multiple boiler operation for optimum system performance, energy efficiency, and the following:

1. Equalize runtime of boilers in service.
2. Operate multiple boilers hot to minimize disruption of service in the event of single boiler failure.
3. Configure controls so any boiler can be taken out of service with power disconnected and not impact multiple boiler operation.

C. Seismic Performance: Boiler shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the boiler will remain in place without separation of any parts when subjected to the seismic forces specified and the boiler will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

D. Operation Following Loss of Normal Power:

1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to back-up power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a back-up power source or through normal power if restored before back-up power is brought online.
2. Refer to Drawings for equipment served by back-up power systems.
3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

G. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

H. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

2.2 FINNED WATER-TUBE BOILERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lochinvar, LLC.
2. Raypak.
3. RBI.
4. Smith, A. O. Corporation.

B. Description: Factory-fabricated, -assembled, and -tested boiler, with tubes sealed into headers pressure tight, and set on a steel base; including insulated jacket, flue-gas vent, combustion-air-intake connections, water supply and return connections, and controls.

C. Heat Exchanger:

1. Finned 316L stainless steel with stainless-steel baffles.
2. Steel headers.
3. Two-pass, horizontal configuration.
4. Tubes shall be sealed in header with silicone O-ring gaskets, by welding, or by mechanically rolling tubes in header.

D. Combustion Chamber Internal Insulation: Interlocking panels of refractory insulation, high-temperature cements, mineral fiber, and ceramic refractory tile for service temperatures of up to 2000 deg F.

E. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosure: NEMA 250, Type 1A.
3. Finish: Baked enamel over primer.
4. Insulation: Minimum 2-inch- thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connection: Inlet duct collar and sheet metal closure over burner compartment.
6. Mounting base to secure boiler.

F. Burner:

1. Burner Tubes and Orifices: Stainless steel, for natural gas.

    a. Sealed Combustion: Factory-mounted centrifugal fan to draw outside air into boiler and discharge into burner compartment.

2. Gas Train: Control devices and full-modulation control sequence shall comply with ASME CSD-1 requirements. In addition to these requirements, include shutoff cock, pressure regulator, and control valve.
3. Gas Train: Combination gas valve with manual shutoff, pressure regulator, and pilot adjustment.
4. Pilot: Intermittent-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.
5. Flue-Gas Recirculation System: Centrifugal fans on burner assembly to recirculate flue gas to decrease emissions to requirements indicated. Complete package integrating burner, fan, damper, fuel train, and controls. Provide interconnecting external ducting if required by manufacturer's design.
6. Motors: Comply with requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

G. Hot-Water Boiler Trim:

1. Hot-Water Temperature Controllers: Operating, firing rate, and high limit.
2. Safety Relief Valve: ASME rated.
3. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.
4. Boiler Air Vent: Automatic.
5. Drain Valve: Minimum NPS 3/4 hose-end valve.

H. Controls:

1. Boiler operating controls shall include the following devices and features:

    a. Control transformer.
    b. Set-Point Adjust: Set points shall be adjustable.

c. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outdoor-air temperature. At 32 deg F outdoor-air temperature, set supply-water temperature at 180 deg F; at 60 deg F outdoor-air temperature, set supply-water temperature at 140 deg F.
d. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

2. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

a. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
b. Water Flow Switch: Automatic-reset paddle-switch shall prevent burner operation on low water flow.
c. Blocked Vent Safety Switch: Manual-reset switch factory mounted on draft diverter.
d. Rollout Safety Switch: Factory mounted on boiler combustion chamber.
e. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

3. Building Automation System Interface: Factory install hardware and software to enable system to monitor, control, and display boiler status and alarms for communication to the countywide Honeywell EMS.

a. Hardwired I/O Points:

1) Monitoring: On/off status, common trouble alarm.
2) Control: On/off operation, hot-water-supply temperature set-point adjustment.
3) All temperatures, setpoints, and all analog and digital data shall be programmed for communication to the 230900 Instrumentation and Control for HVAC Building Automation System.

b. Communication Interface: ASHRAE 135 (BACnet) communication interface shall enable control system operator to remotely control on/off operation and capacity of boiler and monitor the boiler operation from an operator workstation. The control features and monitoring points at the boiler-control panel shall be available to the control system through an interface.

c. Equipment provided under this section shall be provided with a BACnet Server (ASHRAE Standard 135) interface fully configured and ready for BACnet MS/TP communications by the equipment provider. Equipment shall be configured and enabled for BACnet discovery and integration to the associated BACnet Router, or Building Controller (B-BC), and subsequently to the BACnet Advanced Operator Workstation (B-AWS) front-end system.

d. The equipment shall be fully programmed and configured utilizing only open, BACnet objects including the following types: analog input, analog output, analog value, binary value, binary output, binary value, and alarm object. BACnet

proprietary objects, or manufacturer specific, BACnet container points and multi-state points having more than 5 states shall not be utilized.

e. BACnet Server systems and devices shall be BTL tested, listed, and certified with a copy of the BTL certificate included in the submittal package.

f. The equipment submittal package shall be provided to the 230900 Instrumentation and Control System supplier for review and approval. The submittal documentation shall include a list of the equipment being provided and the Instance ID and MAC address for each piece of equipment. This is required for all BACnet MS/TP communicating devices provided under this section.

g. Equipment submittals shall also include the BACnet Protocol Implementation Conformance Statements (PICs) and a completed BACnet point table that lists each point including:

1) Point name that conforms to the County of Monterey point naming convention. Naming convention for this building is “CF_X_Equipment_Point name.”
2) Unique description of each point.
3) Indication of the functionality supported and enabled for each BACnet object (i.e. Read, Writeable, Trend, Schedule, Notifications) to facilitate integration and interoperability.
4) Default Alarm High and Low values with indication of adjustable/writeable.
5) All BACnet objects (points) referenced in the design drawings and sequences of operation for the subject equipment shall be defined and configured by the equipment supplier for BACnet MS/TP discovery and routing to the BACnet client display and command/control integration as defined in the tables below for the equipment including the minimum points and functionality indicated. Any deviation regarding support of the required points list and functionality shall be described in the equipment proposal and submittals, and approved in advance by the County of Monterey, and the Controls System Integrator.

Object Name	Object Type	Object Instance	Units	Min	Max	Resolution
Binary Values						
Boiler Enable	BV	0	none	0	1	1
Tank Thermostat	BV	4	none	0	1	1
Binary Inputs						
Manual Reset High Limit	BI	0	none	0	1	1
Flow Switch	BI	1	none	0	1	1
Gas Pressure Switch	BI	2	none	0	1	1
Louver Proving Switch	BI	3	none	0	1	1
Air Pressure Switch	BI	4	none	0	1	1
Blocked Drain Switch	BI	5	none	0	1	1
Flame 1	BI	7	none	0	1	1
Enable	BI	8	none	0	1	1
Tank Thermostat	BI	9	none	0	1	1
Fan 1 Proving Switch	BI	10	none	0	1	1
Fan 2 Proving Switch	BI	12	none	0	1	1
Flue Damper Switch	BI	20	none	0	1	1
Flame 2	BI	22	none	0	1	1
Run Time Contacts	BI	32	none	0	1	1
Alarm Contacts	BI	33	none	0	1	1
Boiler Pump	BI	34	none	0	1	1
DHW Pump	BI	35	none	0	1	1
Louver Relay	BI	36	none	0	1	1
Gas Valve 1	BI	37	none	0	1	1
System Pump	BI	38	none	0	1	1
Flue Damper Output	BI	43	none	0	1	1
Gas Valve 2	BI	45	none	0	1	1
Transition Gas Valve**	BI	46	none	0	1	1
Main Fan 1	BI	48	none	0	1	1
Main Fan 2*	BI	49	none	0	1	1
External Spark / HSI	BI	50	none	0	1	1
Air Valve Trigger**	BI	51	none	0	1	1
Air Valve Proving**	BI	52	none	0	1	1

Object Name	Object Type	Object Instance	Units	Min	Max	Resolution
Inputs						
Binary Inputs 0-15	AI	0	none	0	65535	1
Binary Inputs 16-31	AI	1	none	0	65535	1
Binary Inputs 32-47	AI	2	none	0	65535	1
System / Cascade Setpoint	AI	3	Deg. C	0	130	0.5
System Pump Speed	AI	4	Percent	0	100	1
Cascade Total Power	AI	5	Percent	100	800	1
Cascade Current Power	AI	6	Percent	0	800	1
Outlet Setpoint	AI	7	Deg C	0	130	5
Outlet Temperature	AI	8	Deg C	0	130	1
Inlet Temperature	AI	9	Deg C	-20	130	1
Flue Temperature	AI	10	Deg C	-20	130	1
Firing Rate	AI	11	Percent	0	100	1
Boiler Pump Speed	AI	12	Percent	0	100	1
Boiler Status Code	AI	13	none	0	65535	1
Boiler Blocking Code	AI	14	none	0	65535	1
Boiler Lockout Code	AI	15	none	0	65535	1
Binary Inputs 48-63	AI	25	none	0	65535	1
Lock-Out Error Leader	AI	26	none	0	1	1
Object Name	**Object Type**	**Object Instance**	**Units**	**Min**	**Max**	**Resolution**
Lock-Out Error Member 1	AI	27	none	0	1	1
Lock-Out Error Member 2	AI	28	none	0	1	1
Lock-Out Error Member 3	AI	29	none	0	1	1
Lock-Out Error Member 4	AI	30	none	0	1	1
Lock-Out Error Member 5	AI	31	none	0	1	1
Lock-Out Error Member 6	AI	32	none	0	1	1
Lock-Out Error Member 7	AI	33	none	0	1	1
Analog Values						
Configuration	AI	0	none	0	65535	1
Coils	AI	1	none	0	65535	1
0-10 Volt Input / Rate Command / Setpoint Command	AI	2	Percent	0	100	1
Tank Setpoint	AI	3	Deg C	0	875	5
Tank Temperature	AI	4	Deg C	-20	130	1
Outdoor Temperature	AI	5	Deg C	-40	60	1
System Supply Temperature	AI	6	Deg C	-20	130	1
System Return Temperature	AI	7	Deg C	-20	130	1

h. The equipment/subsystem shall be provided with ALL software, licensing, hardware, and interconnecting cables, accessories, tools, and modules required to make programming and configuration changes to the delivered devices and equipment.

i. The equipment supplier shall coordinate with the Section 230900 Instrumentation and Control contractor and be present on the site to provide support and any trouble shooting necessary to properly enable and configure the equipment for standard BACnet discovery by the BACnet client B-AWS system to ensure successful integration and start-up.

j. Note that equipment shall not be commissioned and started-up until after the BACnet point data has been fully integrated into the BACnet client B-AWS front-end and verified by the County of Monterey and the Section 230900 Instrumentation and Controls contractor.

2.3 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. Enclosure: NEMA 250, Type 1.

   a. Enclosure shall have integral vents, fans, heat, and air conditioner as required to automatically control temperature inside enclosure within safe operating limits of devices installed within the enclosure.
   b. Mounted on boiler assembly at a location convenient to operator.
   c. Enclosure shall have hinged full-size door with key lock with common key for all locks.

2. Wiring shall be numbered and color-coded to match wiring diagram. Provide a laminated wiring diagram located inside enclosure.
3. Install factory wiring outside of an enclosure in araceway. Make final connections to motors using flexible conduit. Provide watertight installation for applications exposed to moisture.
4. Field power interface shall be to nonfused disconnect switch. Withstanding rating of disconnecting means shall protect equipment. Coordinate requirements with field electrical power source.
5. Provide branch power circuit to each motor and to controls.
6. Provide each motor with NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection. Provide variable-frequency controller with manual bypass and line reactors for each variable-speed motor indicated.

2.4 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap, and sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and flue; piping; controls; and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for flue, piping, controls, and electrical connections.

B. Examine areas where boilers will be installed for suitable conditions.

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

3.2 BOILER INSTALLATION

A. Coordinate size and location of bases. Cast anchor-bolt inserts into concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

C. Install gas-fired boilers according to NFPA 54.

D. Assemble boiler tubes in sequence and seal each tube joint.

E. Assemble and install boiler trim, components, and accessories that are not factory installed.

F. Install control and electrical devices furnished with boiler that are not factory mounted.

G. Install control and power wiring to field-mounted control and electrical devices furnished with boiler that are not factory installed.

H. Perform boil-out and cleaning procedures according to manufacturer's written instructions after completion of hydrostatic testing and before performing other field tests. Following boil-out and cleaning procedures, boiler shall be washed and flushed until water leaving boiler is clear.

I. Protect boiler fireside and waterside from corrosion.

1. Before boiler is filled with water, protect by dry storage method recommended by boiler manufacturer.
2. After boiler is filled with water, and left not fired for more than 10 days, protect by wet storage method recommended by boiler manufacturer.
3. Chemical Treatment: Quality of water in boilers shall be maintained by a professional water-treatment organization that shall provide on-site supervision to maintain the required water quality during periods of boiler storage as well as during operating, standby, and test conditions.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to boiler(s), allow space for service and maintenance.

C. Connect gas piping to boiler gas-train inlet with dirt leg, shutoff valve, and union or flange. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

D. Connect hot-water piping to supply- and return-boiler connections with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to nearest floor drain.

F. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

G. Hot equipment drains connected to sanitary drainage system shall be cooled before discharging into the system if required to comply with more stringent of governing code requirements and requirements indicated.

3.4 FLUE CONNECTIONS

A. Boiler Flue Venting:

1. Install venting kit and combustion-air intake.
2. Connect full size to boiler connections. Comply with requirements in Section 235123 "Gas Vents."

B. Install easily accessible test ports for field testing of flue gas from each boiler.

3.5 ELECTRICAL POWER CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 CONTROLS CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between boilers and other equipment to interlock operation as required, to provide a complete and functioning system.

C. Connect control wiring between boiler control interface and DDC control system for remote monitoring and control of boilers.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Hydrostatic Leak Test: Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
    b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
    c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Boiler will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 237413

PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Economizer outdoor- and return-air damper section.
3. Integral, space temperature controls.

B. Related Sections:

1. Section 077213 “Manufactured Curbs” for roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. EC Motor: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating

operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with seismic performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Review: Review and approve roof curb shop drawings prepared by Division 07 contractor.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

D. 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.

1.9 WARRANTY

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

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON.
2. Alliance Air.
3. Amairco Airflow Solutions.
4. Engineered Air.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with baked phenolic finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: 0.0626 inch thick.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: Galvanized steel, 0.034 inch thick.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: as needed to provide R-13 rigid foam.

E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple both sides of drain pan.

2.3 FANS

A. Direct-Driven Supply-Air Fans for units 7 ½ tons and less: Double width, backward inclined, centrifugal; with permanently lubricated, EC motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Belt-Driven Supply-Air Fans for units 10 tons and larger: Plug fan, centrifugal; with permanently lubricated, premium efficiency motor with variable frequency drive, installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

C. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

D. Relief-Air Fan: Axial fan with EC motor for units 7 ½ tons and less; backward linclined, shaft mounted on permanently lubricated motor with VFD.

E. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

F. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Coil Split: Interlaced.
3. Condensate Drain Pan: Stainless steel formed with pitch and drain connections.

B. Outdoor-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Baked phenolic coating.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: One for units 7 ½ tons and smaller; two for units 10 tons and larger.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief. Provide variable capacity scroll compressor for first stage of cooling.

C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated: Minimum 30 percent arrestance, and MERV 8 for pre-filter.
2. Pleated: Minimum 85 percent arrestance, and MERV 13 for main filter.

2.7 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.8 ELECTRICAL POWER CONNECTION

A. Provide two power connections. First power connection (emergency power) shall feed supply-air fan, relief-air fan, and all controls. Second power connection (normal power) shall feed compressors, condenser fans, and unit mounted 115V receptacle.

2.9 CONTROLS

A. DDC Controller Provided by Section 230900 Instrumentation and Control contractor for factory mounting:

1. Section 230900 Instrumentation and Controls contractor shall provide the controller with volatile-memory backup, Input/Output boards, relays, sensors, actuators, and control wiring diagrams to the AHU factory.
2. The AHU factory shall provide a complete installation of all the 230900 instrumentation and control equipment, including mounting equipment, terminating wiring, installation of tubing, sensors, relays, controllers, power supply, and terminal blocks for a single BACnet bus transmission connection to each AHU.
3. Safety Control Operation:

    a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
    b. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F.

4. Scheduled Operation: Occupied and unoccupied periods on 365-day clock with a minimum of four programmable periods per day.
5. Unoccupied Period:

    a. Heating Setback: 10 deg F.
    b. Cooling Setback: System off.
    c. Override Operation: Two hours.

6. Supply Fan Operation:

    a. Occupied Periods: Run fan continuously.
    b. Unoccupied Periods: Cycle fan to maintain setback temperature.

7. Refrigerant Circuit Operation:

    a. Occupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain room temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
    b. Unoccupied Periods: Compressors off.

8. Economizer Outdoor-Air Damper Operation:

a. Occupied Periods: Open to percent needed to provide minimum outdoor air indicated in equipment schedule, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F. Use mixed-air and outdoor-air temperature to adjust mixing dampers. Relief-air fan shall modulate based on outdoor-air damper position. During economizer cycle operation, lock out cooling.
b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

B. Interface Requirements for HVAC Instrumentation and Control System:

1. BACnet interface for scheduled operation.
2. BACnet interface to provide indication of fault codes and points at the Honeywell countywide EMS, and diagnostic code storage.
3. BACnet interface with all setpoints, parameters, analog and digital inputs and outputs to the factory provided DDC controller.

2.10 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Coil guards of painted, galvanized-steel wire.

2.11 ROOF CURBS

A. Materials: Roof curbs shall be furnished and installed by Division 07 contractor.

B. Curb Height: Varies with roof slope and insulation thickness. Roof curb will extend a minimum of 12” above roof membrane surface.

C. Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Roof Curb: Coordinate roof curb installation with Division 07 contractor. Attach supply and return air ductwork to roof curb. Install RTUs on curb, and secure to upper rail per the manufacturer's instructions, and per the mechanical drawings.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Assist the TAB contractor with adjustment of the DDC Controller setpoints and parameters to meet the Sequence of Operation.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Remove packing from vibration isolators.
11. Verify lubrication on fan and motor bearings.
12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
13. Adjust fan belts to proper alignment and tension.
14. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Calibrate thermostats.
18. Adjust and inspect high-temperature limits.
19. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
20. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

21. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
22. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

23. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.

b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

24. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

a. High-temperature limit on gas-fired heat exchanger.
b. Low-temperature safety operation.
c. Filter high-pressure differential alarm.
d. Economizer to minimum outdoor-air changeover.
e. Relief-air fan operation.
f. Smoke alarms.

25. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 238123.13

COMPUTER-ROOM AIR-CONDITIONERS, CEILING-MOUNTED UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes ceiling-mounted, computer-room air conditioners.

B. Related Sections:

1. Section 077213 “Manufactured Curbs” for roof mounted equipment supports.

1.3 DEFINITIONS

A. COP: Coefficient of performance.

B. EER: Energy efficiency ratio.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions, dimensions of individual components and profiles, and finishes for computer-room air-conditioning units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For computer-room air conditioners.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For computer-room air conditioners, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Compu-Aire, Inc.
2. Data Aire Inc.
3. Liebert; a brand of Emerson Electric Co.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Computer-room air-conditioners, ceiling-mounted units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

2.3 MANUFACTURED UNITS

A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls.

1. Mounting Configuration: Concealed above ceiling.

B. Cabinet: Galvanized steel serviceable from one side, with baked-enamel finish, insulated with 1/2-inch-thick duct liner, and mounting bracket attached to the unit.

1. Unit with supply and return collars for ducting in the field.
2. Unit with single-speed, centrifugal belt-driven fan.

C. Supply-Air Fan:

1. Forward curved, double width, double inlet, centrifugal, with adjustable V-belt drive.

D. Refrigeration System:

1. Compressor: Scroll, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
2. Refrigeration Circuit Components:

a. Low-pressure switch.
b. Manually reset, high-pressure switch.
c. Thermal-expansion valve with external equalizer.
d. Sight glass with moisture indicator.
e. Service shutoff valves.
f. Charging valves.
g. Hot-gas bypass.
h. Refrigerant charge.

3. Refrigerant: R-407C or R-410A.
4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
5. Refrigerant line sets precharged in lengths of sufficient length to serve the unit from its condensing unit.
6. Refrigerant line-sweat-adapter kit to permit field brazing of refrigerant lines.

a. Mount stainless-steel drain pan having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir under coil assembly.

7. Remote, Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with direct-drive, propeller fan.
8. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

E. Filter: 1-inch-thick, disposable, glass-fiber media.

1. MERV: 8 according to ASHRAE 52.2.

F. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

G. Control System:

1. Microprocessor unit-mounted panel.
2. Fan contactor.
3. Compressor contactor.
4. Compressor start capacitor.
5. Control transformer with circuit breaker.
6. Solid-state temperature-control modules.
7. Time-delay relay.
8. Heating contactor.
9. Smoke sensor.
10. Filter clog switch.
11. Alarm contacts.
12. High-temperature thermostat.
13. Remote panel to monitor and change temperature set points and sensitivities of the unit and unit alarms.
14. Provide a BACnet MS/TP or BACnet I/P connection to the computer room unit controllers.

a. Provide a complete points list for each unit for installation of graphics and data in the countywide Honeywell EMS.
b. Provide technical support on startup, and assistance with the communication from the computer room units to the EMS.

H. Fan Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

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

3.2 INSTALLATION

A. Layout and install computer-room air conditioners and suspension system coordinated with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

C. Suspended Computer-Room Air Conditioners: Install using continuous-thread hanger rods and elastomeric hangers of size required to support weight of computer-room air conditioner.

1. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

D. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads on equipment supports furnished and installed by Division 07 contractor, and specified in Section 077213 "Manufactured Curbs." Anchor units to supports with removable, cadmium-plated fasteners. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Minimum Deflection: 1/4 inch.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.

2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION

SECTION 238126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

B. Related Sections:

1. Section 077213 "Manufactured Curbs" for roof mounted equipment supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.
c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; a unit of United Technologies Corp.
2. Daikin AC.
3. Fujitsu.
4. Mitsubishi Electric & Electronics USA, Inc.
5. SANYO North America Corporation.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

6. Filters: Permanent, cleanable.
7. Condensate Drain Pans:

    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

    b. Single-wall, stainless-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 1.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Refrigerant Charge: R-410A.
    c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.

2.4 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Provide a BACnet MS/TP or BACnet I/P connection to the controller on the split air system.

C. Provide a points list, and technical support for the connection to the split system BACnet interface.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

F. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077213 "Manufactured Curbs." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

DIVISIONS 24 - 25
NOT USED

DIVISION 26
ELECTRICAL

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Basic Electrical Requirements, materials and methods common to multiple electrical systems, specifically applicable to all Sections in Division 26.

B. Related Sections
   1. Section 05 05 55 - Tamper Proof Metal Fastenings.
   2. Section 26 08 13 - Acceptance Testing.

1.2 REFERENCES

A. CEC- 2013 - CALIFORNIA ELECTRICAL CODE, PART 3, CCR TITLE 24 AND 2013 CALIFORNIA FIRE Code, Part 9, CCR Title 24.

B. NEMA ICS-6-R2006 - Industrial Control and Systems: Enclosures.

1.3 DEFINITIONS

A. The meaning of words shall be as defined in the CEC Article 100, Definitions, unless defined otherwise in an individual section.

B. Inmate Accessible Areas: Areas within the prison project, at and below ten-feet above adjacent floor or grade, except as specifically exempted in Section 05 05 55, or by the County Representative.

C. Exercise Yard: The area surrounded by housing units and associated support buildings to the fence connecting the buildings including the exterior of these buildings.

D. Exposed Fasteners:
   1. Fasteners not completely concealed within building construction.
   2. Fasteners which may be accessed and removed, without the prior removal of other fasteners designated as “tamper proof” or “security”.

E. Exposed Locations: All locations are considered exposed, except the following;
   1. Mechanical and electrical rooms.
   2. Areas above suspended ceilings, behind access panels, and within pipe and duct chases.
   3. Roofs.
   4. Control rooms, however control consoles are considered exposed.
   5. Within fences around equipment pads at distances greater than 4 feet from fence.

F. Security Screws/Fasteners: Tamper proof metal fasteners as specified in Section 05 05 55; removable or non-removable types as indicated.

G. Secured Perimeter System: System comprised of double fencing, gates, towers, lighting, and electronic detection system.

H. The following specification development organizations are referenced throughout the various specification sections of Division 26:
1. AASHTO - American Association of State Highway and Transportation Officials.
2. ADAAG - Americans with Disabilities Act Accessibility Guidelines
3. Air Pollution Control District, Air Quality Management District
4. ANSI - American National Standards Institute
5. AQMD - Air Quality Management District
6. APCD - Air Pollution Control District
7. ASME - American Society of Mechanical Engineers
8. ASTM - American Society for Testing and Materials
9. CBC - California Building Code
10. CCR - California Code of Regulations Title 24. State Chapters.
11. CEC - California Electrical Code
12. CFC - California Fire Code
13. CMC - California Mechanical Code
14. CSA - Canadian Standards Association
15. EIA - Electronic Industries Association
16. FCC - Federal Communications Commission.
17. FM - Factory Mutual.
18. FS - Federal Specifications
19. ICEA - Insulated Cable Engineers Association
20. IEC - International Electrotechnical Commission
21. IEEE - Institute of Electrical and Electronic Engineers
22. IETA - International Electrical Testing Association
23. ISA - Instrument Society of America
24. ISO - International Organization for Standardization
25. MIL - Military Specifications
26. NACE - National Association of Corrosion Engineers
27. NECA - National Electrical Contractor’s Association
28. NEMA - National Electrical Manufacturing Association
29. NETA - International Electrical Testing Association
30. NFPA - National Fire Protection Association
31. NIST - National Institute of Standards and Technology
32. OSHA - Occupational Safety and Health Administration
33. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc.
34. UL - Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

A. Performance Requirements
1. Furnish and install all materials to provide functioning systems in compliance with performance requirements specified, and any modifications required by reviewed shop drawings and field coordinated drawings.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data

1. Submit product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
2. Quantity of Submittals Required
   a. Submit six copies of product data.
   b. Five copies will be returned.
   c. If comments are required, comment sheet(s) will be returned with each copy.
   d. One copy will be retained by the Engineer.

C. Shop Drawings
1. Submit shop drawings grouped to include complete submittals of related systems, products, and accessories in a single submittal.
2. Submit a composite drawing for each cell chase, including the coordinated layout of all other trades' distinct components and detailing the intended electrical installation.
3. Quantity of Submittals Required:
   a. Submit one reproducible transparency and one print.
   b. Upon review, transparency will be annotated and returned. Print will be retained by Engineer.
   c. Copies of this transparency will serve as record copies for Architect and Engineer.
   d. Additional prints will not be reviewed nor returned.
4. Corrections or comments made on the shop drawings during review do not relieve the Contractor from compliance with requirements of the drawings and specifications. Shop drawing checking by the Engineer is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for:
   a. Confirming and correlating all quantities and dimensions.
   b. Selecting fabrication processes and techniques of construction.
   c. Coordinating his work with all other trades.
   d. Performing his work in a safe and satisfactory manner.
   e. Provide equipment that can be installed in the available space with all code clearances. This shall be coordinated prior to ordering any equipment.

D. Samples
1. Submit as directed by the architect and as required in each specification section.

E. Quality Control/Control Submittals
1. Submit material control record procedures for approval. Submit records during the project upon request by the County Representative. Submit at the end of the project for record.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements
1. Conform to CEC.
2. Furnish products listed and classified by UL or other independent laboratory acceptable to the County Representative as suitable for purpose specified and shown when a listing is available for the type of product.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle and protect products under provisions of Section 01 65 00.

B. Maintain material control records for all products for traceability to manufacturer and order number. Have records available for inspection by the County Representative.

C. Store material and equipment in an environment similar to the final installation environment.

D. Store and handle material and equipment in accordance with manufacturers' recommendations.

1.8 PROJECT CONDITIONS

A. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. Install Work in locations shown on Drawings, unless prevented by Project conditions.

C. Prepare and submit drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of the County Representative before proceeding.

1.9 SEQUENCING AND SCHEDULING

A. Sequence work under provisions of Section 01 31 13.

B. Coordinate the incoming electrical and telephone service with the local utility companies Contractor providing service. Install utility service trench and duct systems in accordance with the servicing utility company requirements.

C. Coordinate Hand Hole locations with existing site conditions. Hand Hole is approximately 5 feet from building or as indicated on drawings.

1.10 SHORT CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY

A. Provide a short circuit and protective device coordination study and arc flash study to the County Representative for review and approval. Provide all short circuit characteristic information on electrical equipment. Provide time current curves for all circuit breakers in the submittal. Set and adjust all devices in accordance with the results of this study before energizing equipment.

1.11 MAINTENANCE AND SERVICE

A. Maintenance and service shall be provided as part of the Contract during the two year warranty period starting the day that Project Completion is awarded by the County Representative.
   1. Contractor shall be responsible for systems and system components as defined in these documents.
   2. Scheduled maintenance shall be conducted on a weekly and quarterly basis. Responsibilities for scheduled maintenance are as follows:
      a. Weekly - County's personnel.
      b. Quarterly - Contractor's personnel.
   3. All maintenance activity shall be conducted on a schedule that is convenient to the County Representative. All Contractors personnel shall provide written notice of all visits.

B. Daily operational inspections by County shall consist of inspections to determine the operational state of a system. It is not intended that the County perform adjustments or modifications for system restoration.

C. Non-scheduled maintenance will be initiated by staff personnel as a result of daily inspections or operational use of the systems. Categories of maintenance support and the response time for system restoration are defined as follows:
   1. Critical - Items which compromise the security of the facility or have an adverse effect on the operations of the facility. Items in this category shall be returned to service within eight (8) actual hours after receipt of a service call. Service shall be available on a seven (7) day, twenty-four (24) hour basis.
   2. Sensitive - Items which adversely impact the operations of the facility but are not considered “critical” as defined above. Items in this category shall be returned to service within forty eight (48) actual hours after receipt of a service call. Service shall be available on a normal eight (8) hour, five (5) day a week basis.
   3. Normal - Items which require maintenance support but are not “critical” or “sensitive” as defined above. These are typically items which staff personnel identify and accept that maintenance during the standard quarterly inspection.

D. Contractor shall provide scheduled maintenance in accordance with the description of services and maintenance schedule.

E. Contractor shall maintain all documents and modify drawings, schedules, and other documents as required to effect documentation which reflects the current system or wiring configuration.

F. Upon termination of the service contract, Contractor shall return all system documents to the County Representative.

G. Contractor shall develop maintenance reports, or logs, which identify maintenance activities on the system. If requested, the reports, or logs, shall be provided to the County Representative on a monthly basis.

H. In the event software is introduced which will enhance the system operation, Contractor shall inform the County Representative of the software, its features, and the cost to upgrade the existing software. If accepted by the County Representative, Contractor shall furnish and install the software and invoice County in the amount approved by the County Representative. Contractor to train the County staff on new system features or software which may be provided to enhance the systems capability.

I. Insurance requirements shall be maintained through the maintenance and service period.

1.12 SPARE PARTS

A. Spare parts shall be provided and maintained by Contractor to support the maintenance response requirements defined in this document.

B. The spare parts inventory may be comprised of Contractor furnished, Contractor maintained parts.

C. Contractor shall maintain a spare parts inventory as he deems necessary to support the maintenance and service requirements of this section.

D. During the maintenance and service period, Contractor shall maintain a log of all component failures and parts replaced.

E. Six months prior to the expiration of the maintenance and service period, Contractor shall submit the replaced parts log to the County Representative. The County Representative will use the replaced parts log to evaluate the on-site spare parts inventory required for future maintenance by the County.

F. At a minimum, the following spare parts shall be stored at the site in a location identified by the County Representative. The spare parts shall be property of the County. This requirement is not intended to include all spare parts required to meet the service response time limits. The contractor shall replace any of these spare parts, if used for service work during the warrantee period within 10 days. The spare parts shall be the same type submitted and installed in the facility.
   1. Lighting fixture ballast.
   2. Branch panelboard circuit breakers.
   3. Fuses.
   4. Lighting occupancy sensors and switches.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Weather Proof Equipment
   1. Where weatherproof (WP) equipment is indicated, use NEMA 3R or NEMA 4 cast metal or stainless steel enclosures where applicable unless otherwise specified or indicated.

B. Outdoor Equipment
   1. Equipment and devices to be installed outdoors or in unheated enclosures shall be capable of continuous operation within an ambient temperature range of 32 degrees F. to 120 degrees F.

C. All building services shall be metered
   1. Meters shall be digital type with reporting capability, compatible with Facility Energy Management System.
   2. Meters shall be connected to a central location where electrical use can be monitored on a real time basis.

2.2 SOURCE QUALITY CONTROL

A. The County Representative may elect to visit manufacturers'/suppliers' facilities prior to, or at any time during, fabrication of equipment. Manufacturers/suppliers shall grant access to their facilities for the County Representative visits.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment to permit easy access for normal operation and maintenance to switches, motors, drives, pull boxes and receptacles in accordance with CEC Article 110, Requirements for Electrical Installation.

B. Coordinate electrical work with the County Representative and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.

C. Check and coordinate the approximate locations of electrical stub-ins, light fixtures, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify the County Representative in writing. The County Representative's decision shall govern. Make modifications and changes required to correct conflicts.

3.2 HOUSEKEEPING PADS AND FOUNDATIONS

A. Concrete work required for housekeeping pads and foundations shall be provided by General Construction Work.

B. Furnish required dimensional drawings and specify locations. Minimum height of housekeeping pads shall be 4 inches and shall extend out 6 inches from the footprint of the equipment.

C. Furnish anchor bolts and sleeves, and verify accuracy of installation.

D. Provide for:
1. Switchboards.
2. Floor mounted ATS.
3. Distribution panels.
4. Floor mounted transformers.
5. Other items as required.

3.3 SITE TESTS

A. Test under provisions of Section 26 08 13.
1. At completion of installation, test for operation, panel load balance, short circuits, and ground.
2. Each building service and separately derived system to have neutral bonding jumper opened and neutral and ground buses to be tested for infinite resistance. Test to be demonstrated to the County Representative. Where infinite resistance is not achieved, correct deficiencies and retest in the presence of County personnel.
3. Provide written test results for all tests.

3.4 ADJUSTING

A. Adjust work under provisions of Section 26 08 13.

B. Inspect all equipment and put in good working order.

3.5 CLEANING

A. Clean work under provisions of Section 01 35 43.

B. Clean all items.

3.6 PROTECTION

A. Protect finished installation under provisions of Section 01 35 43.

B. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do not have space heaters.

C. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided that is acceptable to the County Representative. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.

3.7 FINAL CONNECTION

A. Make final connection to the power distribution system at the building service point.

3.8 PUTTING SYSTEMS IN OPERATION - START UP

A. Operate all systems in good working order for a period of 5 consecutive days, at time period agreed to by the County Representative, prior to inspection.

END OF SECTION

SECTION 26 05 13

MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Medium voltage cable system, 10 AWG and larger, splices and terminations.
   2. Pulling lubricant.
   3. Cable fault indicators.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 08 13 - Acceptance Testing.

1.2 REFERENCES

A. AEIC CS8-2007 - Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV.

B. IEEE 48-1996 - Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV.

C. IEEE 386-1995 - Separable Insulated Connector Systems for Power Distribution Systems Above 600V.

D. NEMA WC 70-1999 - Nonshielded Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy (ANSI/ICEA S-95-658).

E. NEMA WC 71-1990 - Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy (ANSI/ICEA S-96-659).

F. NEMA WC 74-2006 - 5-46 kV Shielded Power Cable for use in the Transmission and Distribution of Electric Energy (ANSI/ICEA S-93-639).

1.3 SYSTEM DESCRIPTION

A. Medium voltage cable includes single conductor, insulated power cables for applications rated 5-15 kV. Cable characteristics include operating continuously in both wet and dry locations at conductor temperatures of 90 degrees Celsius for normal operations, 130 degrees Celsius under emergency conditions and 250 degrees Celsius under short circuit conditions.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
   1. Submit product data for each type of cable, termination, and accessory.

   2. Indicate the proposed item and area of application.

C. Quality Assurance/Control Submittals
   1. Required for 10 AWG and larger cables only.
   2. Test Reports
      a. Submit certified high potential test results.
      b. Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30-second intervals at maximum voltage.
      c. Submit field cable pulling results
   3. Certificates
      a. Certify compliance with regulatory requirements of Section 26 05 00.
   4. Manufacturer's instructions
      a. Submit manufacturer's installation instructions.
      b. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
      c. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

D. Closeout Submittals.
   1. Project Record Documents: Accurately record actual sizes and locations of cables.
   2. Operation and Maintenance Data: Include instructions for testing and cleaning cable and accessories.
   3. Schedule of cable pulls including calculated maximum pulling tensions, sidewall pressure and cable routing.

1.5 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
   2. Installer: Company specializing in installing products specified in this section with minimum five years experience; approved by manufacturer.

B. Regulatory Requirement
   1. Conform to requirements of CEC.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provision of Section 01 65 00.

B. Accept cable and accessories on-site in manufacturer's packaging. Inspect for damage.

C. Store and protect in accordance with manufacturer's instructions.

D. Protect from weather. Provide adequate ventilation to prevent condensation.

1.7 PROJECT CONDITIONS

A. Verify routing and termination locations of cable bank prior to rough-in.

B. Cable routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

C. Verify the field measurements are as shown on Drawings.

1.8 MAINTENANCE

A. Submit maintenance materials under provisions of Section 01 78 23.

B. Submit surge protector spare parts for field replaceable components. Minimum of one each.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Okonite

B. General Cable

C. Kerite

2.2 MEDIUM VOLTAGE CABLE SYSTEMS - 10 AWG AND LARGER

A. Medium Voltage Cable:
1. Description: Single conductor insulated power cables for medium voltage applications rated 5-15 kilovolts for operation in wet and dry locations.
2. Conductors: Class B stranded, concentric or compact round, soft or yield copper per NEMA WC 70.
3. Strand shield: Extruded black, semi conducting, thermo setting, compound applied over conductor which is compatible with conductor metal, uniformly and firmly bonded to overlaying insulation and free stripping from conductor.
4. Insulation: High quality, heat, moisture, ozone, and corona resistant, ethylene propylene rubber compound with color in contrast from strand screen and insulation shield per AEIC CS-8. Insulation level shall be 133 percent per the following:

Conductor Size	Insulation Thickness
5 kV	115 mils
15 kV	220 mils
25 kV	345 mils
35 kV	420 mils

a. Minimum thickness of insulation at any point is 90 percent or greater of specified nominal thickness.

5. Insulation Shield: Extruded black, semi conducting, thermosetting compound applied directly over insulation which is compatible with insulation and overlying metallic shield. Shield is free-stripping from insulation and leaves no conductive residue on surface of insulation after stripping. Strand screen insulation and insulation shield applied in single pass triple extrusion process to provide virtual corona free cable core. The EPR insulation shall not be exposed to the atmosphere or release oils during manufacture.

6. Metallic Shield: 0.005 inches thickness of tin copper tape, applied over insulation shield material with minimum 12.5 overlap.
7. Jacket: Extruded polyvinyl chloride (PVC material) meeting physical and dimensional requirement of NEMA WC 70.
8. Identification: Overall jacket printed in contrasting color with information as follows:
   a. Manufacturer name
   b. Location code of plant
   c. Conductor size
   d. Insulation type and thickness
   e. Voltage rating
   f. UL designation

B. Potheads: IEEE 48; Class 1 termination. Pothead with porcelain insulators, cable connector and aerial lug, sealed cable entrance and support, and insulating compound.

C. Cable Terminations: IEEE 48; Class 2 porcelain insulator cable terminator in kit form.

D. Cast Epoxy Cable Termination: IEEE 48; Class 1 cast epoxy cable termination in kit from with stress cone, shield ground connection, wet porcelain rain shield for outdoor units, epoxy resin molding material, and accessories and molds required for proper application.

E. Modular Cable Termination: IEEE 48; Class 1, molded rubber cable termination in kit form with stress cone, ground clamp, non-tracking rubber skirts, (load break) connector, rubber cap, and aerial lug.

F. Tape Termination: IEEE 48; Class 1, tape termination kit with semi-conductive tape, stress control tape, splicing tape, vinyl plastic tape, stress cone, mechanical ground straps, and cable preparation kit.

G. Elbow Connectors and Bushings: IEEE 386, as indicated.

H. Pulling Lubricant: Specifically approved by the wire/cable manufacturer.

2.3 CABLE FAULT INDICATORS

A. Provide single-phase auto resetting type cable fault indicators. Fault indicators shall provide positive visual indication for normal and faulted condition. Trip current shall be two times full load current of cable to be attached to. Provide a fault indicator test tool to allow testing of fault indicators.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that mechanical work likely to damage wire is complete.

B. Verify that raceway is ready to receive cable.

3.2 PREPARATION

A. Completely and thoroughly clean raceway before pulling cables.

3.3 INSTALLATION

A. Install cable and accessories in accordance with manufacturer's instructions.

B. Avoid abrasion and other damage to cables during installation.

C. Use suitable lubricants and pulling equipment.

D. Utilize pull boxes and manholes for pulling cables.

E. Do not exceed cable pulling tensions and bending radius. Record and submit actual pulling tensions for each pull.
   1. If actual pulling tension exceeds manufacturer's maximum pulling tension, remove and discard cable.
   2. Install ground cable in manholes along wall providing longest route.

F. Terminate ground cable and, where a splice is made, the medium voltage shield wire to a ground rod in the pull box or manhole.

G. Install cables in manholes along wall providing longest route. All cables shall be securely supported from the manhole or pull box walls by hot-dipped galvanized cable racks equipped with adjustable hooks and insulators.

H. Arrange cable in manholes to avoid interference with duct entrances.

I. Fireproof cables in manholes using fireproofing tape in half-lapped wrapping. Extend fireproofing 1 inch into duct.

J. Label each wire in each pull box and cabinet with wire numbers shown on cabinet shop drawings.

K. Make terminations in accordance with the termination manufacturer's instruction.

L. Cable splices shall be suitable for continuous immersion in water. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint.

M. Component watertight packaging shall be unopened until immediately before materials are to be installed on the cable. Junctions shall be installed with the shipping caps in place until elbows or dead-end caps are installed.

N. Install cable fault indicators at cable elbow terminators, at the pad-mounted vacuum switches, pad-mounted transformers, and the metal-clad switchgear.

O. Equipment grounding conductors shall be installed with each medium-voltage circuit. Grounding conductors shall be 600-volt class, THW or THWN, insulated cables of the indicated sizes and as specified in Sections 26 05 19 and 26 05 26.

3.4 FIELD QUALITY CONTROL

A. Site Tests
   1. Test under provisions of Section 26 08 13.
   2. High Potential Test:
      a. Perform high potential test on cable after installation. Test each length of each cable in system with terminations in place when disconnected from equipment.
      b. Test in accordance with ATS, voltage test after installation. Use DC test voltage of 50 kV for 12 kV cables, and 25 kV for 5 kV cables.
      c. Record date, time, temperature and humidity.
      d. Increase test voltage from one step to next in five equal steps. Make duration of each step long enough for absorption current to obtain reasonable stabilization; 1 minute minimum. Record current and voltage readings at each step and prepare a written copy of test for submission to the County Representative and including operations and maintenance manual.
      e. Following tests, a hazardous voltage may exist on cable grid. Prior to handling, ground the conductor to drain any charge to earth.
      f. Repair or replace cables which fail test. Test repaired or replaced cables in same manner.

B. Inspection
   1. Field inspection and testing will be performed under provisions of Section 01 45 00.
   2. Inspect exposed cable sections for physical damage.
   3. Inspect shield grounding, cable supports, and terminations for proper installation.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600V AND BELOW)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Conductors (600V and below).
   2. Wiring connectors and connections.
   3. Communications data cable.
   4. Pulling lubricant.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. UL 486A-486B-2003 - Wire Connectors.

B. UL 510-2005 - Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installation.

C. Quality Assurance/Control Submittals
   1. Test Reports
      a. Submit certified megger test results.

1.4 QUALITY ASSURANCE

A. QUALIFICATIONS
   1. Manufacturer: Company specialized in manufacturing products specified in the Section with a minimum of 5 years experience.

1.5 PROJECT CONDITIONS

A. Existing Conditions
   1. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

2. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

B. Field Measurements
1. Verify that field measurements are as shown on Drawings.

PART 2 PRODUCTS

2.1 CONDUCTORS (600V AND BELOW)

A. Description: Single conductor insulated wire.

B. Conductor: Copper

C. Insulation Voltage Rating:600 volts.

D. Conductor Identification: Color code all conductors in accordance with CEC Article 310 - Conductors for General Wiring comply with temperature requirements of CEC 110-14(c).
1. Color code all feeders and branch circuits with the following colors.
2. Use the following colors in lighting and power wiring:

	120/208 VOLT	277/480 VOLT
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutrals	White	Gray/White
Ground	Green or Bare	Green or Bare

3. Color coding of ends only will be acceptable for feeder phase conductors.
4. Wire marker sleeves permanently marked with wire/circuit designation may be used in lieu of color coding for control wiring.

E. Insulation:
1. Type THHN/THWN or XHHW insulation for feeders and branch circuits larger than 4 AWG;
2. Type THHN/THWN insulation for feeders and branch circuits 6 AWG and smaller.
3. Type SFF-2 for fixture wires or circuit runs in fixtures.

F. Stranding:
1. #8 AWG and larger; stranded, Class B.
2. Totally within panels or cabinets; stranded, Class B
3. Hinged wiring; extra flexible stranding, Class C.
4. Other situations; solid.

G. Equipment Grounding Conductors:
1. Stranded copper conductors, size as required by CEC.

H. Comply with CEC Articles 210 - Branch Circuits, 215 - Feeders, and 250 - Grounding.

2.2 WIRING CONNECTORS

A. Spring Wire Connectors:
1. 3M Model Scotchlok or Hyflex.
2. Buchanan.
3. Burndy.
4. Elastimold.
5. Ideal Model Wingnut or Wirenut.
6. Thomas & Betts.

B. Compression Connectors:
1. Type with prestressed insulation to equal insulation of wire being installed.
2. Conform to UL 486A-486B.

C. Power Conductors Splicers:
1. Blackburn.
2. Burndy “Hylug”.
3. Ilsco.
4. O.Z. Gedney.

D. Insulating Tape.
1. Conform to UL 510.

E. Cable Ties.
1. Scotchflex #760.
2. Thomas & Betts “Tyrap”.

2.3 COMMUNICATIONS DATA CABLE

A. Communications Data Cable for PLC and Remote I/O Network: Type recommended by the equipment manufacturer.

B. Provide shielding, if required to prevent interference from data cables installed in the same conduits as other intercom and low-level dc signal cables.

2.4 PULLING LUBRICANT

A. Specifically approved for pulling wire/cable in accordance with the wire/cable manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verifications of Conditions
1. Verify that interior of building has been protected from weather.
2. Verify that mechanical work likely to damage wire has been completed.
3. Verify conduit and raceway systems are completed.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Application;
   1. Use conductor not smaller than 12 AWG for power and lighting circuits.
   2. Use conductor not smaller than 14 AWG for control circuits, unless otherwise indicated.
   3. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet. Use same size wire for entire circuit, except for taps.
   4. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet. Use same size wire for entire circuit, except for taps.
   5. Install all wiring in raceway. Lighting and receptacle home runs indicated are for identification purposes only.
   6. Two or three branch circuits may be carried on one neutral leg as permitted by CEC.
   7. Run panelboard and motor feeders in individual conduits.

C. Pulling wire;
   1. Verify conduit is clean before pulling cable.
   2. Utilize pull rope for pulling in cable.
   3. Pull all conductors into raceway at same time.
   4. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
   5. Install feeder cables in one continuous length.
   6. Control wiring shall be numbered at both ends with wiremarkers, per Section 26 05 53.
   7. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
   8. Utilize pull boxes and junction boxes for pulling cable.

D. Connections;
   1. Neatly train and lace wiring inside boxes, equipment, and panelboards.
   2. Clean conductor surfaces before installing lugs and connectors.
   3. Make splices, taps, and terminations to carry full capacity of conductors with no perceptible temperature rise.
   4. Use copper split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
   5. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
   6. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
   7. Tighten screws to the value recommended by the manufacturer.
      a. In the absence of manufacturer's recommendations for torque settings, tighten screws to the values shown in UL 486A-486B.
   8. Provide and use terminals for control wiring terminations.

3.4 INTERFACE WITH OTHER WORK

A. Identify wire and cable under provisions of Section 26 05 53.

B. Identify each conductor with its circuit number or other designation indicated in Contract Documents.

C. Mark properly torqued connections with a line, black ink.

3.5 FIELD QUALITY CONTROL

A. Inspect wire for physical damage and proper connection.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

C. Verify continuity of each branch circuit conductor.

D. Megger test and record all feeder conductors.
   1. Replace conductors failing test.
   2. Test replaced conductors in same manner.

END OF SECTION

SECTION 26 05 19

WIRE & CABLE

PART 1 GENERAL

1.1 RELATED WORK ELSEWHERE

A. Section 26 05 33: Conduit and Fittings

B. Section 26 05 26: Grounding

1.2 QUALITY ASSURANCE

A. All wire and cable shall comply with applicable standards of the Underwriters Laboratories, Inc.

B. Certify to the Engineer that all terminations made where a crimping tool is required, have been made using a crimping tool approved by the lug manufacturer.

C. Medium voltage cable (15Kv) terminations shall be made by certified electricians.

1.3 PRODUCT DELIVER, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Contracting Officer, secure from weather or accidental damage.

PART 2 PRODUCTS

2.1 LABELING

A. Electrical conductors for power shall be delivered to the job site plainly marked or tagged on 24" centers as follows:

1. Underwriters Label
2. Gauge
3. Voltage
4. Kind of Insulation
5. Name of Manufacturer
6. Trade Name

B. Conductor labels shall be white PVC tubing with machine printed black marking. Tubing shall be sized to fit conductor insulation. Adhesive strips are not acceptable.

2.2 INSULATION

A. All conductors #10 and smaller shall be 600 volt, type THWN, or THHN except as noted otherwise.

B. All conductors #8 and larger shall be 600 volt, type THWN, XHHW, or THHN except as noted otherwise.

C. All circuit conductors installed within fluorescent fixture raceways shall be 600 volt, 105 degree type, RHH, or THHN except in fixtures that have wiring raceways specifically approved for 75 degree Centigrade wire.

D. All conductors for 12.4 V system be 15 KV, type XLP, shielded.

2.3 CONDUCTORS

A. Unless specifically noted otherwise herein, all conductors for general wiring shall be a minimum of 98% conductivity, stranded, soft drawn copper.

B. All conductors for control wiring shall be stranded copper only.

C. Except where noted on the plans or in this specification, the minimum conductor size shall be #12.

D. Armored cable (Type AC or MC Cable), a fabricated assembly of insulated conductors in a flexible metallic enclosure, is not permissible for use on this project.

E. Nonmetallic-Sheathed Cable (Type NM and NMC), a factory assembly of two or more insulated conductors having and outer sheath moisture resistant, flame retardant, non-metallic material, is not permissible for use on this project.

F. All conductors shall have identical color insulation from circuit breaker or control panel to load or device.

2.4 PULLING LUBRICANT

A. Wire pulling lubricant shall be UL or Factory Mutual approved wire pulling compound.

2.5 CONNECTIONS

A. Wire nuts for joints, splices and taps for conductors #8 and smaller shall consist of a cone shaped expandable coil spring insert, insulated with a teflon or plastic shell. Threaded or crimp types will not be accepted. Use "Skotchlock", "Hydent", or equal.

B. Terminals for stranded conductors #8 and smaller shall be a pre-insulated crimp type.

C. Lugs and connectors for conductors #6 and larger shall be compression types of one piece tubular construction with flat rectangular tongues. Two hole lugs shall be used for sizes 4/0 and larger. Fittings for copper conductors shall be tin-plated copper. Fittings for aluminum conductors shall be tin-plated aluminum, factory filled with a corrosion inhibiting and oxide penetrating compound.

D. Electrical tape shall be UL approved plastic.

2.6 GROUNDING WIRE

A. #12 AWG minimum, tinned, stranded copper conductor with green color insulation.

B. Isolated ground conductors shall be #12 AWG minimum tinned, stranded copper with green color insulation and yellow tracer.

PART 3 EXECUTION

3.1 CLEANING

A. All debris and moisture shall be removed from raceways, boxes, and cabinets before installing wire or cable.

3.2 PULLING

A. No oil, grease or similar substances shall be used to facilitate the pulling in of conductors. Use a specifically approved anti-static wire pulling compound.

B. No wire or cable shall be pulled in until all construction which might damage insulation or fill conduit with foreign material is completed.

C. Wire shall be pulled into conduits with care to prevent damage to insulation. Use basket pulling grips to avoid slipping of insulation on conductors. Nylon rope or other "soft" surfaced cable must be used for pulling in conduits other than steel.

D. Provide a mandrel pull in all switchboard and panelboard feeder conduits prior to installing conductors.

3.3 CONNECTIONS

A. Stranded conductors #8 and smaller shall be terminated with terminals of appropriate size where connected to screw type lugs.

B. Joints, splices and taps in dry locations for conductors #8 and smaller shall be made with twist-on connectors suitably sized for the number and gauge of the conductors.

C. Furnish and install proper lugs in all panelboards, switchboards and gutters as required to properly terminate every cable. Where paralleled conductors or conductors of large size are to terminate on a breaker, a short length of copper cable (of capacity of the breaker) shall be connected to the breaker, and the proper compression type lug installed to connect this cable to the feeder cable. The cutting of cable strands to fit the breaker will not be permitted.

D. Connections of copper to aluminum bus bars and lugs shall be made using Belleville washers and flat washers to compensate for differing rates of thermal expansion.

E. Only crimping tools approved by the manufacturer of the terminals or lugs shall be used.

F. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire and switchboards, with all irregular surfaces properly padded with insulating putty prior to application of tape. Wire in panels, cabinets, pullboxes and wiring gutters shall be neatly grouped together and laced with #12 standard lacing twine, or cable ties.

G. In underground locations, joints, splices and taps shall be insulated by the "Skotchcast" epoxy-resin method.

3.4 COLOR CODING AND LABELING

A. All wiring shall be color coded as follows:

	277/480V	120/208V
Phase A:	Brown	Black
Phase B:	Orange	Red
Phase C:	Yellow	Blue
Neutral:	Gray	White
Ground:	Green	Green

B. In addition to color coding, all power, control and alarm wiring shall be numbered and identified by means of wire markers at all switchboards, panelboards, auxiliary gutters, junction boxes, pullboxes, receptacle outlets, light outlets, disconnect switches, and circuit breakers. These markers shall correspond to numbers on shop drawings.

3.5 FIELD QUALITY CONTROL

A. Operating Test: After installation has been completed, Contractor shall conduct an operating test. The equipment shall be demonstrated to operate in accordance with the requirements of this section of the specifications. Contractor shall furnish necessary instruments and personnel required for test.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Materials and methods for grounding systems and equipment.
   2. Grounding electrodes and conductors.
   3. Equipment grounding conductors.
   4. Bonding.
   5. Grounding well.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 08 13 - Acceptance Testing.

1.2 SYSTEM DESCRIPTION

A. The following shall be acceptable grounding electrodes:
   1. Concrete-encased electrode.
   2. Ground ring.
   3. Rod electrode.
   4. Metal Underground Pipe.
   5. Metal Frame of Building.

1.3 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance:
   1. Building grounding electrode: 10 ohms.
   2. Separately Derived Sources grounding electrode: 10 ohms.
   3. Non-Current carrying metal parts: 25 ohms.
   4. Grounds not covered above: 25 ohms.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installations.

C. Quality Assurance/Control Submittals
   1. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
   2. Manufacturer’s Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

D. Closeout Submittals
   1. Project Record Documents: Accurately record actual locations of grounding electrodes.

PART 2 PRODUCTS

2.1 ROD ELECTRODE

A. Material: Copper-clad steel.

B. Diameter: 3/4 inch.

C. Length: 10 feet.

2.2 MECHANICAL CONNECTORS

A. Acceptable Manufacturers:
   1. Burndy.
   2. Thomas & Betts.

B. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

A. Acceptable Manufacturers:
   1. Burndy.
   2. Cadweld Division, Erico Products.

2.4 WIRE

A. Material: Stranded bare copper.

B. Foundation Electrodes: #4 AWG minimum.

C. Grounding Electrode Conductor: as indicated or per CEC Article 250, whichever is larger.

2.5 GROUNDING WELL COMPONENTS

A. Well Pipe: 11 x 17 x 12 inch square clay tile or concrete pipe with belled end.

B. Well Cover: Cast iron with legend “GROUND” embossed on cover.

2.6 GROUNDING CLAMPS

A. Acceptable Manufacturers:
   1. Burndy.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Install Products in accordance with manufacturers’ instructions.

B. Ground Electrodes: Provide a grounding electrode system in the main electrical room/space of each building as follows:
   1. Provide a 2-inch x 1/4-inch copper ground bar. Length shall be a minimum of 12 inches but longer as required for the number of connections made to the bar. This bar shall serve as the connection point for all grounding electrodes in the building. Install the copper ground bar in a NEMA 1 screw cover cabinet, minimum size 18 inches x 12 inches x 6 inches.
   2. Connect the copper ground bar to the underground metal pipe (other than gas).
      a. Connect to metal pipe with approved pipe clamp near the pressure reducing valve.
      b. Connect to ground bar with exothermic weld.
      c. Connect to metal pipe with copper clamp where copper water pipe occurs and with a malleable iron clamp where cast iron pipe occurs.
      d. Install grounding conductor, sized as indicated on plans, in a 3/4-inch metal conduit from the ground cabinet to the water pipe. Provide grounding bushings at each end of the conduit.
   3. Connect the copper ground bar to the metal frame of the building.
      a. At all steel framed buildings, provide a connection to the closest column.
      b. Connect to column with exothermic weld.
      c. Connect to the ground bar with exothermic weld or bolted-type connector.
      d. Install grounding conductor, sized as indicated on the plans, in a 3/4-inch metal conduit from the ground cabinet to the column. Provide grounding bushing at each end of the conduit.
   4. Connect the copper ground bar to a concrete-encased electrode/Ufer.
      a. Install a minimum of 20 feet of #310 AWG conductor (minimum unless noted otherwise) encased in a minimum of 3 inches of concrete. Provide a non-metallic protective sleeve, minimum 6 inches long (3 inches in the concrete and 3 inches out of the concrete), located where the conductor exits the concrete.
      b. Install a #310 conductor from the ground bar to the concrete-encased electrode in a 3/4-inch metal conduit with grounding bushings. Make connections to the concrete-encased electrode with a bolted-type connector and transition from the metal conduit and non-metallic sleeve.
      c. Connect to the ground bar with exothermic weld or bolted-type connector.
      d. plans.
   5. Provide additional ground rod or concrete-encased electrodes as required to meet the performance requirements listed in paragraph 1.03 at the ground bar.
      a. Install additional ground rods a minimum of 5 feet from any other rod.
      b. Notify the County Representative if performance requirements have not been met after installing 2 additional ground rods or concrete-encased electrodes.
   6. Install other grounding electrodes as indicated on the single line diagram and other Contract Documents.

C. Grounding Electrode Conductor
   1. Install grounding electrode conductor from the main normal and emergency power panels and each separately derived system in the building to the ground bar (grounding electrode system). Install grounding electrode conductor in steel conduit and bond grounding conductor to conduit at entrance and exit. Connect to the ground bar (grounding electrode system) with exothermic weld.
      a. Unless otherwise indicated, install main ground unspliced.
      b. Make connections easily accessible for inspection in ground bar cabinet.
   2. Grounding electrode conductor shall be of the same type and quality as other conductors in the building.

3. The main neutral to ground bonding jumper will be located at the site utilities switchboard. Locate additional neutral to ground bonding jumper at separately derived systems only, or at the main service panel when the building is served from a dedicated transformer. Neutral bar with all interior secondary neutrals shall be isolated from the common equipment grounding bus at all other locations.

D. Bonding
1. Provide bonding to meet requirements of CEC.
2. Bond together metal siding not attached to grounded structure; bond to ground.
3. Bond pre-fabricated metal building to grounding electrode system at a minimum of one location.
4. Bond together all metallic conduit, boxes, cabinets and enclosures.

E. Grounding Conductors
1. Provide isolated grounding conductor for circuits indicated.
2. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder circuit raceway and within each motor feeder raceway. Terminate each end on suitable lug, bus, or bushing.
3. Provide separate, isolated grounding conductor for each circuit which is installed (all or in part) in non-metallic conduit.
4. Provide separate grounding conductor for circuits installed in flexible steel conduit. Terminate each end on a suitable lug, bus or bushing.
5. Ground all conduit systems, cabinets, equipment, motor frames, etc., in accordance with CEC and applicable codes.

F. Grounding Connections
1. Ground shields of shielded power cable and signal cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer.
2. Ground metal sheathing and exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to that equipment. Provide good electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.
3. Ground all fencing as shown on the grounding details on the Drawings.
4. Bond neutrals of transformers within buildings to the system ground network, and to additional indicated grounding electrodes.
5. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade.
6. Make connections of sections of outdoor ground mats (counterpoise) for substations or other equipment underground. Make connections of other grounding conductors generally accessible.
7. In manhole pull boxes, install ground rods with ends 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.
8. When making thermite welds, wire brush or file the point of contact to a bare metal surface. Use thermite welding cartridges and molds in accordance with the manufacturer’s recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint. Re-galvanize area if required. For compression connectors, use homogeneous copper, anti-corrosion, surface treatment compound at connectors in accordance with connector manufacturer’s recommendations. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer’s compression tool. Notify the County Representative prior to backfilling any ground connections.

9. Grounding pad plates shall be cast into the slab with the surface flush with the finished floor.

3.3 FIELD QUALITY CONTROL

A. Site Tests
   1. Test under provisions of Section 26 08 13.
   2. Notify the County Representative five days before inspection and testing.
   3. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.
   4. Remove main bonding jumper at main service switchboard and at each separately derived system and test for infinite resistance between neutral and ground systems. Reconnect bonding jumper(s).
   5. Record test results in accordance with 26 05 00 and submit.

B. Inspection
   1. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Equipment supports.
   2. Raceway supports.
   3. Anchors and fasteners.

B. Related Sections
   1. Section 05 05 55 - Tamper Proof Metal Fastenings.
   2. Section 26 05 00 - Common Work Results for Electrical.
   3. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

1.2 REFERENCES

A. ASTM A36/A36M-2008 - Carbon Structural Steel.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Hangers and supports shall have minimum safety factor of five (5), based on ultimate tensile or compressive strength, as applicable, of material used.
   2. Anchors shall be applied in accordance with the ANCHOR CAPACITY TABLE following paragraph 3.2.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Design Data
   1. Indicate hanger and support framing and attachment methods.
   2. Submit seismic zone 4 and structural calculations in accordance with Section 26 05 48.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide corrosion resistance that provides as a minimum the same protection as the products being supported.

B. Provide materials, sizes and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire equal to full capacity of raceway in calculations for supports.

C. Anchors and Fasteners.
   1. Sheet Metal Screws: Steel.
   2. Machine Screws, Bolts, Nuts, and Washers: Steel.

3. Precast Inserts: Suitable for the purpose.
4. Anchor bolts, expansion type (stainless steel).
   a. Phillips Red-Head.
   b. Hilti Kwik-Bolt.
   c. WEJ-IT
5. Cast-in-Place Anchors: Suitable for the purpose (hot-dip galvanized except cadmium plated in dry locations).
6. Beam Clamps: Steel.
7. Tamper Proof Metal Fasteners: In accordance with Section 05 05 55.

D. Raceway Supports
1. Conduit Straps Used with Rigid Steel Conduit: One hole malleable iron, cadmium plated.
2. Conduit Straps Used with Other Than Rigid Steel Conduit: One or two hole steel, cadmium plated.
3. Clamp Backs: Steel, cadmium plated.

E. Channels
1. Acceptable Manufacturers
   a. Unistrut.
   b. Powerstrut.
   c. B-line.
2. Material
   a. 12 gauge steel, 1-5/8 inches by 1-5/8 inches when not attached to building surface.
   b. 14 gauge steel, 1-5/8 inches wide by 13/16 inches deep when connected directly to building surface.
   c. Hot-dip galvanized except cadmium plated in dry locations.
3. Fittings: By channel manufacturer.

F. Hanger Rods:
1. Material: 1/4 inch minimum hot-dip galvanized after fabrication.

G. Structural Steel:
1. Material: ASTM A36/A36C.
2. Finish:
   a. Dry Locations: Shop coat of rust inhibiting primer.
   b. Otherwise hot-dipped galvanized after fabrication.

H. Pipe/Conduit Hangers: Hot dipped galvanized steel or malleable iron.

PART 3 EXECUTION

3.1 INSTALLATION

A. General
1. Install products in accordance with manufacturer's instructions.
2. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.
3. Do not drill or cut structural members without approval of the Structural Engineer.
4. Provide and install tamper proof metal fasteners in inmate accessible areas in accordance with Section 05 05 55.

B. Anchors
   1. Concrete - Precast inserts, cast-in-place anchors or expansion type anchor bolts.
      a. When installing drilled-in anchors in non-prestressed reinforced concrete, avoid the reinforcing bars.
      b. When installing drilled-in anchors into prestressed concrete (pre- or post-tensioned), locate tendons by using a non-destructive method prior to installation. Maintain a minimum clearance of one-inch between the reinforcement and the drilled-in anchor.
   2. Sheet Metal - Sheet metal screws or machine bolts, nuts and washers.
   3. Structural Steel Members - Beam clamps, machine screws, bolts, nuts and washers.

C. Supports
   1. Fabricate supports from structural steel or steel channel. Rigidly weld or bolt members to present a neat appearance with adequate strength and rigidity.
   2. Vertical adjustment on threaded rods shall be with 2 nuts on each end for positioning and locking.

D. Conduit
   1. In damp or wet locations, space conduit support directly from concrete or metal structure out at least 1/4 inch using straps with spacers or, if three (3) or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8 inch to 1 inch by means of channel.
   2. Runs of individual conduit suspended from the floor or ceiling shall be supported with pipe hangers. Where three (3) or more conduits are suspended from the floor/ceiling, suitable racks shall be constructed from channel material with suitable fittings.
   3. Space supporting points no greater than required by CEC.

E. Raceway Other Than Conduit
   1. Support from structure in accordance with manufacturers' instructions.

F. Equipment
   1. Install surface-mounted cabinets and panelboards with a minimum of four anchors.
   2. In wet and damp locations use steel channel supports to stand cabinets and panelboards 13/16 inch minimum off wall.
   3. Use sheet metal channels to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
   4. Support equipment in accordance with manufacturer's instructions.
   5. Verify that equipment will fit support layouts indicated.
      a. Where substitute equipment is used, revise indicated supports to fit at no additional cost.
   6. Arrange for necessary openings to allow entry of equipment.
      a. Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves or other devices to allow later installation.

G. Sleeves
   1. Set sleeves in position in formwork. Provide reinforcing around sleeves.
   2. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.
   3. Where raceway penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal.

3.2 FIELD QUALITY CONTROL

A. All expansion anchors shall have 50 percent of the bolts (alternate bolts in any group arrangement) proof tested in tension and certified by a recognized testing agency at the values indicated in the following table, except where shown otherwise in the Contract Documents. If there are any failures, the immediately adjacent bolts must then also be tested. Anchor capacities shall not exceed 80 percent of the values in the published ICBO report.

ANCHOR CAPACITY (3,000 PSI MINIMUM STONE AGGREGATE CONCRETE)							
	1/2 inch	5/8 inch	3/4 inch	7/8 inch	1 inch	1-1/4 inches	UNITS
IN TENSION	680	960	1,360	1,900	2,700	3,600	LBS
IN SHEAR	1,170	1,680	2,420	3,500	5,020	6,700	LBS
TYPE OF TEST:							
DIRECT PULL-TENSION, LBS.	1,360	1,920	2,720	3,800	5,400	7,200	LBS
MINIMUM EMBEDMENT	3	3-3/4	4-1/2	5-1/4	6	7-1/2	INCHES

END OF SECTION

SECTION 26 05 34

OUTLET AND JUNCTION BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Outlet boxes.
   2. Floor boxes.
   3. Pull and junction boxes.

B. Related Sections
   1. Section 05 05 55 - Tamper Proof Metal Fastenings.
   2. Section 07 84 00 - Firestopping.
   3. Section 08 31 13 - Access Doors and Frames.
   4. Section 26 27 16 - Electrical Cabinets and Enclosures

1.2 REFERENCES

A. NEMA OS 1-2003 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

B. NEMA 250-2003 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. UL 514A-2004 - Metallic Outlet Boxes.

D. UL 886-1994 -Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Closeout Submittals
   1. Project Record Documents: Accurately record actual locations and mounting heights of all boxes.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Furnish products listed and classified by UL as suitable for purpose specified and shown.
   2. Compliance with CEC with particular attention to Article 110.

1.5 PROJECT CONDITIONS

A. Field Measurements
   1. Verify field measurements are as shown on the Drawings.
   2. Boxes are indicated in approximate locations unless dimensioned. Verify locations prior to rough-in.
   3. Coordinate mounting heights and locations of boxes mounted above, below, in, or on counters, benches and backsplashes.
   4. Coordinate cutting of masonry to achieve neat installation.

5. Provide access panels in ceilings, partitions, enclosures, etc. as required in order to achieve easy access to all equipment and devices provided or installed under Division 26 Work. Many access panel locations may be indicated on the Drawings. Provide additional access panels as required.
    a. For non-security walls, partitions, ceilings, enclosures, etc.: Provide non-security access panels as Work of Division 26 Requirements for access doors/panels are specified in Section 08 31 13.

    b. For security walls, partitions, ceilings, enclosures, etc.: Provide security access panels as Work of Division 26 Requirements for security access panels are specified in Section 08 34 53.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal: NEMA OS 1, galvanized steel.
1. Manufacturers:
    a. Appleton.
    b. Bowers.
    c. Raco.
    d. Steel City.
2. Concrete/Masonry Boxes: Concrete/Masonry Type.
3. Minimum Size: 4 inches square; 2-1/2 inches deep at ceilings; 3-1/2 inches deep at concrete or masonry walls; 2-1/8 inches deep with a raised 1-inch device cover at metal stud walls.
    a. Use of 2-1/2-inch deep single gang boxes shall be permitted when there is only one conduit entry into the box.

B. Cast Boxes
1. Manufacturers:
    a. Crouse Hinds, FS or FD Series.
    b. Non-hazardous rating: UL 514A, Type FD, cast feraloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
    c. Boxes in Hazardous Locations: UL 886.

2.2 FLOOR BOXES

A. Stamped Steel - Watertight
1. NEMA OS 1, fully adjustable, stamped steel with galvanized finish or cast metal, rectangular, and shall accept a standard duplex receptacle, data or communications device.
2. For concrete pours 3 inches and greater
    a. Box shall have a 1-1/4-inch prior to and 3/8-inch after pour vertical and angular adjustment.
    b. Box shall have six 3/4-inch and nine 1/2-inch knockouts.
    c. Minimum box capacity shall be 36 cubic inches.
    d. Box shall have a removable top for conduit connections.
3. For concrete pours 4 inches and greater:
    a. Box shall have 1-1/4-inch prior to and 3/8-inch after pour vertical and angular adjustment.

b. Box shall have two 1-1/4-inch, two 1-inch, four 3/4-inch and five 1/2-inch knockouts.
c. Minimum box capacity shall be 53 cubic inches.

B. Cast Iron - Concrete Tight
1. For concrete pours, 3 inches and greater:
a. Box shall be cast iron with a gray polyester corrosion-resistant finish.
b. Box shall have a removable top for conduit connections.
2. For shallow pours, 2 inches and greater:
a. Box shall be cast iron and semi-adjustable type.

C. Covers
1. For stamped steel and cast iron, round and rectangular:
a. Covers shall be brushed brass and able to be mounted to the aforementioned boxes.
b. Flush mounted, suitable for single, duplex receptacle, data and communications devices.

2.3 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Surface-Mounted: NEMA 250, Type 4; flat-flanged.
1. Material: Galvanized cast iron or steel.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

C. In-Ground Cast: NEMA 250, Type 6, outside or inside flanged, as required recessed cover box for flush mounting.
1. Material: Galvanized cast iron.
2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: ELECTRIC.

PART 3 EXECUTION

3.1 INSTALLATION

A. General
1. Provide boxes as indicated, and as required by the CEC.
2. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
3. Install boxes to preserve fire resistance rating of partitions and other elements using materials and methods per Section 07 84 00.
4. Do not install flush mounting boxes back-to-back in walls.
a. Provide minimum 24inches separation between boxes in acoustic and fire-rated walls and 6inch separation between boxes in other locations.
b. Install flush mounting box without damaging wall insulating or reducing its effectiveness.
5. At access panel in ceilings, install boxes not more than 6 inches horizontally from panel opening or from removable recessed luminaries.
6. At masonry walls and partitions, locate flush mounting box at corner of block to reduce cutting.

B. Outlet Boxes
   1. Minimum Size: 4 inches square; 2-1/2 inches deep at ceilings; 3-1/2 inches deep at walls.
      a. Exception: 2-1/2 inches deep box allowed if allowed if rebar or other obstructions prevents the use of deeper boxes.
      b. Exception: Single gang 3-1/2 inches deep boxes shall be used in masonry walls when single gang backing plates for single gauge security device plates are provided by others.
   2. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

3.2 APPLICATION

A. Exterior
   1. In-ground: Provide in-ground cast box with cover.
   2. Above-ground: Provide cast box.

B. Interior
   1. Finished Areas: Provide flush-mounted boxes.
   2. Interior Unfinished Areas: Provide flush or surface-mounted boxes, except that exposed surface-mounted boxes will not be acceptable in inmate accessible areas.
   3. Floor Boxes:
      a. Cast iron boxes shall be used in slabs on grade level or below.
      b. Stamped steel boxes shall be used in slabs above grade level.

C. Pull Boxes Larger than 100 Cubic Inches in Volume or 12 Inches in Any Dimension:
      a. 1. Dry Locations: Provide hinged enclosure under provisions of Section 26 27 16.
   2. At stud walls and partitions, install box and plaster ring allowing for thickness of surface finish. Provide boxes for luminaires and electrical connections to equipment shown on Drawings.
   3. For 1-gang outlets in non-masonry walls, use four-inch square box with four-inch square plaster ring with 1-gang opening.
      a. Boxes smaller than four-inches square not permitted.
   4. For 2-gang outlets, use four-inch square box with four-inch square plaster ring with 2-gang opening.
      a. When normal and emergency circuits are in same box, provide barrier between them.

D. Use gang box where more than one device is mounted together. Do not use sectional box. Provide box with interior barrier for devices on normal and emergency power which are mounted together. In addition, provide barriers where the voltage between adjacent switches exceeds that which is allowed by the CEC.

END OF THE SECTION

SECTION 26 05 35

RACEWAY FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Rigid metal conduit.
2. Intermediate metal conduit.
3. PVC coated rigid metal conduit.
4. Flexible metal conduit.
5. Liquid tight flexible metal conduit.
6. Electrical metallic tubing.
7. Rigid nonmetallic conduit.
8. Fittings.
9. Warning tape.
10. Cable/conduit locator.

B. Related Documents and Sections
1. Section 07 60 00 - Flashing and Sheet Metal.
2. Section 07 84 00 - Firestopping.
3. Section 26 05 00 - Common Work Results for Electrical.
4. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
5. Section 26 05 29 - Hangers and Supports for Electrical Systems.
6. Section 26 05 34 - Outlet and Junction Boxes for Electrical Systems.
7. Section 26 05 63 - Identification for Electrical Systems.
8. Section 27 05 28.34 - Telephone Raceway System.
9. Section 31 23 33 - Trenching and Backfill.

1.2 REFERENCES

A. ANSI C80.1-2005 - Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.3-2005 - Steel Electrical Metallic Tubing (EMT)

C. NEMA FB 1-2007 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

D. NEMA RN 1-2005 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

E. NEMA TC 2-2003 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.

F. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

G. UL 1-2005- Flexible Metal Conduit.

H. UL 6-2007- Electrical Rigid Metal Conduit - Steel.

I. UL 360-2003 - Liquid-tight Flexible Steel Conduit.

J. UL 514B-2004 - Conduit, Tubing, and Cable Fittings.

K. UL 651-2005 - Schedule 40 and 80 Rigid PVC Conduit and Fittings.

L. UL 797-2007 - Electrical Metallic Tubing - Steel.

M. UL 1242-2006 - Electrical Intermediate Metal Conduit - Steel.

N. FS-A-A-55810-1996 - Conduit, Metal, Flexible.

O. FS-A-A-50552-1995 - Fittings, For Cable, Power, Electrical and Conduit, Metal, Flexible.

P. FS-A-A-50553A-2005- Fittings for Conduit, Metal Rigid (Thick-wall and Thin-wall).

1.3 DESIGN REQUIREMENTS

A. Conduit Size: As indicated. When not indicated or when equipment has been substituted, size per CEC except no smaller than 3/4-inch.

1.4 SUBMITTALS

A. Submit under provisions of Division 01 33 00.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installation.

1.5 AS-BUILT DOCUMENTS

A. Submit under provisions of Section 01 78 00.

B. Accurately record actual routing of conduits larger than 2 inches in diameter.

1.6 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 PRODUCTS

2.1 RIGID METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1, UL 6.
1. Stamp each length with manufacturer’s name or trademark and U/L label.

2.2 INTERMEDIATE METAL CONDUIT

A. Material: Rigid steel; hot-dip galvanized.
1. UL 1242 and UL 514B.

2.3 PVC COATED RIGID METAL CONDUIT

A. Rigid steel conduit with external PVC coating, 40 mil thick: Requirements for rigid steel conduit and NEMA RN 1.

B. Fittings and Conduit Bodies: Steel fittings with external PVC coating to match conduit.

C. Tape for Joints: As recommended by conduit manufacturer.

D. PVC Coating on conduit and fittings shall have no sags, blisters or other surface defects and shall be free of holes.

E. At Contractor's option, rigid steel conduit may be field wrapped. Use Scotch 51 system, or substitute accepted under provisions of Division 0, with minimum 50 percent overlap.

2.4 FLEXIBLE METAL CONDUIT

A. Interlocked Steel Construction: UL 1, FS-A-A-55810.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Interlocked steel construction with PVC jacket: UL 1 and UL 360.

2.6 ELECTRICAL METALLIC TUBING (EMT)

A. Galvanized Steel Tubing: ANSI C80.3, UL 797 and UL 797.

B. Maximum size shall be 2 inches.

2.7 NONMETALLIC CONDUIT

A. Schedule 40 PVC: NEMA TC 2 and UL 651.
   1. Mark each length clearly and durably with size type of material and U/L label.

B. Solvent and Cement: In accordance with manufacturers' recommendations.

2.8 FITTINGS

A. Acceptable Manufacturer
   1. Thomas and Betts, (T&B).
      a. For reference, Thomas & Betts series numbers are listed below.
   2. Appleton.
   3. Crouse-Hinds.
   4. O.Z. Gedney.

B. Standards
   1. Metallic: NEMA FB1 and UL 514B ferrous.
      a. Flexible: FS-A-A-50553A.
   2. Non-metallic: NEMA TC3.

C. Locknuts:
   1. Hardened Steel or malleable iron construction, electro zinc plated, capable of insuring positive bond to enclosure.
      a. Non-bonding: T & B Series 142.
      b. Bonding: T & B Series 107.

c. Crouse-Hinds.
d. Appleton.

D. Bushings:
1. Insulated: T & B Series 223.
2. Insulated Metallic Bushing: T & B Series 1223.
3. Insulated Grounding and Bonding Bushing: T & B Series 3871.
4. Crouse-Hinds.
5. Appleton.

E. Couplings:
1. Non-metallic Conduit Coupling: By non-metallic conduit manufacturer for the purpose.
2. Threaded Rigid Metal Conduit Couplings: By conduit manufacturer for the purpose.
3. Threadless Coupling: “Erickson” Type; T & B Series 676.
4. EMT Coupling, Raintight: T & B Series 5220.
5. Expansion Type: permit 3/4 inch movement any direction.
a. Exposed: Weatherproof with external bonding jumper.
b. Embedded: Watertight with internal bonding jumper.
6. Crouse-Hinds.
7. Appleton.

F. Connectors:
1. Non-Metallic Conduit Connector: By conduit manufacturer for the purpose.
2. Threaded Hubs: Electro zinc coated with nylon insulated throat and oil/moisture resistant recessed sealing ring, raintight.
a. Non-bonding: T & B series 371.
b. Bonding: T & B Series 371 with 107 series bonding locknut.
3. EMT Connectors, Raintight: T & B Series 5223.
4. EMT to Rigid Metal Conduit Connector: Raintight - T & B Series 531.
5. Flexible metal conduit connector - Insulated throat, suitable as grounding means. T & B Series 3115.
6. Liquid-tight flexible metal conduit connector FS-A-A-50552, electro zinc plated inside and outside, with nylon insulating throat and taper threaded hub.
a. Non-External Bonding - T & B Series 5333.
b. External Bonding - T & B Series 5333GR.
7. Crouse-Hinds.
8. Appleton.

G. Nipple: “Chase” Type, Insulated; T & B Series 1943.

H. Sealing Gaskets: Oil and moisture resistant rubber bonded to metallic retainer.
1. With rigid conduit - T & B Series 5303.
2. With liquid tight flexible conduit - T & B Series 5263.
3. Fittings not specifically listed but required shall be of similar style and quality.

2.9 CONDUIT BODIES

A. Standards - NEMA FB-1 and FS-A-A-50553A.

B. Ferrous with threaded hubs and gasketed cover.

2.10 SEALANT

A. Internal to fittings.
   1. Approved by manufacturer for application.
   2. Manufacturer:
      a. Crouse Hinds Chico A-P and Chico X Fiber.
      b. O.Z. Gedney.

2.11 WARNING TAPE

A. Tape: Heavy-gauge, yellow plastic; minimum 6inch width for use in trenches containing electric circuits; material resistant to corrosive soil and containing a metallic tracer wire for use with cable locators; printed warning that electric circuit is located below the tape.
   1. Manufacturers and Types:
      a. 3M.
      b. Calpico.
      c. Plymouth, Vinyl Tape.
      d. Griffolyn Co, Terra Tape.
      e. ITT Blackburn, Type YT or RT.

2.12 CABLE/CONDUIT LOCATOR

A. Locator: Hand-held, self contained, cable/conduit locator capable of inducing a signal on a cable and detecting a 60 Hz power signal.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Installation Standards:
   1. Install conduit in accordance with NECA “Standard of Installation.”
   2. Telephone system conduits shall be installed in accordance with Section 27 05 28.34.
   3. Ground and bond conduit under provision of Section 26 05 26.
   4. Identify conduit under provisions of Section 26 05 53.
   5. Where conduit systems penetrate or parallel fire and/or smoke rated walls, ceilings, roofs or floors, maintain the fire rating integrity. Comply with Section 07 84 00.
   6. Install nonmetallic conduit in accordance with manufacturer’s instructions.
   7. Provide heavy nylon cord pull string in each empty conduit except sleeves and nipples. Pull line to have a minimum of 200 pound pull strength. Tag each end of string with destination. Leave a minimum of 24 inches of slack and tie-off at each end.
   8. Within finished areas of building. Install all conduits concealed.
   9. Exposed overhead conduit may be used in areas with exposed metal structure, Switchgear Rooms, Mechanical Equipment Rooms, Electric Closets, and Equipment Rooms only.
   10. Locate boxes in accordance with Section 26 05 34 before installing conduit.
   11. Do not use setscrew type couplings, bushings, elbows, nipples, or other fittings for Intermediate Metal Conduit unless specifically approved by the County Representative.

B. Supports:
   1. Arrange supports to prevent misalignment during wiring installation.
   2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

3. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
4. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.
5. Do not attach conduit to ceiling support wires.
6. Conduit Installation:
    a. Support all conduit systems from building structure or walls with approved hangers.
        1) Do not support from piping, ducts or support system for piping or ducts.
        2) Do not install to prevent ready removal of piping, ducts or ceiling tiles.
        3) Do not support from ceiling or ceiling support systems.

C. Routing:
1. Arrange conduit to maintain headroom and present neat appearance.
2. Route conduit in and under slab from point-to-point.
3. Route other conduit parallel and perpendicular to walls.
4. Unless otherwise indicated or specifically approved by the County Representative, route conduit below metal decks without concrete toppings.
5. Maintain adequate clearance between conduit and piping.
6. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
7. In outdoor, underground, or wet locations, use watertight couplings and connections in raceways.
8. Thoroughly clean threads of oil, tailings and paint threads of galvanized conduits that are installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound before assembling.
9. Do not notch or penetrate structural members for passage of raceways except with prior approval of the County Representative.
10. Do not run raceways in equipment foundation pads.
11. Install concealed, embedded, and buried raceways so that they emerge at right angles to the surface and have none of the curved portion of the bend exposed.

D. Fitting:
1. Cut conduit square using saw or pipe cutter; de-burr cut ends.
2. Bring conduit to shoulder of fittings; fasten securely.
3. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
4. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
5. Install no more than equivalent of four 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2 inch size.
6. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
7. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic zone 4, control and expansion joints.
8. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
9. Make joints in threaded conduit watertight with white nonleaded compound applied to male threads only.
    a. Cut square, ream smooth, and properly thread filed joints to receive couplings.

b. Do not use running threads. Fit all conduit ends at switch and outlet boxes with approved lock nuts and bushing forming approved tight bond with box when screwed tightly in place.

10. Remove moisture and debris from conduit before wire is drawn into place. Tightly plug ends of conduit with plastic inserts until wire is pulled.
11. Neatly seal openings around conduits, etc., where they pass through fire rated construction or exterior walls or roof in accordance with Section 07 84 00.
12. Install conduit to roof exhaust fans through fan housing with no conduit exposed.
13. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified under Section 07 60 00.
14. Provide escutcheon plates at exposed wall, ceiling and floor conduit penetrations.

E. Bends:
1. Make changes in direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible, but where necessary, make with an acceptable hickey or conduit bending machine. Do not heat metal raceways to facilitate bending.
2. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel and of neat appearance. Factory elbows may be used in parallel or banked raceways if there is a change in the plane of the run and the raceways are of the same size. Otherwise, make field bends in parallel runs.
3. For PVC conduits, use factory made elbows for all bends 30 degrees or larger. Use acceptable heating methods for forming smaller bends.
4. For duct bank runs for site electrical distribution including signal/communications ducts, use only utility type large radius sweeps, (12 times trade size).
5. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduit's flexibility.

F. Bushing and Insulating Sleeves:
1. Where metallic conduit enters metal equipment enclosures through conduit openings, install a bonding bushing on the end of each conduit. Install a bonding jumper from the bushing to any equipment ground bus or ground pad.
2. If neither exists, connect the jumper to a lag-bolt connection to the metallic enclosure.
3. Use manufacturer's standard insulating sleeves in all metallic conduits terminating at an enclosure.

G. Penetrations:
1. Seal the interior of all raceways entering structures including manholes, handholes, and pullboxes at the first box or outlet with oakum or suitable plastic expandable compound to prevent the entrance into the structure of gases, liquids, or rodents.
2. Dry pack with nonshrink grout around raceways that penetrate concrete walls, manholes, handholes, pullboxes, or floors, or use one of the methods specified for underground penetrations. The seal shall prevent water seepage around the raceways.
3. Where an underground raceway enters a structure through a non-waterproofed wall, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.
4. Where raceways penetrate fire-rated walls, floors, or ceilings, fire stop openings around electrical penetrations to maintain the fire-resistance rating.

3.2 INSTALLATION REQUIREMENTS FOR UNDERGROUND DIRECT BURIAL RACEWAYS

A. General:
1. Coordinate installation of underground raceways with other outside and building construction work.
2. Remove entirely and properly reinstall all raceway installations not in compliance with these requirements.
3. Do not use union type fittings underground.
4. Provide a minimum cover of 30 inches over all low voltage and communication underground raceways unless otherwise indicated. Provide a minimum cover of 36 inches over all high voltage underground raceways unless otherwise indicated.
5. Do not backfill underground direct burial raceways until they have been inspected by the County Representative.
6. Warning Tapes: Bury warning tapes approximately 12 inches above all underground conduit runs or duct banks. Align parallel to and within 12 inches of the centerline of runs.
7. Trenching requirements shall be in conformance with Specification Section 31 23 33.

B. Separation and Support:
1. Separate parallel runs of two or more raceways in a single trench with preformed, nonmetallic spacers designed for the purpose. Install spacers at intervals not greater than that specified in the CEC for support of the type raceways used, and in no case greater than 10 feet.
2. Support raceways installed in fill areas to prevent accidental bending until backfilling is complete. Tie raceways to supports, and raceways and supports to the ground, so that raceways will not be displaced when concrete encasement or earth backfill is placed.

C. Arrangement and Routing:
1. Arrange multiple conduit runs substantially in accordance with any details shown on the Drawings and as required in Figure 310-60 of the California Electric Code. Locate underground conduits where indicated on the Drawings.

2. Make minor changes in location or cross-section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, refer the condition to the County Representative for instructions before further work is done.
3. Where other utility piping systems are encountered or being installed along a raceway route, maintain a 12 inch minimum vertical separation between raceways and other systems at crossings. Maintain a 12 inch minimum separation between raceways and other systems in parallel runs unless otherwise noted. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the County Representative for instructions before further work is done.
4. Provide bell-ends flush with manhole walls on all nonmetallic raceways entering manholes.
5. In multiple conduit runs, stagger raceway coupling locations so that couplings in adjacent raceways are not in the same transverse line.
6. All communications conduits must enter communications manholes and pull boxes from the ends only.

3.3 PRODUCT APPLICATION - RACEWAY - GENERAL LOCATIONS

A. Underground
1. Conduit:

a. PVC Coated Rigid Metal Conduit.
1) Wrap connection point of fitting and conduit to maintain integrity of coating system.
b. Rigid Nonmetallic conduit.
2. Encase underground conduits to 5 feet of building concrete where passing under roadways.
3. Install underground conduit 30 inches minimum below grade unless otherwise noted. Do not backfill before observation by the County Representative.
4. Separate conduit from face to face by 3 inches.
5. Make transition from underground rigid non-metallic conduit to rigid metal conduit after entering but prior to exiting the concrete slab. If during this transition the metal conduit comes in contact with the earth, then PVC coated rigid metal conduit must be installed.

B. Outdoors, Above Grade:
1. Do not install in exercise yards unless specifically indicated.
2. Liquid-tight Flexible Conduit:
a. Where greater than 12 feet above grade in exercise yard where allowed.
b. Other locations where protected from physical damage.
c. Maximum 3 foot lengths.
3. Electrical Metallic Tubing:
a. Do not use in exercise yards.
b. Where protected from weather and physical damage.
4. Rigid Metallic Conduit:
a. Use in exercise yard where allowed.
b. Other locations not otherwise indicated.

C. In Slabs and Masonry:
1. Rigid metal conduit.
2. Rigid nonmetallic conduit.
3. PVC coated rigid conduit.
4. Conduits to be installed in precast concrete during casting and through extruded concrete planks.
5. Install no conduit larger than 1 inch in floor slabs on grade.
a. Where installed in composite floors, conduit runs shall have no crossovers.
b. Do not install conduit under pads for fans, pumps, boilers, or other machinery.
6. Install expansion joint fittings on conduit in slab at all building expansion joints. Allow for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by the manufacturer and as required.
7. In concrete floor slabs, not on grade:
a. Install conduits so that the structural strength of the slab is not impaired.
b. Install conduit in the middle one-third of the slab except as necessary to avoid structural reinforcement material and maintain at least 1 inch of cover.
c. Provide minimum spacing of 3 diameters except at cabinet and panel locations.
d. Do not cross conduits.
e. Place conduit larger than 1 inch parallel with or at right angles to reinforcement.

D. Dry Locations - Concealed:
1. Rigid metal conduit.
2. Flexible metal conduit.
3. Liquidtight flexible metal conduit.
4. Electrical metallic tubing.
5. Connections and Fittings:

a. Above lay-in tile ceilings, make connections to lay-in type fixtures with 1/2-inch flexible metal conduit.
   1) Include No. 12 branch and grounding conductors.
   2) Arrange conduit and box systems for easy removal of lay-in ceiling.

E. Dry Locations - Exposed.
1. Rigid metal conduit.
2. Flexible metal conduit - 6 feet maximum length.
3. Liquidtight flexible metal conduit - 6 feet maximum length.
4. Electrical metallic tubing.
5. Inmate Accessible Areas: Rigid metal conduit only.

3.4 PRODUCT APPLICATION - RACEWAY - SPECIAL LOCATIONS

A. The following requirements modify the general location requirements listed above.

B. Hazardous Locations:
1. Rigid Metal Conduit.
2. Flexible Metallic Conduit: As limited by CEC.
3. Liquidtight flexible metallic conduit: As limited by CEC.
4. Use sealing fittings. Fill with sealant in accordance with manufacturers instructions. Install in accord with CEC.

C. Corrosive Areas:
1. PVC coated rigid metal conduit.
2. Liquidtight flexible metal conduit.

D. Motor Connections:
1. Make motor and equipment connections with flexible metal conduit not exceeding 24 inches in length.
   a. Use liquidtight metal conduit in damp and wet locations.
   b. Damp locations include but are not limited to: Dietary production, dishwashing, decontamination sterilizers and pumps.

E. Freezer and Refrigeration Rooms:
1. Rigid metal conduit.
2. Use sealing fittings on refrigeration and freezer room conduit runs in accord with CEC 300-7(a).

F. Hospitals, Clinics and Health Facilities
1. The use of rigid non-metallic conduit is to be restricted to areas only indicated on the Non-metallic Conduit Guideline as detailed on the Drawings. Do not use rigid non-metallic conduit without a Non-metallic Conduit Guideline Detail.

3.5 PRODUCT APPLICATIONS - CONNECTIONS

A. Rigid Metal Conduit:
1. At building expansion joints, use expansion type fittings.
2. Where an expansion type fitting is not required, use a threaded rigid metal conduit coupling or “Erickson” type coupling as appropriate.
3. Make connections to NEMA 12 boxes with a threaded hub.

4. Make connections to a threadless opening with locknuts on the inside and outside of the box. The conduit end shall be fitted with an insulating bushing. In wet locations, a sealing gasket shall be provided between the outside locknut and the box.
5. Bonding type locknuts shall be used where the raceway and associated fittings are part of the equipment grounding system.
6. Insulated grounding and bonding bushings shall be used to terminate service conduits, rigid metal conduit used as the grounding electrode conductor enclosure, where assurance of electrical continuity between isolated sections of raceways is required in accordance with CEC and where a bonding jumper around unpunched knockouts is required in accordance with CEC.
7. Terminate in sealing type fittings when leaving refrigerator and freezer boxes and when leaving hazardous areas.
8. Repair any marred galvanized finish to maintain the same level of corrosion protection.

B. PVC Coated Rigid Metal Conduit:
1. Tape over all connections below grade to maintain the continuity of the corrosion protection.
2. Repair any damaged PVC covering of the conduit or fittings.
3. The requirements for rigid metal conduit also apply.

C. Flexible Metal Conduit:
1. Terminate with a flexible metal conduit connector. Use a locknut in unthreaded boxes.

D. Liquidtight Flexible Metal Conduit:
1. Terminate with a liquidtight flexible metal conduit connector. Use external bonding type with equipment bonding jumper in hazardous locations (where allowed). Fasten bonding jumper to conduit with cable ties every foot.
2. In wet locations, use a sealing gasket.

E. Electrical Metallic Tubing:
1. At building expansion joints, use expansion type fittings.
2. Where an expansion type fitting is not required, use an EMT coupling to connect EMT sections.
3. Make connections with EMT connectors.

F. Rigid non-metallic conduit:
1. Make connections in accordance with the manufacturers published instructions.

G. System-to-System Connections:
1. Make EMT to rigid metal conduit connections with an EMT to rigid metal conduit connector.
2. Make a box-to-box connection with a “chase” type nipple and locknut.

3.6 PREPARATION FOR PULLING IN CONDUCTORS

A. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions. Raceways that are not usable because of being crashed or obstructions shall be replaced. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.

B. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors. Provide a permanent removable cap over each end of each empty raceway.

3.7 EMPTY RACEWAYS

A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with tags at each end the origin and destination of each such empty raceway. Provide a permanent cap over each end of each empty raceway. Provide a nylon pull wire in each empty raceway, tie-off at both ends.

3.8 TESTING & INSPECTION

A. Do not cover up conduit work until inspected. Notify the County representative at least 3 days before inspection is desired.

END OF SECTION

SECTION 26 05 41

SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Surface metal raceways.
   2. Multi-outlet assemblies.
   3. Wireway.
   4. Wall duct.

B. Related Documents and Sections
   1. Section 05 05 55 - Tamper Proof Metal Fastenings.
   2. Section 26 05 00 - Common Work Results for Electrical.
   3. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   4. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   5. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. NEMA WD 6-2002 - Wiring Devices - Dimensional Requirements.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
   1. Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.
   2. Submit documentation confirming compliance with regulatory requirements.

1.4 QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by UL or other nationally recognized testing laboratory. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

PART 2 PRODUCTS

2.1 SURFACE METAL RACEWAY

A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

B. Size: As shown on Drawings.

C. Finish: Gray enamel.

D. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories.

2.2 MULTI-OUTLET ASSEMBLY

A. Multi-outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi-outlet assembly.

B. Size: As indicated on Drawings.

C. Receptacles:
1. Provide covers and accessories to accept receptacles specified in Section 26 27 26 or, if not shown on drawings, provide:
a. NEMA WD 6, type 5-20R, single receptacle.

D. Receptacle Spacing: 18 inches on center or as indicated.

E. Receptacle Color: Gray.

F. Emergency Receptacle Color: Red.

G. Channel Finish: Gray enamel.

H. Fittings: Furnish manufacturer's standard couplings, elbows, outlet and device boxes, and connectors.

2.3 WIREWAY

A. Description: NEMA 12 gasketed type wireway.

B. Knockouts: Manufacturer's standard.

C. Size: As indicated on Drawings.

D. Cover: Hinged cover with full gasketing.

E. Connector: Slip-in.

F. Fittings: Lay-in type with removable top, bottom, and side; captive screws.

G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.4 WALL DUCT

A. Description: Sheet metal wall duct rated for installation of X-ray cables; with surface covers and accessories.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Mount plumb and level.
   1. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces.
   2. Use tamper proof metal fasteners in inmate accessible areas in accordance with Section 05 05 55.

C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

D. Wireway Supports: Provide steel channel as specified in Section 26 05 29.

E. Close ends of wireway and unused conduit openings.

F. Ground and bond raceway and wireway under provisions of Section 26 05 26.

END OF SECTION

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Anchoring and restraints.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 05 29 - Hangers and Supporters for Electrical Systems.

1.2 REFERENCES

A. ASTM E2265-2003 - Standard Terminology for Anchors and Fasteners in Concrete and Masonry.

1.3 SYSTEM DESCRIPTION

A. Design Requirements
   1. Provide the work in compliance with CCR Title 24, Part 2, State Chapters. Drawings and calculations to be stamped and signed by a California licensed structural engineer.
   2. Provide seismic zone 4 restraints for the listed materials and equipment. The attachments shall resist forces to the center of gravity of the component. Criteria shall be the operating weight of the item times 0.5g for horizontal force to be applied in any direction. Wall-mounted or suspended components shall in addition, resist a downward force of 200 pounds minimum added to the operating weight.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Submit proposed system to the County Representative for review prior to installation.

C. Project Information:
   1. Static seismic zone 4 calculations for all electrical equipment and conduit where isolation restraints are supplied.
   2. Calculations performed by a professional structural engineer licensed in the state of California.
   3. Certification of seismic zone 4 restraints.
      a. Substantiated by calculations or test reports verified by a professional structural engineer licensed in the State of California.

D. Shop Drawings
   1. Submit lighting fixture installation shop drawing for approval prior to installation.

1.5 QUALITY ASSURANCE

A. SMACNA Guidelines for seismic zone 4 restraints of mechanical systems and plumbing piping systems.

B. Anchor Bolts: ASTM A307

PART 2 PRODUCTS

2.1 GENERAL

A. Acceptable Manufacturers:
   1. Seismic Zone 4 Control Devices
      a. Mason Industries.
      b. Vibration Eliminator Co.
      c. Korfund Dynamics Corp.
      d. Amber-Booth Co.
      e. Consolidated Kinetics.

B. Provide conduit and equipment anchoring systems as indicated in the Contract Documents.

C. Provide all mounting hardware, support wires, conduits for alignment, eyebolts, bolts, nuts and washers required for equipment mounting and seismic zone 4 control. Structural blocking/backing and hardware required for installation shall be provided as indicated in the Contract Documents.

2.2 ANCHORING AND RESTRAINTS

A. Equipment Anchors:
   1. Anchor all equipment in accordance with the approved shop drawings.
   2. Contractor shall be responsible for design and acquiring of approval for anchoring of equipment which varies from the design.

B. Conduit Supports:
   1. Conduits shall be supported and braced in accordance with SMACNA Guidelines.
   2. Conduit weights shall be as listed for same size pipes full of water as listed in SMACNA Guidelines.

C. Lighting Fixture Supports:
   1. Provide independent seismic zone 4 support system for all fixtures not directly anchored to concrete walls or concrete ceilings.

D. Motor Control Centers Supports:
   1. Support per certifications.

E. Floor Mounted Switchgear:
   Support per certifications.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturers' written instructions in a manner to achieve full capacity of support.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Nameplates.
   2. Wire markers.
   3. Conduit and electrical markers.
   4. Buried utility tape.

1.2 REFERENCES

A. Refer to Requirements of Section 26 05 00.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Furnish products listed and classified by UL as suitable for purpose specified and shown.
   2. Compliance with the CEC and in particular, Article 110.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Description
   1. Nameplates: Engraved three-layer laminated plastic, white letters on black background.
   2. Letter Size:
      a. Use 1/8-inch letters for identifying individual equipment and loads.
      b. Use 1/4-inch letters for identifying grouped equipment and loads.

2.2 WIRE MARKERS

A. Manufacturers:
   1. Brady.
   2. E-Z Code by T&B.
   3. Pan-Code by Panduit.
   4. Plymark by Plymouth and Bishop.
   5. ScotchCode by 3M.
   6. Ideal.

B. Description:
   1. Vinyl cloth, self laminating vinyl, heat shrink sleeving, or tube type markers.
   2. Legend:
      a. Power and Lighting Circuits: Branch circuit or feeder number indicated on Drawings.
      b. Control Circuits: Control wire number indicated on shop drawings.

2.3 CONDUIT AND ELECTRICAL MARKERS

A. Manufacturers:
1. E-Z Code by T&B.
2. Pan-Code by Panduit.
3. Ideal.

B. Description: Tape, 2 inches wide.

C. Legend and Color:
1. Black Lettering on Orange Background.
a. All voltages.
b. Emergency Electrical System: “EMERGENCY” Black lettering on orange background.
2. White Lettering on red background.
a. Fire Alarm System: “FIRE”
3. White Lettering on Blue Background.
a. Telephone system: “TELE”
b. Correctional management information system, “DWI”
c. Spare communications, “SPARE.”
4. Red lettering on White Background.
a. Master antenna television system, “MATV.”
b. Closed Circuit TV system, “CCTV.”
c. Personal alarm system, “PAS.”
d. Site intercom system, “SIC.”
e. Regional intercom system, “RIC.”
f. Local intercom system “LIC.”
g. Public address system, “PAGE.”

2.4 BURIED UTILITY TAPE

A. Manufacturers:
1. E-Z Code by T&B.
2. Pan-Code by Panduit.
3. Terra Tape.

B. Description: 6inch wide plastic tape, detectable type, colored red with warning legend: “HIGH VOLTAGE LINE”.

PART 3 EXECUTION

3.1 PREPARATION

A. Surface Preparation
1. Degrease and clean surfaces to receive nameplates, wire markers, conduit and electrical markers.

3.2 APPLICATION

A. Nameplates
1. Provide nameplates for electrical equipment, such as distribution panels, sub panels, transformers, and disconnects.
2. Recessed Panelboards: Install nameplate with metal screws to inside surface of door.

B. Wire Markers.
   1. Provide for each conductor at panelboard, gutter, pull box, junction box, convenience outlet, cabinet, and each load connection.
   2. For feeder and branch circuits, use circuit numbers indicated on the Drawings. For control circuits, use circuit numbers indicated on the shop drawings.

C. Above Grade Conduit
   1. Provide conduit/electrical markers for all exposed conduits, longer than 20 feet, which pass through a room or any open area without terminating.
      a. Mark conduit every 20 feet.
   2. Interior or exterior located mechanical equipment: Provide conduit/electrical markers to distinguish voltage differences when fed by two or more conduits.

D. Below Grade Conduit or Utility Duct
   1. Provide utility tape for entire length of conduit or duct.
      a. Install utility tape 12 inches maximum above conduit or duct.

END OF SECTION

SECTION 26 05 74

OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Enclosed molded case circuit breakers.
   2. Fuses.
   3. Fused switches.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
   3. Section 26 08 13 - Acceptance Testing.
   4. Section 26 24 00 - Switchboards.
   5. Section 26 24 16 - Panelboards.
   6. Section 26 28 16 - Enclosed Switches and Circuit Breakers.

1.2 REFERENCES

A. Refer to Requirements of Divisions 27 and 28.

B. FS W-C-375D-2006 - Circuit Breakers, Molded Case, Branch Circuit and Service.

C. UL 489 - Molded-Case Circuit Breakers. Molded Case Switches, and Circuit-Breaker Enclosures.

D. NEMA KS 1-2001 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

E. UL 512-1993 - Fuseholders.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00.

B. Product Data
   1. Include circuit breaker ratings, trip current and let-through current curves, outline dimensions, and terminal lug sizes.

C. Quality Assurance/Control Submittals
   1. Manufacturers' Instructions

      a. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements
1. Use devices listed by Underwriters' Laboratories, Inc., and suitable for specific application. Circuit breakers added in the field to existing panels shall be U.L. listed for installation in the existing panels, without exception.
2. Comply with the California Electrical Code.

1.5 MAINTENANCE

A. Extra Materials
1. Submit extra materials under provisions of Section 01 78 23.
2. Fuses: Furnish 5 spare fuses of each type and rating installed.
3. Fuse Pullers: Furnish 5 fuse pullers.

PART 2 PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

A. Circuit Breaker: UL 489.

B. Manufacturers
1. Square D class 600.
2. Westinghouse Seltronic.
3. General Electric Q-Line.

C. Service Conditions:
1. Temperature: 120 degrees F maximum.
2. Altitude: 5,000 feet maximum.

2.2 CONFIGURATION

A. Configuration: Instantaneous automatic tripping.

B. All devices shall be UL listed and meet NEMA Standards Publication AB1. Breakers covered under this Specification may be installed in switchboards, panelboards, motor control centers, combination motor starter, and individual enclosures. Three (3) position "on" "off" and "tripped". "Tripped" condition to be clearly indicated. All poles open and close simultaneously.

C. Circuit breakers shall be quick-make and quick-break on manual or automatic operation. The handle mechanism shall be trip-free to prevent holding contacts closed against a short circuit sustained overload. The contacts shall be of the high-pressure butt type and shall be made of a silver-alloy material.

D. Solid-State Circuit Breaker: Provide circuit breaker as scheduled with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip; and adjustable short time trip.

E. Molded Case Circuit Breakers: UL 489; bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Plug-in circuit breakers are not permitted.

F. Provide approved “Lock-Off” devices for all circuit breakers serving lighting circuits without local switching.

G. Provide approved “Lock-On” devices for all circuit breakers serving essential circuits, including Fire Alarm, Time Clocks, and Heat Trace.

H. Do not use tandem circuit breakers.

I. Provide shunt trip mechanism on breakers where indicated.

J. Ground fault circuit interrupter circuit breakers:
   1. Operate on differential transformer principle; rated 20A, 120V, or 240V, Class A fault-trip sensitivity of 5 milliamperes, U/L approved, with built-in testing switch on ON-OFF switch.
   2. Provide in panelboards in lieu of standard circuit breakers to serve circuits where specifically indicated.

K. Insulated case type providing adjustable inverse time overload, adjustable instantaneous short circuit, adjustable short time delay, and adjustable ground fault protection by means of a solid state trip element with two-step stored energy mechanism. Provide interchangeable rating plug. Rate for application at 100 percent of frame size.
   1. Electrically operated where indicated. Provide motor driven operator for charging mechanism with open, close and charge push buttons.
   2. Make manually operated breakers field convertible to electrically operate by adding the motor operator.

L. Provide ground fault sensing system with electrical reset on breakers where indicated (type GFR).

2.3 RATINGS

A. Ratings: UL 489; as follows:
   1. Voltage: 240, 480 volts.
   2. Poles: as shown on the Drawings.
   3. Minimum interrupting rating of molded-case circuit breakers shall be as follows:
      Interrupting Rating System:

Voltage	Amps Frame	Amps Interrupting Capacity
120/208	up to 31	10,000
120/208	40 to 100	22,000
120/208	125 to 400	42,000
480/277	15 to 100	14,000
480/277	100 to 400	30,000

   4. Minimum interrupting rating of insulated case type circuit breakers shall be as follows:
      Interrupting Rating System:

Voltage	Amps Frame	Amps Interrupting Capacity
120/240	up to 801	65,000
277/480	up to 801	50,000
120/240	801 to 2000	85,000
277/480	801 to 2000	65,000
120/240	2001 to 4000	200,000
277/480	2001 to 4000	150,000

5. Interrupting rating of circuit breaker shall not be less that the rating shown on the Drawings for the panelboard in which it is installed.

2.4 TERMINAL LUGS

A. Size: UL 489. As scheduled.

2.5 ENCLOSURE

A. Enclosure: UL 489. Fabricate enclosure from steel.

B. Finish using manufacturer's standard enamel finish.

2.6 ACCESSORIES

A. Provide accessories as scheduled, to UL 489.

B. Shunt Trip Device: 120 VAC.

C. Under-voltage Trip Device: 120 VAC.

D. Auxiliary Switch: 120 VAC.

E. Alarm Switch: 120 VAC.

F. Electrical Operator: 120 VAC.

G. Handle Lock: Include provisions for padlocking sealing.

H. Provide mechanical trip device.

2.7 MANUFACTURERS - FUSES

A. ITE Siemens.

B. Gould.

C. Bussman.

D. Littlefuse.

2.8 FUSES

A. UL Class RK-5 fuses: Dual-element time-delay and current-limiting rejection types fuses; UL Class RK-5 listed for 200,000 RMS AIC symmetrical, 0-600A.
   1. Manufacturers
      a. Bussmann "Fusetron", 250 V FRN-RK and 600 V FRS-RK.
      b. Gould "TRI-ONIC" 250 V TR-R, 600 TRS-R.
      c. Littlefuse "SLO-BLO" 250 V FLN-R, 600 V FLS-R.
   2. Use for motor feeder and branch circuit devices where fuses are shown.

B. UL Class RK-1 dual-element fuses: Dual-element time-delay and current-limiting rejection type fuses; UL Class RK-1 listed for 200,000 RMS AIC symmetrical, 0-600 A.
   1. Manufacturers

a. Bussmann “Low-Peak”, 250 V LPN-RK and 600 V LPS-RK.
b. Littlefuse “Little Peak” 250 V LLN-RK, 600 LLS-RK.
c. Gould “AMPTRAP II” 250 V A2D-R, 600 V A6D-R.

2. Use for main feeder devices 600A and smaller where fuses are shown.

C. UL Class RK-1 single-element fuses: Fast-acting current-limiting rejection type fuses; UL Class RK-1 listed for 200,000 RMS AIC symmetrical, 1/10-600A.
1. Manufacturers
a. Bussmann “Limitron”, 250 V KTN-RK and 600 V KTS-RK.
b. Gould “AMPTRAP” 250 V A2K-R, 600 V A6K-R.
c. Littlefuse 250 V RLN-R, 600 RLS-R.
2. Use where indicated.

D. UL Class L fuses: Dual-element time-delay and current-limiting type fuses; UL Class L listed for 200,000 RMS AIC symmetrical.
1. Manufacturers
a. Bussmann “Hi-Cap” 600 V, 601-6000A, Type KRP-C
b. Gould “AMPTRAP” 600 V 200-600 A Type A4BY
c. Littlefuse “HI-INT” 600 V 601-6000A Type KLP-C.
2. Use for main and main feeder devices over 600A, where fuses are shown.

2.9 MANUFACTURERS - FUSIBLE SWITCHES

A. General Electric.

B. Cutler-Hammer

C. Square D.

2.10 FUSIBLE SWITCHES

A. Panelboard type suitable for mounting in switchboards or panelboards as indicated.
1. 200,000 AIC, 30 thru 600A, type FDP and 800 thru 1200A, type CBC with fuses.
2. Ground fault protection system where indicated. Provide current sensor, shunt trip and control power transformer.

B. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: UL 512. Designed to accommodate Class R fuses, type as specified.

C. Fusible switches shall be of the quick-make, quick-break, visible blade type and shall be UL listed and horsepower rated. Phase sequence and circuit numbering shall be uniform. Temperature rise and current carrying capacity of busses and parts shall be in accordance with NEMA Standards and CEC requirements.

D. Components shall possess sufficient mechanical strength and rigidity to safely withstand any stresses imposed by shipping, erection, or short circuits.

E. Identification nameplates shall be provided in accordance with the Article entitled “Identification of Circuits and Equipment.”

PART 3 EXECUTION

3.1 EXAMINATION

F. Site Verification of Conditions
1. Verify that surfaces are ready to receive work.
2. Verify field measurements are as shown on Drawings.
3. Verify that required utilities are available, in proper location, and ready for use.
4. Beginning of installation means installer accepts conditions.

3.2 INSTALLATION

A. Install enclosed devices where shown on Drawings, in accordance with manufacturer's instructions.

B. Install individually enclosed as specified in other sections or indicated. Use NEMA 1 enclosure unless shown otherwise.

C. Equipment and devices by same manufacturer.

3.3 FIELD QUALITY CONTROL

A. Site Tests
1. Perform tests under provisions of Section 26 08 13.
2. Test each circuit breaker to UL 489.
3. Perform several mechanical ON-OFF operations on each device.
4. Verify circuit continuity on each pole in closed position.
5. Determine that device will trip on overcurrent condition, with tripping time to UL 489 requirements.
6. Include description of testing and results in test report.

B. Inspection
1. Perform field inspection under provisions of Division 1.
2. Inspect each circuit breaker to UL 489.
3. Inspect visually several mechanical ON-OFF operations on each device.

3.4 ADJUSTING

A. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.

B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION

SECTION 26 05 78

CONTACTORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. General purpose contactors.
   2. Lighting contactors.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

A. NEMA ICS 6-1993(R2006) - Industrial Control and Systems: Enclosures.

B. NEMA ICS 2-2000(R2005) - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
   1. Include dimensions, size, voltage ratings and current ratings.

C. Closeout Submittals
   1. Project Record Documents
      a. Accurately record actual locations of each contactor and indicate circuits controlled.
   2. Operation and Maintenance Data
      a. Submit under provisions of Division 1.
      b. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Conform to requirements of CEC.
   2. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

A. Description: NEMA ICS 2, AC general purpose magnetic contactor.

B. Coil Voltage: 120 volts, 60 Hertz.

C. Poles: As indicated.

D. Size: As indicated or required for the circuit, whichever is larger.

E. Enclosure: NEMA ICS 6, Type 1 as indicated or as required to meet conditions of installation, whichever is more protective.

F. Accessories: Unless otherwise indicated, provide
   1. Pushbutton: ON/OFF
   2. Selector Switch: ON/OFF/AUTOMATIC
   3. Indicating Light: GREEN
   4. Auxiliary Contacts: One normally open.

2.2 LIGHTING CONTACTORS

A. Description: NEMA ICS 2, magnetic lighting contactor.

B. Configuration: Electrically held 3 wire control.

C. Coil Voltage: 120 volts, 60 Hertz.

D. Poles: As indicated plus one (1) spare.

E. Contact Rating: 600V amps to match branch circuit overcurrent protection, considering derating for continuous loads.

F. Enclosure: NEMA ICS 6, as indicated or as required to meet conditions of installation, whichever is more restrictive.

G. Accessories:
   1. Selector Switch: ON/OFF/AUTOMATIC (Not required when driven by time switch).
   2. Indicating Light: RED
   3. Auxiliary Contacts: One field convertible.

2.3 ACCESSORIES

A. Pushbuttons and Selector Switches: NEMA ICS 2, heavy duty type.

B. Indicating Lights: NEMA ICS 2, transformer type.

C. Auxiliary Contacts: NEMA ICS 2, Class A300.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

END OF SECTION

SECTION 26 08 13

ACCEPTANCE TESTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Quality assurance.
   2. Field quality control.

B. Related Sections
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 24 13 - Switchboards.
   3. Section 26 12 16 - Dry-Type, Medium-Voltage Transformers.
   4. Section 26 24 16 – Panelboards.

1.2 REFERENCES

A. Refer to requirements of Section 26 05 00.

B. International Electrical Testing Association (NETA)
   1. ATS - Acceptance Testing Associations for Electrical Power Distribution Equipment and Systems.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements
   1. Inspections and tests shall be performed in accordance with applicable codes and standards including CEC, ANSI, IEEE, NFPA, and NEMA as referenced in the related Sections.

1.4 SUBMITTALS

A. Submit under provisions of 01 33 00.

B. Quality Assurance/Control Submittals
   1. Test Reports: Certified test reports shall be submitted at the completion of the project. The final report shall be signed and include the following information:
      a. Summary of the project.
      b. Description of the equipment tested.
      c. Visual inspection report.
      d. Description of the tests.
      e. Test results.
      f. Conclusions and recommendations.
      g. Appendix including appropriate test forms.
      h. Identification of the test equipment used.
      i. Name of Company & individual conducting tests.
   2. After the evaluation of the system and equipment has been made, the testing organization shall submit for approval an acceptance test procedure for each item of electrical distribution equipment to be tested on this project. Test procedures shall

include the proposed system function test. No testing shall be performed unless the test procedures have been approved.

C. Qualification Statements: The qualifications of the testing organization and field engineer responsible for the testing shall be submitted for approval prior to the start of the testing.

1.5 QUALITY ASSURANCE

A. Qualifications
1. The Contractor shall engage the services of a qualified testing organization to provide final inspection, testing, calibration and adjusting on the electrical system as defined in this Contract. The testing organization shall have been engaged in full practice for a minimum of five years.
2. The testing organization shall have a calibration program with accuracy traceable every six months, and in an unbroken chain, the National Institute of Standards and Technology (N.I.S.T.).
3. Testing, inspection and calibration shall be performed by an Engineering Technician, certified by a national organization with a minimum of 5 years experience inspecting, testing and calibrating electrical distribution equipment, systems and devices. Information substantiating the qualifications of the Certified Engineering Technician shall be submitted for approval prior to the start of work.
4. The Contractor shall supply to the testing organization complete sets of approved shop drawings, coordination study, settings of all adjustable devices and other information necessary for an accurate inspection and evaluation of the system prior to the performance of any tests.
5. Membership in the International Electrical Testing Association or equivalent organization.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment necessary to perform the inspection and tests.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Site Tests
1. Test under provisions of Section 01 45 00.
2. Perform tests in accordance with the latest edition of ATS.
3. Field Acceptance Testing shall be accomplished on each item of electrical equipment installed or connected to a part of this Contract. This shall include:
a. Grounding System: Perform inspection and testing as required in Section 26 05 26 and ATS.
b. Switchboards: Perform inspection and testing as required in Section 26 04 00 and ATS.
c. Dry Type Transformers: Perform inspection and testing as required in Section 26 12 16 and ATS.
d. Over Current Protective Device: Perform primary injection test to prove circuit breakers rated 400-amps and above.

e. AC Motors: Perform inspection and testing as required in ATS for all motors rated 10 HP and higher.
f. Motor Control: Perform inspection and testing as described in the Motor Control, Low Voltage section of ATS.
g. Meters and Associated Instrument Transformers: Perform inspection and testing described in ATS.
h. Short-Circuit Analysis and Coordination Study: Perform inspection, setting, testing and calibration of applicable devices as described in ATS.
i. Battery System: Perform inspection and testing as described in ATS.

4. All interlocks, safety devices, fail-safe functions, and design functions shall be tested.
5. Each system covered by this Section shall be function tested to ensure total system operation.
6. Upon satisfactory completion of equipment acceptance tests, the system functional tests shall be performed. Prove proper interaction of sensing, processing and action devices to effect the designed end product and results.
7. System shall be energized or otherwise placed in service only after completion of all required tests and an evaluation of the test results has been completed.

B. Inspection
1. Visual inspection of installed equipment shall be performed by the testing organization to verify that the equipment installed and to be tested is the equipment denoted on the approved shop drawings. The inspection shall check the equipment designations, device characteristics, special installation requirements, applicable codes and standards.
2. After completion of the visual inspection, a report shall be developed stating any discrepancies that may have been found. Discrepancies shall be corrected before proceeding further with testing unless allowed in writing by the County representative.

3.2 ADJUSTING

A. Adjust work under provisions of Section 01 45 00.

B. Deficiencies found shall be rectified, and work affected by such deficiencies shall be completely retested. Final acceptance of the electrical power system is contingent upon satisfactory completion of the acceptance and system function tests.

END OF SECTION

SECTION 26 12 00

MEDIUM-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Pad-Mounted Transformers.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 05 13 - Medium-Voltage Cables.
   3. Section 26 08 13 - Acceptance Testing.

1.2 REFERENCES

A. IEEE C57.12.00-2006 - General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

B. ANSI C57.12.28-1999 - Pad-Mounted Equipment - Enclosure Integrity.

C. ANSI C57.12.55-1987 (R1998) - Dry-Type Transformers Used in Unit Installations, Including Unit Substations - Conformance Standards.

D. ANSI/IEEE C57.12.90-1999 - Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.

E. IEEE C57.12.91-2001 - Test Code for Dry-Type Distribution and Power Transformers.

F. IEEE C57.106-2006 - Guide for Acceptance and Maintenance of Insulating Oil in Equipment.

G. IEEE 386-1995 (R2001) - Separable Insulated Connector Systems for Power Distribution Systems above 600 V.

H. NEMA 260-1996 (R2004) - Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
   1. Submit product data indicating standard model tests and options.

C. Shop Drawings
   1. Submit shop drawings indicating outline dimensions, connection and support points, weight, specified ratings and materials.

D. Quality Assurance/Control Submittals
   1. Test Reports

a. Factory Tests: Certified factory test reports shall be submitted for manufacturer performed routine factory tests. Results of factory tests performed shall be certified by the manufacturer or an approved testing laboratory and submitted within 7 days following successful completion of the tests. Factory tests shall be as defined in the latest ANSI standard (ANSI C57.12.90).
b. Submit reports of field tests.

2. Manufacturer's Instructions
   a. Submit manufacturer's installation instructions.
   b. As a minimum, installation and replacement procedures for the current limiting fuses and details of the medium voltage cable terminations.
   c. Procedures shall include current limit fuses, cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate and test the devices and equipment.
   d. Indicate electrical characteristics and connection requirements; fuse "Time-Current" curves, equipment outline dimensions, cable entrance locations, support points, weight, seismic zone 4 anchoring requirements, ventilation and access clearances, specified ratings and materials.

1.4 OWNER'S INSTRUCTIONS

A. Submit operation data under provisions of 01 78 23.

1.5 MAINTENANCE

A. Submit maintenance data under provisions of 01 78 23.

B. Include procedures for sampling and maintaining fluid, cleaning unit and replacing components.

PART 2 PRODUCTS

2.1 PAD-MOUNTED TRANSFORMERS

A. Manufacturers
   1. Cooper Power Systems / RTE Corp.
   2. General Electric Co.
   3. MagneTek.
   4. MGM Transformer.

B. Product Description. Meet the requirements of ANSI C57.12.00.

C. Transformers shall have an efficiency compliant with the U.S. Department of Energy final rule for Distribution Transformers Energy Conservation Standard Rulemaking, 72 FR 58190 (October 12, 2007).

D. Cooling and Temperature Rise; IEEE C57.12.00
   1. Class OA 65 degrees C, self-cooled (OA) for transformers rated less than 1,500 kVA.
   2. Class OA/FA, 55 degrees / 65 degrees rise, self-cooled (OA) and equipped with thermostats, and control system for future forced air (FFA) cooling (provisions to add fans for FA rating) for transformers rated 1,500 kVA and above.

E. Insulating Liquid: Envirotemp FR3

F. Service Conditions
1. Meet requirements for usual service conditions described in IEEE C57.12.00 and ANSI C57.12.55.
2. Maximum Ambient Temperature: 40 degrees C with an average of 30 degrees C within a 24 hour period.
3. Altitude: Below 1,000 feet.
4. Load Current Harmonic Factor: 0.05 per unit (5 percent) maximum.

G. Rating
1. Size as shown on the Drawings.
2. Primary Voltage: 12.4 kV, delta connected. (Verify with utility.)
3. Taps: +/- 2-1/2 percent and +/- 5 percent (4 taps) Standard primary taps.
4. Secondary Voltage: 480/277 volts, Wye connected as indicated.
5. Impedance: 5.75 percent maximum for units 750 kVA or larger. On smaller units, the impedance shall be per ANSI standard.
6. Basic Impulse Level
   a. 15 kV rated winding - 95 kV BIL.
   b. 600 Volts or less rated winding - 30 kV BIL.

H. Standard Accessories
1. Per IEEE C57.12.00 and ANSI C57.12.55, standard accessories.
2. Bolted cover for tank access (45 to 1,000 kVA).
3. Welded cover with hand hole (1,500 kVA to 2,500 kVA).
4. Three point latching door for security.
5. Anodized aluminum nameplate.
6. One-inch drain valve with sampling device in low-voltage compartment.
7. One-inch upper fill plug.
8. Automatic pressure relief device.
9. Minimum 20 inch deep cabinet for 45 kVA through 1,000 kVA rated units.
10. Minimum 24 inch deep cabinet for 1,001 kVA through 1,500 kVA rated units.
11. Minimum 30 inch deep cabinet for 1,501 kVA through 2,500 kVA rated units.
12. Removable sill for easy installation.
13. Steel divider between high-voltage and low-voltage compartments.
14. RTE (15 kV, 200 amp type HTN) bushing wells conforming to IEEE 386.
15. Lifting lugs (4).
16. Stainless steel ground pads (45 kVA to 500 kVA).
17. Stainless steel NEMA 2 hole ground pads (750 kVA to 2,500 kVA).
18. Stainless steel cabinet hinges and mounting studs.

I. Additional Accessories
1. Bay-O-Net fuses in series with ELSP partial range current limiting fuses (Bay-O- Net and current limiting type fuses sized for the transformer).
2. Three (3) spare fuse links for each transformer.
3. Low voltage 4, 6, or 8 hole spade (through 500 kVA).
4. Low voltage 6, 8, or 10 hole spade (750 kVA to 2,500 kVA). 10 hole equipped with supports.
5. RTE 15 kV 600 amp feed-thru inserts or straight inserts with latch indicator as required.
6. Penta-head captive bolt.
7. High voltage warning signs.
8. Tap Changer: No-load, externally operated type.
9. Primary Terminations: furnish six (6) separable insulated connectors (load-break type elbow connectors) with test point) for loop feed. Include bushings; cable shield adaptor,

and insulated parking stand bushings for each insulated load break elbow connectors. Furnish an insulated protective cap for each insulated parking stand bushing.

2.2 FABRICATION

A. Conform to requirements of ANSI C57.12.28.

2.3 FINISHES

A. Clean surfaces before applying paint.

B. Apply phosphate wash pretreatment to assure coating adhesion and inhibit corrosion.

C. Three (3) step electrodeposited and oven-hardened epoxy primer (E-coat) to protect against moisture, salt, and other corrosives.

D. Apply polyester powder coat finish 4 mils thick to provide resistance to abrasion and impact.

E. Final urethane coat for ultraviolet protection.

F. Finish Color: Manufacturer's standard dark gray finish. [Color to be selected by Architect from manufacturer's standard paint chips].

2.4 SOURCE QUALITY CONTROL

A. Provide results of routine factory design testing or tests on similar units, conforming to IEEE C57.12.90. Include routine tests as defined in IEEE C57.12.00 and ANSI C57.12.55 and as specified in paragraph 1.3 (D) above.

B. Pad-Mounted Transformers: Per IEEE C57.12.00 and IEEE C57.12.90. Conduct all routine tests and other tests specified herein as prescribed in IEEE C57.12.00. Submit certified report of factory tests to the County Representative. In addition to routine tests, provide test results for:
   1. Impedance voltage and load loss, secondary shorted, resistance, and reactance.
   2. Insulation resistance.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install transformers and switching apparatus in accordance with manufacturer's instructions and CEC.

B. Install safety labels to NEMA 260.

3.2 FIELD QUALITY CONTROL

A. Site Tests
   1. Test under provisions of Section 26 08 13.
   2. Transformers: Test each transformer in accordance with NETA requirements for Liquid-Filled Transformers. Complete all tests, including optional tests, to the satisfaction of the County Representative. Submit all test results for review by the County Representative. Unacceptable test results shall be considered grounds for requiring retesting and/or replacement of the unit(s) at no extra cost to the County.

3.3 ADJUSTING

A. Adjust work under provisions of Section 26 08 13.

B. Adjust primary taps so that secondary voltage is within two percent of rated voltage.

END OF SECTION

SECTION 26 12 16

DRY-TYPE, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Dry type two winding transformers.
   2. Dry type buck and boost transformers.

B. Related Documents and Sections
   1. Section 03 30 00 - Cast-in-Place Concrete: Concrete Pads.
   2. Section 26 05 00 - Common Work Results for Electrical.
   3. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
   4. Section 26 05 74 - Overcurrent Protection Devices.

1.2 REFERENCES

A. NEMA - ST 1-1988 (R1994, R1997) - Specialty Transformers (Except General Purpose Type).

B. NEMA ST 20-1992 (R1997) - Dry Type Transformers for General Applications.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00.

B. Product Data
   1. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

C. Quality Assurance/Control Submittals
   1. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

PART 2 PRODUCTS

2.1 DRY TYPE TWO WINDING TRANSFORMERS

A. Acceptable Manufacturers
   1. Siemens.
   2. Square D Class 7410/7411.
   3. Cutler-Hammer.

B. Dry Type Transformers: NEMA ST 20; 2016 DOE energy efficient standards, factory-assembled, air cooled dry type transformers; ratings as shown on the Drawings..

C. Insulation system and average winding temperature rise for rated KVA as follows:

Rating	NEMA Class	Rise (degree C)
1-15	185	80
16-500	220	115

D. Case temperature shall not exceed 35 degrees C rise above ambient at its warmest point.

E. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

F. Winding Taps, Transformers 15 KVA and Larger: Four 2-1/2 percent FCBN taps and 2 above.

G. Sound Levels: Maximum sound levels are as follows:

KVA Rating	Sound Level
0-9	40 db
10-50	45 db
51-150	50 db
151-300	55 db
301-500	60 db
501-700	62 db
701-1000	64 db

H. Basic Impulse Level: 10 KV for transformers less than 300 KVA, 30 KV for transformers 300 KVA and larger.

I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

J. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting. Transformers mounted on walls, columns or structures shall be located in the open free of obstructions that block opening for ventilation.

K. Coil Conductors: Continuous windings with terminations brazed or welded.

L. Enclosure: NEMA ST 20; Type 1 indoors; Type 3R outdoors. Enclosures coverplates shall be code gauge sheet steel, captive bolted to the enclosure framework. Enclosure shall have suitable ventilating openings with rodent-proof screens. Transformer shall be furnished complete with mounting channels and mounting bolts. Enclosures shall be provided with lifting lugs and jacking plates as required. Metal parts excepting cores and core mounting frames shall be cleaned, rust-proofed, and be given a heavy coating of an inert primer. Coverplates and external metal parts shall be finished with two full-bodies coatings of oil-resistant industrial gray enamel.

M. Isolate core and coil from enclosure using vibration-absorbing mounts.

N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

O. Windings shall be of the fire-resistant type, designed for natural convection cooling through normal air circulation.

P. Core mounting frames and enclosures shall be of the welded and bolted construction with sufficient mechanical rigidity and strengths to withstand shipping, erection and short circuit stresses.

2.2 DRY TYPE BUCK AND BOOST TRANSFORMERS

A. Acceptable Manufacturers
1. Siemens.
2. Square D.
3. General Electric.

B. Dry Type Buck and Boost Transformers: NEMA ST 1; factory-assembled, dry type winding buck and boost transformers; ratings as shown on the Drawings.

C. Insulation system and average winding temperature rise for rated KVA as follows:

KVA Rating	Insulation Class	Temperature Rise (Degree C.)
0.25-2	185	80
3-7.5	220	80

D. Mounting: Wall.

E. Coil Conductors: Continuous windings.

F. Enclosure: NEMA ST 1; Type 1.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data.

PART 3 EXECUTION

3.1 INSTALLATION

A. Set transformer plumb and level. Installation shall be in accordance with manufacturer's instructions.

B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure. Flexible jumpers shall be installed for grounding continuity from enclosures to conduits or bus ducts.

C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Mounting bolts on floor mounted transformers shall extend into pads only and shall not be in direct contact with building structural members.

D. Transformer conduit windows shall be filled with crushed rock and sealed with one inch of lightweight grout after all conduits are installed.

E. When installed outdoors, pad mounted transformer shall be installed to maintain sixteen-foot clearance from the lowest point of building roofs to the top of transformer enclosure, and

other obstructions to avoid use as a step to building roofs. Maintain minimum of eight-foot clearance in front of transformer.

F. Primary electrical equipment shall be anchored to concrete base in accordance with seismic zone 4 design requirements; Section 26 05 48.

G. Where indicated install transformer on housekeeping pad. Install pad in accordance with Section 03 30 00.

3.2 FIELD QUALITY CONTROL

A. Site Tests
   1. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Inspection
   1. Check for damage and tight connections prior to energizing transformer.

END OF SECTION

SECTION 26 13 00

MEDIUM-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes metal-clad, circuit-breaker switchgear with the following optional components, features, and accessories:

1. Copper, silver-plated main bus at connection points
2. Communication modules.
3. Analog instruments.
4. Relays.
5. Surge arresters.
6. Provisions for future devices.
7. Fungus proofing.
8. Control battery system.
9. Mimic bus.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. GFCI: Ground-Fault Circuit Interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of switchgear and related equipment, include the following:

1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual circuit breakers.
2. Time-current characteristic curves for overcurrent protective devices, including circuit-breaker relay trip devices.

B. Shop Drawings: For each type of switchgear and related equipment, include the following:

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:

a. Tabulation of installed devices with features and ratings.
b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
d. Floor plan drawing showing locations for anchor bolts and leveling channels.
e. Current ratings of buses.
f. Short-time and short-circuit ratings of switchgear assembly.
g. Nameplate legends.
h. Mimic-bus diagram.
i. Utility company's metering provisions with indication of approval by utility company.

2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting seismic restraints.
3. Wiring Diagrams: For each type of switchgear and related equipment, include the following:

a. Power, signal, and control wiring.
b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
c. Schematic control diagrams.
d. Diagrams showing connections of component devices and equipment.
e. Schematic diagrams showing connections to remote devices.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.

D. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.

E. Manufacturer Seismic Qualification Certification: Submit certification that switchgear, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Qualification Data: For testing agency.

G. Source quality-control test reports.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

E. 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.

F. Comply with IEEE C2.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.

B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:

1. Ambient temperature not exceeding 140 deg F (60 deg C) 100 feet.
2. Altitude of 100 feet above sea level.
3. Marine Environment.

B. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.8 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate the switchgear specifications and shop drawings with P.G.&E. and receive P.G.&E. approval prior to ordering equipment. Provide the following information to P.G.&E.:

1. Single Line Diagrams.

2. Meter and Relay Diagrams.

3. Three-line diagrams of required protective device.

4. Control diagrams including DC tripping circuit.

5. Proposed relay specifications and settings.

6. Relay manufacturer, model, style, type, ranges, settings, and a copy of the relay instruction manual.

7. Full-size phase and ground coordination curves showing full coordination with P.G.&E.'s system.

8. Fault-study stamped and signed by a registered electrical engineer.

9. Maintenance program documentation for P.G.&E.-required switches, interrupting devices and protective equipment.

10. On-site test reports for the switches, devices, and relays at least ten (10) working days prior to energizing the new service.

1.9 EXTRA MATERIALS

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

1. Fuses: Six of each type and rating used. Include spares for future transformers, control power circuits, and fusible devices.
2. Indicating Lights: Six of each type installed.
3. Touchup Paint: Three containers of paint matching enclosure finish, each 0.5 pint (250 mL).

B. Maintenance Tools: Furnish tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include the following:

1. Fuse-handling tool.
2. Extension rails, lifting device, transport or dockable dolly or mobile lift, and all other items necessary to remove circuit breaker from housing and transport to remote location.
3. Racking handle to move circuit breaker manually between connected and disconnected positions, and a secondary test coupler to permit testing of circuit breaker without removal from switchgear.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MANUFACTURED UNITS

A. Description: Factory assembled and tested, and complying with IEEE C37.20.1.

B. Ratings: Suitable for application in 3-phase, 60-Hz, solidly grounded-neutral system.

C. System Voltage: 12.4 kV nominal.

2.3 METAL-CLAD, CIRCUIT-BREAKER SWITCHGEAR

A. Acceptance Manufacturers:
1. Eaton Corporation; Cutler-Hammer Products.
2. Siemens Energy & Automation, Inc.
3. Square D; Schneider Electric.

B. Comply with IEEE C37.20.3.

C. Comply with IEEE C37.20.7. Provide arc-resistant switchgear, Type [**1**] [**2**] [**1C**] [**2C**].

D. Nominal Interrupting-Capacity Class: [**250**] [**350**] [**500**] [**750**] [**1000**] MVA.

E. Ratings: Comply with IEEE C37.04.

1. Main-Bus Rating: 1200 A, continuous.

F. Circuit Breakers: Three-pole, single-throw, electrically operated, drawout-mounting units using three individual, vacuum-sealed interrupter modules and including the following features:

1. Designed to operate at rated voltage to interrupt fault current within its rating within three cycles of trip initiation. For systems with X/R ratio of 17 or less, transient voltage during interruption shall not exceed twice the rated line-to-ground voltage of the system.
2. Contact-Wear Indicator: Readily accessible to field maintenance personnel.
3. Minimum of six Type A and six Type B spare contacts.
4. Interchangeability: Circuit breakers are interchangeable with vacuum circuit breakers of same current and interrupting ratings.

5. Operating Mechanism: Electrically charged, mechanically and electrically trip-free, stored-energy operated.

a. Closing speed of moving contacts to be independent of both control and operator.
b. Design mechanism to permit manual charging and slow closing of contacts for inspection or adjustment.

1) Control Power: 48 -V dc for closing and tripping.

2) Control Power: 120 -V ac for closing and tripping.

c. Provide shunt trip capability independent of overcurrent trip.

G. Test Accessories: Relay and meter test plugs.

H. Low-DC-Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote alarm located where indicated. Alarm shall sound if voltage falls to an adjustable value to indicate an impending battery failure. Factory set alarm value at 80 percent of full-charge voltage.

I. Grounding and Testing Device: Suitable for phasing out, testing, and grounding switchgear bus or feeder if device is installed in place of circuit breaker. Include the following:

1. Portable Grounding and Testing Device: Interchangeable with drawout-mounting, medium-voltage circuit breakers to provide interlocked electrical access to either bus or feeder; electrically operated.
2. System control cabinet permanently mounted near switchgear.
3. Portable Remote-Control Station: For grounding and testing device.
4. Control-Cabinet Coupler Cable: Of adequate length to connect device inserted in any switchgear cubicle and control cabinet.
5. Remote-Control Coupler Cable: 50 feet (15 m) long to connect control cabinet and portable remote-control station.
6. Permanent Control Power Wiring: From control cabinet to power source.
7. Protective Cover: Fabricated of heavy-duty plastic and fitted to device.
8. Approval of Grounding and Testing Device System: Obtain approval of final system design from utility company and agency designated by Owner to handle future maintenance of medium-voltage switchgear.

J. Circuit-Breaker Test Cabinet: Separately mounted and containing push buttons for circuit-breaker closing and tripping, control relay, fuses, and secondary coupler with cable approximately 108 inches (2740 mm) long. Include a set of secondary devices for operating circuit breaker if removed from switchgear and moved near test cabinet. Include provision for storage of test and maintenance accessories in cabinet.

K. Remote-Tripping Device: Wall-mounting emergency control station to open circuit breakers; located in red cast-metal box with break-glass operation.

2.4 FABRICATION

A. Outdoor Enclosure: Galvanized steel, weatherproof construction; integral structural-steel base frame with factory-applied asphaltic undercoating.

1. Each compartment shall have the following features:

a. Structural design and anchorage adequate to resist loads imposed by 125-mph (200-km/h) wind.
b. Space heater operating at one-half or less of rated voltage, sized to prevent condensation.
c. Louvers equipped with insect and rodent screen and filter, and arranged to permit air circulation while excluding rodents and exterior dust.

d. Hinged front door with locking provisions.
e. Interior light with switch.
f. Weatherproof GFCI duplex receptacle.
g. Power for heaters, lights, and receptacles to be provided by control power transformer.

2. Weatherproof internal aisle construction shall have the following features:

a. Common internal aisle of sufficient width to permit protective-device withdrawal, disassembly, and servicing in aisle.
b. Aisle access doors at each end with exterior locking provisions and interior panic latches.
c. Aisle space heaters operating at one-half or less of rated voltage, thermostatically controlled.
d. Vaporproof fluorescent aisle lights with low-temperature ballasts, controlled by wall switch at each entrance.
e. GFCI duplex receptacles, a minimum of two, located in aisle.
f. Aisle ventilation louvers equipped with insect and rodent screen and filter, and arranged to permit air circulation while excluding rodents and exterior dust.

B. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.

C. Bus Transition Unit: Arranged to suit bus and adjacent units.

D. Incoming-Line Unit: Arranged to suit incoming line.

E. Outgoing Feeder Units: Arranged to suit distribution feeders.

F. Auxiliary Compartments: Arranged to suit house meters, relays, controls, and auxiliary equipment; isolated from medium-voltage components.

G. Key Interlocks: Arranged to effect interlocking schemes indicated.

H. Provisions for Future Key Interlocks: Mountings and hardware required for future installation of locks, where indicated.

2.5 COMPONENTS

A. Main Bus: Copper, silver plated at connection points full length of switchgear.

B. Ground Bus: Copper, silver plated or copper, tin plated; minimum size 1/4 by 2 inches (6 by 50 mm); full length of switchgear.

C. Bus Insulation: Covered with flame-retardant insulation.

D. Instrument Transformers: Comply with IEEE C57.13.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

E. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems, listed and labeled by an NRTL, and with the following features:

1. Inputs from sensors or 5-A current-transformer secondary's, and potential terminals rated to 600 V.
2. Switch-selectable digital display with the following features:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Three-Phase Real Power: Plus or minus 2 percent.
e. Three-Phase Reactive Power: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.

3. Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements according to Division 26 Section "Electrical Power Monitoring and Control."
4. Mounting: Display and control unit that is flush or semiflush mounted in instrument compartment door.

F. Analog Instruments: Rectangular, 4-1/2 inches (115 mm) square, 1 percent accuracy, semiflush mounting, with antiparallax 250-degree scale and external zero adjustment, and complying with ANSI C39.1.

1. Voltmeters: Cover an expanded scale range of normal voltage plus 10 percent.
2. Voltmeter Selector Switch: Rotary type with off position to provide readings of phase-to-phase voltages.
3. Ammeters: Cover an expanded scale range of bus rating plus 10 percent.
4. Ammeter Selector Switch: Permits current reading in each phase and keeps current-transformer secondary circuits closed in off position.
5. Locate meter and selector switch on circuit-breaker compartment door for indicated feeder circuits only.
6. Watt-Hour Meters: Flush- or semiflush-mounting type, 5 A, 120 V, 3 phase, 3 wire; with 3 elements, 15-minute indicating demand register, and provision for testing and adding pulse initiation.
7. Recording Demand Meter: Usable as totalizing relay or indicating and recording maximum demand meter with 15-minute interval.

a. Operation: Counts and records a succession of pulses entering two channels.
b. Housing: Drawout, back-connected case arranged for semiflush mounting.

G. Relays: Comply with IEEE C37.90, integrated digital type; with test blocks and plugs.

H. Surge Arresters: Distribution class, metal-oxide-varistor type. Comply with NEMA LA 1.

1. Install in cable termination compartments in each phase of circuit.
2. Coordinate rating with circuit voltage.

I. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.

J. Fungus Proofing: Permanent fungicidal treatment for switchgear interior, including instruments and instrument transformers.

K. Control Power Supply: DC battery system.

L. Control Power Supply: Control power transformer supplies 120-V control circuits through secondary disconnect devices. Include the following features:

1. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.
2. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.

a. Secondary windings connected through relay(s) to control bus to affect an automatic transfer scheme.
b. Secondary windings connected through an internal automatic transfer switch to switchgear control power bus.

3. Control Power Fuses: Primary and secondary fuses provide current-limiting and overload protection.

M. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:

1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
2. Conductors sized according to NFPA 70 for duty required.

2.6 CONTROL BATTERY SYSTEM

A. System Requirements: Battery shall have number of cells and ampere-hour capacity based on an initial specific gravity of 1.210 at 25 deg C with electrolyte at normal level and minimum ambient temperature of 13 deg C. Cycle battery before shipment to guarantee rated capacity on installation. Arrange battery to operate ungrounded.

B. Battery: Lead-calcium type in sealed, clear plastic or glass containers, complete with electrolyte, fully charged and arranged for shipment with electrolyte in cells. Limit weight of each container to not more than 70 lb (32 kg) and cells per container to not more than 3. System batteries shall be suitable for service at an ambient temperature ranging from minus 18 to 25 deg C. Limit variation of current output to 0.8 percent for each degree below 25 deg C down to minus 8 deg C.

C. Rack: Two-step rack with electrical connections between battery cells and between rows of cells; include two flexible connectors with bolted-type terminals for output

leads. Rate battery rack, cell supports, and anchorage for seismic requirements. Accessories:

1. Thermometers with specific-gravity correction scales.
2. Hydrometer syringes.
3. Set of socket wrenches and other tools required for battery maintenance.
4. Wall-mounting, nonmetallic storage rack fitted to store above items.
5. Set of cell numerals.

D. Charger: Static-type silicon rectifier equipped with automatic regulation and provision for manual and automatic adjustment of charging rate. Unit shall automatically maintain output voltage within 0.5 percent from no load to rated charger output current, with ac input-voltage variation of plus or minus 10 percent and input-frequency variation of plus or minus 3 Hz. Other features of charger include the following:

1. DC ammeter.
2. DC Voltmeter: Maximum error of 5 percent at full-charge voltage; operates with toggle switch to select between battery and charger voltages.
3. Ground Indication: Two appropriately labeled lights to indicate circuit ground, connected in series between negative and positive terminals, with midpoint junction connected to ground by normally open push-button contact.
4. Capacity: Sufficient to supply steady load, float-charge battery between 2.20 and 2.25 V per cell and equalizing charge at 2.33 V per cell.
5. Charging-Rate Switch: Manually operated switch provides for transferring to higher charging rate. Charger operates automatically after switch operation until manually reset.
6. AC power supply is 120 V, 60 Hz, subject to plus or minus 10 percent variation in voltage and plus or minus 3-Hz variation in frequency. After loss of ac power supply for any interval, charger automatically resumes charging battery. Charger regulates rate of charge to prevent damage due to overload and to prevent fuses or circuit breakers from opening.
7. Protective Feature: Current-limiting device or circuit, which limits output current to rating of charger but does not disconnect charger from either battery or ac supply; to protect charger from damage due to overload, including short circuit on output terminals.
8. Electrical Filtering: Reduces charger's audible noise to less than 26 dB.

2.7 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, devices, controls, and wiring.

B. Mimic Bus: Continuous mimic bus applied to front of switchgear, arranged in single-line diagram format, using symbols and lettered designations consistent with approved final mimic-bus diagram.

1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
2. Medium: Painted graphics, as approved.
3. Color: Contrasting with factory-finish background; selected by Architect.

2.8 SOURCE QUALITY CONTROL

A. Before shipment of equipment, perform the following tests and prepare test reports:

1. Production tests on circuit breakers according to ANSI C37.09.
2. Production tests on completed switchgear assembly according to IEEE C37.20.2.

B. Assemble switchgear and equipment in manufacturer's plant and perform the following:

1. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.
2. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit-breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay targets.

C. Prepare equipment for shipment.

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

2.9 FACTORY FINISHES

A. Finish: Manufacturer's standard color finish applied to equipment before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance.

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

3.2 INSTALLATION

A. Anchor switchgear assembly to 4-inch (100-mm), channel-iron sill embedded in concrete base and attach by bolting.

1. Sills: Select to suit switchgear; level and grout flush into concrete base.
2. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for seismic-restraint requirements.

3. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no less than 3 inches (75 mm) in all directions beyond the maximum dimensions of switchgear, unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Diagram and Instructions:

1. Frame under clear acrylic plastic on front of switchgear.

a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.

2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.4 CONNECTIONS

A. Cable terminations at switchgear are specified in Division 26 Section "Medium-Voltage Cables."

B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Medium-Voltage Cables."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
2. Assist in field testing of equipment.
3. Report results in writing.

C. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:

a. Switchgear.
b. Circuit breakers.
c. Protective relays.
d. Instrument transformers.
e. Metering and instrumentation.
f. Ground-fault systems.
g. Battery systems.
h. Surge arresters.
i. Capacitors.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
2. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable, protective-relay trip characteristics according to results in "Overcurrent Protective Device Coordination Study."

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 13 00

SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Main service switchboard.
   2. Power Distribution Switchboards.

B. Related Documents and Sections
   1. Section 03 30 00 - Cast-in-Place Concrete.
   2. Section 26 05 00 - Common Work Results for Electrical.
   3. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
   4. Section 26 05 74 - Overcurrent Protective Devices.
   5. Section 26 08 13 - Acceptance Testing.

1.2 REFERENCES

A. IEC 61000-4-X-2000 - Electromagnetic Compatibility (EMC).

B. IEEE C37.20.1-2002 - Metal Enclosed Low-Voltage Power Circuit Breaker Switchgear.

C. IEEE C37.90-1989 - Relays and Relays Systems Associated With Electric Power Apparatus.

D. NEMA PB 2-2006 - Deadfront Distribution Switchboards.

E. NEMA PB 2.1-2007 - General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

F. UL 891-2005 - Switchboards.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
   1. Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

C. Shop Drawings
   1. Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

D. Quality Assurance/Control Submittals
   1. Design Data
      a. One line diagrams, wiring diagrams for assembly of components, and interconnection wiring diagrams.
   2. Manufacturer’s Instructions

a. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

3. Qualification Statements
   a. Manufacturer's Qualifications
      1) Provide documentation to show compliance with qualification requirements.
4. Closeout Submittals
5. Operation and Maintenance Data
   a. Submit under provisions of Section 01 33 00.
   b. Maintenance Data
      1) Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals; and Owner operation instructions.

1.4 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: Company specializing in manufacturing or assembling Products specified in this Section with minimum three years documented experience. Companies assembling components manufactured by others must meet the requirements of Paragraph 2.2A.

B. Regulatory Requirements
   1. Conform to requirements of CEC.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect under provisions of Section 01 65 00.

B. Packing, Shipping, Handling, and Unloading
   1. When packaged in shipping splits, deliver individually wrapped for protection and mounted on shipping skids.
   2. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
   3. Handle in accordance with NEMA PB 2.1 and manufacturers' written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.6 PROJECT CONDITIONS

A. Environmental Requirements
   1. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

B. Field Measurements
   1. Verify that field measurements are as indicated.

1.7 MAINTENANCE

A. Extra Materials
   1. Provide six of each size and type of fuse installed. Package fuses and mark package with building name, number and switchboard designation.

B. Maintenance Service
   1. Provide six of each type key.
   2. Provide two fuse pullers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Siemens.

B. Square D.

C. Cutler-Hammer.

D. General Electric.

2.2 MANUFACTURED UNITS

A. Switchboards constructed by local assemblers will not be approved except that switchboards constructed by assemblers utilizing the same manufacturing and quality standards as the manufacturer of the protection devices may be approved.

2.3 SWITCHBOARD

A. Description: NEMA PB 2 and UL 891 with electrical ratings and configurations as indicated.

B. Provide overcurrent devices in accordance with Section 26 05 74.

C. Main Section Devices: Panel mounted.

D. Distribution Section Devices: Panel mounted.

E. Neatly lace all control wiring and leave flexibility at hinge locations.

F. Bus Material: Copper with tin plating, standard size.

G. Bus Connections: Bolted, accessible from front for maintenance.

H. Ground Bus: Extend length of switchboard.

I. Line and Load Terminations: Accessible from the front of the switchboard only, suitable for the conductor materials and sizes indicated.

J. Where indicated provide metering transformer compartment for County use. Provide compartment size, bus spacing and drilling, door, and locking and sealing requirements as required.

K. Pull Section: 18 inch width, depth and height to match switchboard. Arrange as indicated.

L. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

M. Enclosure: NEMA 1 - General Purpose (Interior); NEMA 3R - Raintight (Exterior).

1. Align sections at rear only.
2. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.
3. Finish: Manufacturer's standard light gray enamel on external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
4. Completely enclosed self-supporting metal structure of the required number of formed and welded vertical panel sections, incorporating circuit protective devices and other associated equipment as indicated.
5. Bolt all fastenings between vertical sections.
6. Completely enclose switchboard on front, sides, top and rear with removable sheet steel plates minimum 12 gauge.
7. Provide bolted frame rear to support and house cables and other items.
8. Provide bolted frames and insulating blocks to support and brace main, normal and emergency buses for short circuit stresses up to 65,000 amperes minimum or as determined by the short circuit study.

N. Buses:
1. Make main horizontal buses and connections between main bus and switching device of sufficient size to limit temperature rise to 65 degrees C over average room air.
2. Provide main horizontal bus of rating indicated, full-size continuous with provision for future extension.
3. Neutral bus: Full-size, continuous with provision for future extension.
4. Tin plate each main bus and tap connection over full surface of joints.
5. Current density of all buses shall not exceed 1,000 amperes per square inch for copper.
6. Tightly fasten main bus connections to ensure maximum conductivity. Bolted connections are to be tightened with a torque wrench to manufacturers recommended torques.
7. Properly brace feeder circuit bussing.
8. Provide continuous 1/4 inch x 2 inches copper ground bus for switchboard. Solidly ground to each structure near bottom. In service section provide ground-to-neutral bus disconnecting link on service entrance equipment.

O. Do not use cabling inside switchboard as substitute for bus bar conductors, unless otherwise indicated.

P. Provide each circuit with nameplate in accordance with Section 26 05 74 letters to designate purpose of circuit.

Q. Switchboards and circuit breakers shall be rated for fault current values based on the results of the short circuit studies.

2.4 ELECTRICAL METERING AND VOLTAGE PROTECTION SYSTEM

A. IEEE C37.90 or IEC 61000-4-X.

B. Power meters shall be multi-function 3 phase, 4 wire solid-state units as follows:
1. Meter function shall include the following as a minimum with a minimum of 2 percent accuracy:
a. Amperes per phase, three phases.
b. Volts: Phase-to-phase and phase-to-neutral.
c. Watthours.
d. Watt or Ampere demand.
e. Watt or Ampere peak demand with reset button.

2. Digital readout display on face of unit.
3. Units shall be capable of direct connection to 480/277 or 208/120-volt systems without the use of separate potential transformers. Meters may use a voltage/power module, manufactured specifically for this use, to accomplish direct connection of meters to 480/277-volt circuits. Where unit does not provide internal protection, a 3 pole branch circuit breaker or fuses, sized per manufacturer's recommendations, to protect the voltage sensing conductors.
4. Meters shall be capable of utilizing the voltage sensing circuit for unit control power without the need for a separate control power circuit.
5. Meter units shall be data bus ready for future remote monitoring and control.
6. Meter set points and peak demand values shall be non-volatile under power loss conditions.

C. Current Transformers.
1. Current transformers shall be matched to the power meter and shall be rated for the system voltage, amperage, and required burden capacities. Current transformers shall be single ratio, insulation class 600 volts, 60 hertz, and shall have standard accuracy class as listed in Table 5 of IEEE C37.20.1.
2. Current transformers shall be rigidly mounted in the service switchboard ahead of the main bus/breaker connection or in meter transformer cabinet or Guard Tower services. Shorting/test terminal blocks shall be provided for all CT leads if recommended by manufacturer.

D. Meters shall be mounted indoor or outdoor as indicated.
1. Indoor meter enclosures shall be NEMA 1, surface wall mount type with hinged front access panel to accept flush mounting of meter.
2. Outdoor meter enclosures shall be NEMA 4X (non-metallic) wall mount type with hinged clear Lexan cover and padlock clasp. Enclosure shall be provided with a strip heater, if recommended by manufacturer (fed from voltage sensing circuit). Environmental conditions are: 0 to 100 degrees F., and 20 to 100 percent relative humidity.

E. Power Meter Manufacturers:
1. Allen Bradley Bulletin 1400 Power Monitor.
2. Siemens 4700 Power Meter.
3. Square D Powerlogic Circuit Monitor.
4. Power Measurement Ltd. 3720 digital power meter.

F. Include provisions for padlocking and sealing.

2.5 SERVICE ENTRANCE CIRCUIT

A. Schedule 40 PVC in accordance with Section 26 05 35.

2.6 SERVICE CONDUCTORS

A. Provide in accordance with Section 26 05 19.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions
1. Verify that surface is suitable for switchboard installation.

2. Verify that service equipment is ready to be connected and energized.
3. Verify characteristics of service circuit including but not limited to voltage and phasing energization.
4. Beginning installation means installer accepts existing conditions.

3.2 PREPARATION

A. Provide concrete housekeeping pad under the provisions of Section 03 30 00 where indicated.

B. Install grounding electrode conductor and grounding electrode in accordance with CEC and Section 26 05 26.

C. Obtain approval from site work/utilities contractor to proceed with building service installation.

3.3 INSTALLATION

A. Brace/Secure in accordance with Section 26 05 48.

B. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.

C. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

D. Install fuses in each switch.

E. Install service entrance conduits from the building service entrance equipment to site work/utility/contractors conduit. Install in accordance with Sections 31 20 00 and 26 05 35. Make final connections between conduits.

F. Install service conductors in accordance with Section 26 05 19.

G. Connect the service conductors at the source end.

H. Connect the service conductors at the load end.

3.4 FIELD QUALITY CONTROL

A. Site Tests
1. Test under provisions of Section 26 08 13.
2. Check tightness of accessible bolted bus joints using calibrated torque wrench.
3. Manually operate all breakers.
4. Verify operation of all switches, indicators and meters.
5. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each, at test voltage of 1,000 volts; minimum acceptable value for insulation resistance is 2 megohms.
6. Physically test key interlock systems to ensure proper function.

B. Inspection
1. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

3.5 ADJUSTING

A. Adjust work under provisions of Section 26 08 13.

B. Adjust all operating mechanisms for free mechanical movement.

C. Tighten bolted bus connections in accordance with manufacturer's instructions.

D. Connect to kilowatt hour metering system in accordance with Section 33 71 73.

E. Adjust circuit breaker trip and time delay settings to values as instructed by the County Representative.

3.6 CLEANING

A. Clean work under provisions of 01 35 43.

B. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Power Distribution panelboards.
2. Lighting and appliance branch circuit panelboards.

B. Related Documents and Sections
1. Section 26 05 00 - Common Work Results for Electrical.
2. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
3. Section 26 05 74 - Overcurrent Protective Devices.
4. Section 26 05 78 - Contactors.
5. Section 26 08 13 - Acceptance Testing.
6. Section 26 24 13 - Switchboards
7. Section 26 29 13 - Enclosed Controllers

1.2 REFERENCES

A. ANSI/UL 50-1995 - Enclosures for Electrical Equipment.

B. ANSI/UL 67-1993 - Panelboards.

C. ANSI/UL 891-2005 - Switchboards.

D. NEMA PB 1-2006 - Panelboards.

E. NEMA PB 1.1-2007 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

F. NEMA PB 2-2006 - Deadfront Distribution Switchboards.

1.3 DEFINITIONS

A. Lighting and Appliance Branch Circuit Panelboards: As defined in the CEC, Article 408.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Shop Drawings:
1. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
2. Identify panels by alphanumeric designation with branch circuit breaker sizes and types indicated in panel schedule or one-line-diagram.

C. Closeout Submittals
1. Operating and Maintenance Data
a. Provide operating and maintenance instructions.

1.5 MAINTENANCE

A. Extra Materials
   1. Keys: Furnish 6 each type to County representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - PANELBOARDS

A. General Electric.

B. Siemens.

C. Square D.

D. Cutler-Hammer.

2.2 POWER DISTRIBUTION PANELBOARDS

A. Description
   1. NEMA panel mounted type.
   2. Louvers at the front, top, and bottom.
   3. Wiring gutters for branch devices in accordance with CEC Article 312-6 as a minimum, with removable gutters.
   4. Each section shall be designed to accept molded case circuit breakers, fusible switches and motor starters.
   5. Voltage Class: 480 Volts.

B. Comply with provisions of:
   1. ANSI/UL 50.
   2. ANSI/UL 67.
   3. NEMA PB-1.
   4. NEMA PB-2.
   5. ANSI/UL 891.

C. Enclosure
   1. Floor or surface mounted.
   2. Bolt together constructions.
   3. Width: 20 inches minimum.
   4. Height: As required, 55 inches minimum.
   5. Painted gray over rust inhibiting primer.

D. Interior
   1. Bus, include ground and neutral bus if required; Copper, ampere rating as indicated, 100 Amps minimum.
   2. Insulators; glass-filled polyester type.
   3. Nameplate:
      a. Manufacturer.
      b. Order number.
      c. Panelboard type.
      d. System voltage.
      e. Bus ampacity.
      f. Short circuit bracing rating.

g. UL label.
h. Service entrance label (if applicable).

4. Provide an individual terminal or lug for each neutral wire.
5. Interrupting Rating: As determined from the short circuit studies

E. Branch Protective Devices
1. As indicated and in compliance with Section 26 05 74.

2.3 LIGHTING AND APPLIANCE BRANCH - CIRCUIT PANELBOARD

A. Description
1. Industrial/Commercial grade.
2. Voltage Class: 208V or 480V as required for application.
3. Current ratings: As indicated, 100 Amps minimum, 800 Amps maximum.

B. Comply with provisions of:
1. ANIS/UL 50.
2. ANSI/UL 67.
3. NEMA PB-1.

C. Enclosure
1. Flush or surface mounted as indicated.
2. Code gauge galvanized steel.
3. Painted gray over rust inhibiting primer.
4. Wiring gutters at top, sides and bottom. Minimum dimensions, 8 inches at top and bottom, 4 inches on sides.
5. Width: 20 inches minimum, unless otherwise indicated.
6. Doors
a. Provide for every panel.
b. Keyed; Key identically.
c. Provide double doors for panels over 30 inches
d. Provide vault handle and three point catches for doors over 36 inches in height

D. Trim
1. Trim and hardware of all cabinets shall be of a matching type.
2. Recessed cabinet fronts shall consist of a flush sheet steel frame with hinged steel door. Face of the frame shall be at least 3/4 inches larger than cabinet on all sides and shall be set with frame flange lapping finish wall. Fronts shall be prime coated for painting adjacent surfaces.
3. Surface mounted cabinet fronts shall consist of an enclosing sheet steel frame with a hinged steel door. Frame shall completely cover front of cabinet and shall have no sharp projections.
4. Concealed hinges.
5. Circuit directory.

E. Interior
1. Bus; copper, as indicated, 100 amps minimum.
2. Insulation; glass-filled polyester.
3. Nameplate
a. Manufacturer.
b. Order number.
c. Panelboard type.
d. System voltage.

e. Bus amperage.
f. Short circuit bracing rating.
g. UL label.
h. Service entrance label (if applicable).

4. Provide an individual lug for each branch requiring a neutral connection.
5. Interrupting Rating: As determined from the short circuit studies.
6. Bracing; As determined from the short circuit studies.

F. Branch Protective Devices
1. As indicated and in compliance with Section 26 05 74.
a. All breakers shall be bolt on type.
2. Provisions for future breakers shall be at the bottom of the panel.

G. Ground Bus: Copper.

H. Special Features
1. Provide blocking clips on circuit breakers as required or shown.
2. Provide barriered space for mounting contactors and control devices with a hinged door and lock, where shown or required.
3. Provide neutral bars with terminal for all active, spare, and inactive circuits.
4. Provide feed-thru lugs or sub-feed lugs for 2 and 3 section panels.
5. Equip bus bars for panelboard with main lugs, main fused switch or main circuit breaker, capacity as required or indicated.
6. Provide special features such as split bus, lighting contactors, extra-width gutters as required.
7. Provide panels with individual branch circuit power metering where noted on plans for connections to Facility energy management system. Provide square D type NFMVP, NQMVP or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb and when recessed, flush with wall finishes, in conformance with NEMA PB 1.1. Provide all backing for equipment support. Fasten all free-standing equipment to concrete slab. Mounting bolts on floor mounted panels shall extend into pads only and shall not be in direct contact with building structural members.

B. Height: 6 feet.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

E. Stub five empty one-inch conduits to accessible location above ceiling out of each recessed panelboard.

F. Label panels on front with 1/8 inch high white-filled letters on black phenolic nameplates.

G. Provide white-filled letters on red phenolic nameplates for all panels connected to generator and/or UPS power.

3.2 FIELD QUALITY CONTROL

A. Site Tests
   1. Test under provisions of Section 26 08 13.
   2. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Inspection
   1. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Enclosures.
   2. Cabinets.
   3. Accessories.

1.2 REFERENCES

A. NEMA 250-2003 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. NEMA ICS 4-2005 - Industrial Controls and Systems: Terminal Blocks.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
   1. Provide manufacturer's standard data for enclosures and cabinets.

C. Quality Assurance/Control Submittals
   1. Manufacturer's Instructions
      a. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

PART 2 PRODUCTS

2.1 ENCLOSURES

A. Construction: NEMA 250, Type 1 steel enclosure.
   1. 14 gauge minimum, cold-rolled sheet steel, unless otherwise indicated in the Contract Documents.
   2. Cover: Continuous hinge, held closed by flush latch operable by key. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
   3. Enclosure Finish: Manufacturer's standard gray enamel.

2.2 CABINETS

A. Description
   1. Galvanized Steel, 24 inches 36 inches 6 inches deep unless otherwise indicated in the Contract Documents.
   2. Backboard: Provide 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.
   3. Doors: Steel, flush or surface type as indicated with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.

4. Knockouts: Manufacturer's standard.
5. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
6. Provide accessory feet for free-standing equipment.
7. Provide six of each type cabinet key.

B. Construction NEMA Type 4:
1. 14 gauge minimum, cold-rolled sheet steel.
2. Seams continuously welded and ground smooth. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale, or other imperfections and shall not be welded for the attachment of wiring or devices where such holes or fastenings will be visible.
3. Rolled lip around all sides of enclosure opening to exclude liquids and contaminants.
4. All exterior hardware shall be stainless steel.
5. Stainless steel door clamps on three sides of door with lock kit.
6. Door removed by pulling stainless steel continuous hinge pin.
7. Door and body stiffeners in larger enclosures.
8. Collar studs for mounting optional panels.
9. Finish: Gray polyester powder coating inside and out over phosphatized surfaces.

C. Construction NEMA Type 4X
1. Same as NEMA Type 4, except Type 304 stainless steel, unpainted.

2.3 ACCESSORIES

A. Terminal Blocks
1. NEMA ICS 4.
2. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, black, rated 600 volts; current rating for circuit, 25 amps minimum.
3. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, black, rated 300 volts; current rating 20 amps minimum.
4. Provide ground bus terminal block, with each connector bonded to enclosure.

B. Wiring Duct
1. Body: Rigid vinyl (PVC), size for 40 percent fill maximum.
2. Cover: Hi-impact rigid vinyl, angled and interlocking lips on duct cover and sidewalls permit cover to be snapped on.

PART 3 EXECUTION

3.1 APPLICATION

A. Enclosure Types for Non-hazardous Locations
1. Indoor locations - Provide NEMA type 1.
a. Exceptions: Provide NEMA type 4x in food handling areas located in central kitchen, retherm kitchens, food service satellites and cafeterias.
2. Outdoor Locations: Provide NEMA type 4.
a. NEMA type 3R not permitted.

3.2 INSTALLATION

A. Install Products in accordance with manufacturers' instructions.

B. Install cabinets, cabinet fronts, and enclosures plumb.

C. Anchor securely to wall and structural supports at each corner.

D. Install in accordance with Section 26 05 29.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Wall switches.
   2. Wall dimmers, LED.
   3. Occupancy sensors.
   4. Receptacles.
   5. Device plates and decorative box covers.
   6. Floor box service fittings.
   7. Access floor boxes.

B. Related Sections
   1. Section 05 05 55 - Tamperproof Metal Fastenings.
   2. Section 26 05 00 - Common Work Results for Electrical.
   3. Section 26 05 35 - Raceway for Electrical Systems.
   4. Section 26 08 13 - Acceptance Testing.

1.2 REFERENCES

A. NEMA WD 1-1999 (R2005) - General Color Requirements for Wiring Devices.

B. NEMA WD 6-2002 - Wiring Devices - Dimensional Requirements.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installations.

C. Product Data
   1. Provide manufacturer’s catalog information showing dimensions, colors and configurations.

D. Quality Assurance/Control Submittals
   1. Manufacturer’s Instructions
      a. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory requirements contained in Section 26 05 00.
      b. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

1.4 MAINTENANCE

A. Extra Materials
   1. Provide two of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:
1. Hubbell.
2. Bryant.
3. Pass and Seymour.
4. General Electric.
5. Slater.
6. Arrow-Hart.
7. Sylvania.
8. Leviton.

B. Description: NEMA WD 1, heavy-duty, AC only general-use snap switch, specification grade.

C. Device Body: Ivory plastic with toggle handle; unless otherwise indicated in the Contract Documents.

D. Indicator Light: Separate pilot strap; red color lens.

E. Voltage Rating: 120-277 VAC.

F. Current Rating: 20 amperes.

G. Ratings: Match branch circuit and load characteristics.

H. Typical Switches:
1. Single-pole: Hubbell 1221-I, Bryant #4901-GI, Pass & Seymour #20AC1-I.
2. Double-pole: Hubbell 1222-I, Bryant #4902-GI, Pass & Seymour #20AC2-I.
3. Three-way: Hubbell 1223-I, Bryant #4903-GI, Pass & Seymour #20AC3-I.
4. Four-way: Hubbell 1224-I, Bryant #4904-GI, Pass & Seymour #20AC4-I.
   a. Single-pole key switch: Hubbell 1221-L, Bryant #4801-L, Pass & Seymour #20AC1-L.
5. Switches with pilot light in red toggle handle:
   a. Handle to light when switch is on.
   b. Hubbell 1221-PL, Bryant #4901-PLR, Pass & Seymour #20AC1-PLR.
6. Narrow switches for hollow metal jamb posts:
   a. Arrow Hart No. QST-91I, with mounting strap No. 1657, Bryant #4641-I with strap #1347, Pass & Seymour #ACD201-I with strap # 347.
7. Three position single-pole, double throw, Hubbell #1385-I, Bryant #4922-I, Pass & Seymour #1225-I.

I. Weatherproof Switches: Where switches are indicated on Drawings as “WP”, the switches shall be of the types specified above, mounted in cast metal box with gasketed weatherproof device plate.

2.2 WALL DIMMERS

A. Description: NEMA WD 1, Type II semiconductor dimmer for LED lamps.

B. Device Body: Ivory plastic with linear slide.

C. Voltage: As required for controlled fixtures.

D. Power Rating: Match load shown on Drawings; 1000 Watts minimum.

E. Accessory Wall Switch: Match dimmer appearance.

2.3 OCCUPANCY SENSORS

A. Manufacturers
   1. Wattstopper.
   2. Leviton.
   3. Lutron.
   4. Hubbel.

B. Description: Wall or ceiling mounted.

C. Device Body: Ivory

D. Occupancy sensors in showers shall be listed for wet location.

2.4 RECEPTACLES

A. Manufacturers:
   1. Hubbell.
   2. Arrow-Hart.
   3. Pass & Seymour.
   4. General Electric.
   5. Slater.
   6. Bryant.
   7. Sylvania.
   8. Leviton Spec-Master series (with nylon face).

B. Description: NEMA WD 1; heavy-duty general-use receptacle.

C. Device Body: Ivory, unless otherwise indicated, plastic.

D. Configuration: NEMA WD 6; type as specified and indicated.

E. Use red devices on “emergency” circuits.

F. Refer to symbol legend, Hubbell Nos. listed unless otherwise noted.

G. Receptacle Outlet; Duplex: 20A, 125V, 2 pole, 3 wire grounding, NEMA 5-20R; ivory (5362-I), red (5362-R).

H. Receptacle Outlet; Simplex: 20A, 125V, 2 pole, 3 wire grounding; NEMA 5-20R; ivory (5361-I), red (5361-R).

I. Weatherproof GFCI Receptacle Outlet: 20A, 125V, 3 wire grounding, duplex, with cast metal double lift cover plate for Type “FS” cast metal boxes, including gasket; Hubbell WPFS26.

J. GFCI Type Duplex Receptacle Outlet: Built-in ground-fault circuit interruption, 5-mA sensitivity, with indicator and reset button; UL listed; standard model for ground-fault

protection at individual location; feed-through model for ground fault protection of "downstream" conventional receptacles.

1. 20A, 125V, 3 wire duplex: NEMA 5-20R ivory (Arrow Hart GF5242-I), red Arrow Hart GF5242-R).

K. Special Purpose Receptacle Outlet A: 20A, 250V, 2 pole, 3 wire grounding, side and back wired, single: NEMA 6-20 R; ivory (5461-I).

L. Special Purpose Receptacle B: Surge suppression duplex receptacle outlet; NEMA 5-20R .

M. Special Purpose Receptacle Outlet C: 20A, 250V, 3 pole, 4 wire, 3 phase grounding, single: NEMA 15-20R; black (8420).

N. Special Purpose Receptacle Outlet D: 20A, 125/250V, 3 pole, 4 wire, 1 phase grounding, single: NEMA 14-20R; black (8410).

O. Special Purpose Receptacle Outlet F: 30A, 125V, 2 pole, 3 wire grounding, single; NEMA 5-30R; black (9308).

P. Special Purpose Receptacle Outlet G: 30A, 250V, 2 pole, 3 wire grounding, single; NEMA 6-30R; black (9330).

Q. Special Purpose Receptacle Outlet H: 30A, 250V, 3 pole, 4 wire, 3 hose, grounding, single; NEMA 15-30R; black (8430A).

R. Special Purpose Receptacle Outlet J: 30A, 125/250V, 3 pole, 4 wire, 1 phase grounding, single; NEMA 14-30 R; black (9430A).

S. Special Purpose Receptacle Outlet K: 30A, 250V, 2 pole, 3 wire, 1 phase grounding, single, twist-lock; NEMA L6-30R; black (2620).

T. Special Purpose Receptacle Outlet L: 30A, 250V, 3 pole, 4 wire, 3 phase, grounding, single, twist-lock; NEMA L15-30R; black (2720).

U. Special Purpose Receptacle Outlet M: 50A, 250V, 2 pole, 3 wire, 1 phase, grounding, single; NEMA 6-50R; black (9367).

V. Special Purpose Receptacle Outlet N: 50A, 250V, 2 pole, 3 wire, 1 phase, grounding, single, twist-lock; black (25505), with wall plate per NFPA 56A. Portable x-ray receptacle in corridors.

W. Special Purpose Receptacle Outlet P: 20A, 250V, 2 pole, 3 wire, 1 phase, grounding, single, twist-lock; NEMA L6-20R; black (2320).

X. Special Purpose Receptacle Outlet Q: 50A, 125/250V, 3 pole, 4 wire, 1 phase, grounding, single; NEMA 14-50R; black (9450A).

Y. Special Receptacle R: 20A, 4 pole, 5 wire, 3 phase Y, 120/208V; NEMA L21-20; black (2510).

Z. Special Receptacle S: 30A, 4 pole, 5 wire, 3 phase Y, 120/208V; NEMA L21-30; black (2810).

AA. Special Purpose Receptacle Outlet U: 15A, 125V, 2 pole, 3 wire, isolated ground, duplex; NEMA 5-15R; orange (IG-5262).

BB. Special Purpose Receptacle Outlet V: 20A, 125V, 2 pole, 3 wire, isolated ground, duplex; NEMA 5029R; orange (IG-5362).

CC. Special Purpose Receptacle Outlet W: 30A, 125V, 2 pole, 3 wire, 1 phase, grounding, single, twist-lock; NEMA L5-30R; black (2610).

DD. Special Purpose Receptacle Outlet X: 20A, 125V, 2 pole, 3 wire, single, twist-lick; NEMA L5-20R; black.

EE. Special Receptacle Outlet Y: 30A, 250V, 2 pole, 3 wire, 1 phase grounding, single, twist lock, isolated ground; NEMA L6-30R; orange (IG-2620).

FF. Special Receptacle Outlet Z: 30A, 4 pole, 5 wire, 3 phase Y, 277/408V; NEMA L22-30, black.

GG. Special Receptacle Outlet AA: 60A, 3 pole, 4 wire, 3 phase, 480V; watertight pin and sleeve type; red, Hubbell 460R7W with BB601W 15 degree angle back box.

HH. Special Receptacle Outlet AB: 60A, 277/480V, 4 pole, 5 wire, single pin and sleeve.
1. Manufacturers:
   a. Appleton Model .
   b. Hubbell; Model 560R7W.

II. Special Receptacle Outlet AC: 60A, 250V, 3 pole, 4 wire, 3 phase, grounding, single; NEMA 15-60R; black.
1. Manufacturers:
   a. Bryant; Model 8460.
   b. Hubbell; Model 8460A.
   c. Pass & Seymour; Model 5760-BL.

2.5 DEVICE PLATES

A. Device plates for concealed wiring: Same manufacturer as wiring devices, to suit device covered, single or ganged, in one piece with beveled edges that match faces of plates.
1. Minimum Level Device Plate: Type 430 stainless steel flush, satin finish, approximately 20 gauge.
   a. Hollow Metal Jamb Posts: Arrow-Hart #T-1650; Bryant, Stainless Steel.
2. Medium Level Device Plate: Stainless steel; Type 430.
3. Maximum Level Device Plate:
   a. Back Plate: Cold rolled steel; 10 gauge; prime painted.
   b. Cover Plate: Steel; 10 gauge; prime painted.
   c. Fasteners: Minimum 4 security fasteners.
   d. Manufacturers: Fail-Safe; Mark.
4. Cast Metal Plates for Surface Type Boxes: Corrosion resistant cast ferrous metal, designed for application.
5. Plastic Device Plates: Not permitted.
6. Fasteners: Tamper proof metal fasteners under provisions of Section 05 05 23.

B. Device plate locations:

1. Device plates installed in Housing Units, Patient Cells, Holding Cells, and Receiving Tanks shall be Maximum level device plates.
2. Device plates installed in Mechanical Rooms, Control Rooms, and areas 12 feet or more above the finished floor shall be Minimum level device plates.
3. Device plates installed in other areas shall be Medium level device plates.

2.6 FLOOR MOUNTED SERVICE FITTINGS

A. Pedestal-Type Floor-Mounted Duplex Receptacle Outlet: 20A, 125V, 3 wire, grounding, back and side wired, NEMA 5-20R.
   1. Horizontal design housing with threaded conduit fitting in base, with satin chromium finish.
   2. Hubbell SC3091 with ivory duplex receptacles installed on adjustable 4 inch flush floor box, Hubbell B2529 and cover plate Hubbell S2525 or Walker #523AL, #825SF-CK adpt. kit, #885 box or Steel City #SFH-40-RG, #68-S box.

B. Flush In Floor Receptacles: 20A, 125V, 3 wire, grounding, ivory, NEMA 5-20R.
   1. Dual level, fully adjustable box, Hubbell B-2536 or B-2537 with S-3725 power fitting and S-3182 brass carpet flange, Walker #851 Assy. or Steel City #P-60-DU, #604-SC box.

C. Table Mounted Duplex Receptacle Outlet: Similar to floor-mounted pedestal type.

D. Pedestal Communication Outlet: Similar to Paragraph A.

E. Flush Cover Communication Outlet: Similar to Paragraph B.

2.7 ACCESS FLOOR BOX

A. Description: Sheet metal box suitable for mounting in access floor system.

B. Size: As required.

C. Cover: Impact resistant plastic.

D. Convenience Receptacle: One.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions
   1. Verify conditions under provisions of Division 1.
   2. Verify outlet boxes are installed at proper height.
   3. Verify wall openings are neatly cut and will be completely covered by wall plates.
   4. Verify floor boxes are adjusted properly.
   5. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
   6. Verify openings in access floor are in proper locations.
   7. Beginning installation means installer accepts existing conditions.

3.5 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.6 INSTALLATION

A. Install products in accordance with manufacturers' instructions.

B. Install products in accordance with CEC.

C. Install devices plumb and level.

D. Install switches with OFF position down.

E. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

F. Do not share neutral conductor on load side of dimmers.

G. Install receptacles with grounding pole on bottom.

H. Except for devices on isolated ground circuits, connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor if present.

I. For isolated ground circuits, connect ground wire directly to device.

J. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

K. Install security device plates. Include installation of backing plates with a minimum of four wall anchors.

L. Connect wiring devices by wrapping conductor around screw terminal.

M. Use jumbo size plates for outlets installed in masonry walls.

N. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

O. Center outlets with regard to paneling, furring, trim, etc.

P. Where several outlets occur in a room, symmetrically arrange them.

Q. Set outlets plumb or horizontal and extending to finished surface of wall, ceiling or floor as case may be without projecting beyond same.

R. Install wall switch 42 inches above finished floor.

S. Install convenience receptacle in mechanical rooms 48 inches above finished floor.

T. Install convenience receptacles in locations not specified above at 18 inches above floor.

U. Install dimmer 42 inches above finished floor.

V. Where GFCI receptacles are indicated, install GFCI receptacles at each location. Use of a GFCI receptacle to protect downstream receptacles is not permitted unless otherwise indicated. Do not use GFCI circuit breakers unless specifically indicated.

3.7 CONSTRUCTION

A. Interface with Other Work
   1. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights specified unless otherwise indicated on Drawings. All dimensions are to the center of the item.
   2. Install convenience receptacle 4 inches above backsplash of counter or 4 inches above counter if no backsplash.
   3. Install Electric Water Cooler outlet boxes centered behind unit, behind Electric Water Cooler cover.

3.8 FIELD QUALITY CONTROL

A. Site Tests
   1. Test under provisions of Section 01 45 00.
   2. Operate each wall switch with circuit energized and verify proper operation.
   3. Verify that each receptacle device is energized.
   4. Test each receptacle device for proper polarity.
   5. Test each GFCI receptacle device for proper operation.

B. Inspection
   1. Inspect under provisions of Section 26 08 13.
   2. Inspect each wiring device for defects.

3.9 ADJUSTING

A. Adjust work under provisions of Section 26 08 13.

B. Adjust devices and wall plates to be flush and level.

END OF SECTION

SECTION 26 27 29

EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Electrical connections to equipment specified under other sections.

B. Related Sections
   1. Section 11 00 00 - Equipment.
   2. Section 22 30 00 - Plumbing Equipment.
   3. Section 23 81 26 - Split-System Air-Conditioners
   4. Section 26 05 00 - Common Work Results for Electrical.
   5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600V and Below.
   6. Section 26 05 35 - Raceway for Electrical Systems.
   7. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. NEMA WD 1-1999 (R2005) - General Color Requirements for Wiring Devices.

B. NEMA WD 6-2002 - Wiring Devices - Dimensional Requirements.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installations.

C. Quality Assurance/Control Submittals
   1. Manufacturer’s Instructions
      a. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements contained in 26 05 00. Include instructions for storage, handling, Protection, examination, preparation, installation, and starting of Product.

1.4 SEQUENCING AND SCHEDULING

A. Sequence work under provisions of Section 01 31 13.

B. Obtain and review shop drawings, product data, and manufacturer’s instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

E. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 PRODUCTS

2.1 CORDS AND CAPS

A. Attachment Plug Construction: Conform to NEMA WD 1. Provide plug equivalent in quality to receptacles provided under Section 26 27 26.

B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

C. Cord Construction: CEC, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations. Minimum construction shall be 3 conductor, 12 AWG conductors.

D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions
   1. Verify that equipment is ready for electrical connection, wiring, and energization.
   2. Conduit system fitting shall be in accordance with Section 26 05 35.
   3. Wiring and cabling shall be in accordance with Section 26 05 19.
   4. Boxes shall be furnished and fitted in accordance with Section 26 05 34.

3.2 INSTALLATION

A. Make electrical connections in accordance with equipment manufacturer’s instructions.

B. Provide and install conduit in accordance with Section 26 05 35.

C. Provide and install wire in accordance with Section 26 05 19.

D. Provide and install boxes in accordance with Section 26 05 34.

E. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.

F. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

G. Provide and install receptacle outlet in accordance with Section 26 27 26, where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

H. Provide and install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

I. Provide and install disconnect switches, controllers, control stations, and control devices as indicated.

J. Modify equipment control wiring with terminal block jumpers as indicated.

K. Provide interconnecting conduit and wiring between devices and equipment where indicated.

L. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.3 CONSTRUCTION

A. Interface with Other Work
   1. Other Sections that have equipment to be connected to under this Section include, but are not limited to:
      a. Section 11 40 00.
      b. Section 11 70 00.
      c. Section 11 74 00.
      d. Section 11 77 00.
      e. Section 23 81 26.

3.4 FIELD QUALITY CONTROL

A. Site Tests
   1. Demonstrate correct equipment operation to the County Representative.

3.5 SCHEDULES

A. See Drawings for schedule.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Disconnect switches.

B. Related Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
   3. Section 26 05 74 - Overcurrent Protective Devices.

1.2 REFERENCES

A. NEMA KS 1-2001 (R2006) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. UL 98-2004 - Enclosed and Dead-Front Switches.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
   1. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

C. Quality Assurance/Control Submittals
   1. Manufacturer's Instructions
      a. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

D. Closeout Submittals
   1. Operating and Maintenance Data: See Section 01 78 00.

1.4 MAINTENANCE

A. Extra Materials
   1. Spare fuses, 10 percent or minimum of 3 of each type and rating of installed fuses.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES

A. General Electric.

B. Siemens.

C. Square D.

D. Cutler-Hammer.

2.2 CIRCUIT DISCONNECT SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses.
   1. Provide fuses in accordance with Section 26 05 74.

B. Non-fusible Switch Assemblies: NEMA KS 1; Type HD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1; Type 1 indoor, 3R outdoor or type 4 where indicated. Baked enamel over rust-inhibiting primer.

2.3 MOTOR DISCONNECT SWITCHES

A. Provide disconnect for motors as indicated. Disconnects shall be horsepower rated, padlockable, heavy duty; Square D type, Heavy duty; Westinghouse Type H-600; Federal Pacific Class 1240; or approved equal, fused or nonfused as indicated, NEMA 1 indoors; NEMA 3R outdoors conforming to UL 98.
   1. Provide fuses in accordance with Section 26 05 74.
   2. Size fuses per motor manufacturer's recommendations.

B. Disconnects for small single-phase motors shall be a horsepower rated, padlockable, manual starter, with overloads, Westinghouse Type B101, Square D, Class 2510, Federal Pacific Class 4003, NEMA 1 indoors or NEMA 3R outdoors conforming to UL 98.

2.4 IDENTIFICATION OF DISCONNECT MEANS

A. Comply with CEC 110-22.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated in the Contract Documents.

B. Install fuses in fusible disconnect switches.

C. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 26 32 14

DIESEL ENGINE GENERATORS (ABOVE 100 KW CAPACITY)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. One diesel engine-generator set.
   2. Engine-generator housing and foundation.
   3. Engine-generator control panels.

B. Related Sections
   1. Section 03 30 00 - Cast-in-Place Concrete.
   2. Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

A. ASTM - A53/A52M-2007 - Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

B. ASTM - A193/A193M-2008 - Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

C. ASTM - A194/A194M-2008 - Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

D. ASTM - A234/A234M-2007 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

E. MIL-STD 705C-1989 - Generator Test Procedures.

F. NFPA 110-2002 - Emergency and Standby Power Systems.

G. NEMA MG-1-2006 - Motors and Generators.

H. NEMA PB1-2006 - Panelboards.

I. NEMA MG-2 2007 - Safety Standard and Guide for Selection, Installation, and Use of Electrical Motors and Generators.

J. IEEE 115-1995 (R2002) - Test Procedures for Synchronous Machines.

K. IEEE C37.20.1-1993 (R1998) - Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

1.3 SYSTEM DESCRIPTION

A. Design Requirements
   1. The Contractor shall provide a complete standby generator system, and construct and install all necessary systems, structures, and components described herein. The auxiliaries shall include an engine-generator control system for the engine-generator

unit. When completed by the Contractor, the standby generator system shall be a complete and finished facility ready for operation by the County Representative.

2. The Contractor shall design and construct the foundation for the engine-generator set.
3. The equipment shall be furnished ready for operation following normal field installation. All equipment specified herein shall be furnished under the responsibility of a single supplier, and like items shall be provided by a single manufacturer.
4. The Contractor shall design and construct an outdoor, self standing, acoustical enclosure with access doors, distribution panel, control interface cabinet, and convenience receptacles for the diesel engine-generator set.

1.4 SUBMITTALS

A. Permit Submittals:
   1. The engine-generators require Authority to Construct and Permits to Operate from the Air Quality Management District (AQMD). The permit applications will be prepared by the Counties air permitting consultant from information obtained by the Contractor from the engine manufacturer.
   2. Submit two complete sets of the following required information for review by the County Representative and for incorporation into the permit applications.
      a. The manufacturer's estimated emissions at 100 percent load in both grams per brake horsepower per hour (gr/bhp-hr) and pounds per hour (lb/hr) of the following:
         1) Nitrogen oxide (NOX).
         2) Carbon monoxide (CO).
         3) Sulfur oxide (SO2).
         4) Reactive organic compounds (non-methane hydrocarbons).
         5) Particulate matter.
      b. Exhaust oxygen concentration expressed as a percent by volume.
      c. Exhaust carbon dioxide concentration expressed as a percent by volume.
      d. Exhaust flow rate in both actual and dry standard cubic-feet per minute.
      e. Exhaust temperature.

B. Product Data and Shop Drawings:
   1. Product Data Submittal: Product data on control panel and engine-generator set to include catalog information, technical description, and specifications of all components.
   2. Certified dimensional outline and installation drawings showing equipment arrangement and all dimensions, weights, connections, and support requirements. The technical description shall include materials and dimensions of cylinders, pistons, crankshaft and other major parts, a complete list of all accessories that are to be provided.
   3. Electrical drawings including circuit schematics, connection and wiring diagrams, and all information necessary for electrical installation.
   4. Include battery charger and water jacket heater power requirements. Complete interconnection diagrams showing all interconnecting wiring, recommended wire and conduit sizes, equipment terminal points, and wire identification.
   5. Curves showing the engine fuel consumption and kW output.
   6. Generator data to include kilowatt and power factor rating, reactance, transient response characteristics, and nameplate information.
   7. Description of parts and service availability.
   8. Engine data to include continuous horsepower rating and fuel consumption under installed conditions, and cooling water requirements.
   9. Control panel drawing showing overall dimensions and arrangement, schematic diagrams and interconnection diagrams.

10. Foundation and seismic zone 4 loading design calculations by a California registered structural engineer. Calculations shall include adequate information such as weight, dimensions, and other details so that they can be fully and independently checked.
11. Foundation, fabrication details and equipment arrangement dimensional outline drawings showing the specific arrangement, weight, and construction of the engine-generator unit and all accessories, including electrical systems, identification of individual engine and generator components (component list) as well as complete definition of materials selection and general method of construction. Drawings and information shall detail the specific unit accessories to be provided under this Contract.
12. Drawings or written specifications detailing the finishes and paint system to be applied to the engine-generator housings.
13. Within 15 days before delivery provide the following:
    a. One copy of the complete training course including all notebooks, references, and training aids.
    b. Complete operation and maintenance manuals as further described herein.
14. Engine-generator mounting details and vibration isolator details.
15. Engine-generator acoustical enclosure layout, elevations and construction details.
16. Electric starter, battery and battery charging system.
17. Generator terminal box layout and details.
18. 120/208 VAC panelboard.
19. Control interface cabinet layout and wiring diagram.
20. Acoustical enclosure plan.
21. Interconnection diagrams between the control interface cabinet and devices located on the engine-generator set.
22. Grounding reactor sizing calculations, size, weight and enclosure details for the unit.

C. Quality Assurance/Control Submittals:
    1. Test Reports:
        a. Factory test report.
        b. Field test report.
    2. Certificates
        a. Manufacturer’s certificate of proper installation.
        b. Field certification.

D. Closeout Submittals
    1. Operation and Maintenance Manuals
        a. Provide detailed Operation and Maintenance Manuals for the engine-generator unit, control equipment, and all accessories, as required herein, to include the following information illustrated with drawings, schematics, and tables:
            1) Complete information on how to operate the engine-generator equipment during startup, sustained operation test conditions, shutdown, and emergency and fault conditions.
            2) Information on failure repair including subcomponent (parts) identification and assembly/disassembly diagrams and sketches.
            3) Information and data necessary for lubrication, tolerance adjustment, calibration, expendables replacement, and other necessary servicing. Provide detailed definition of all servicing frequencies. Provide all control device set points and calibration sheets for all instrumentation and control sensors.
            4) As-built general arrangement and construction drawings, machine cutaways, and parts list for the engine-generator unit and accessories. Copies of all test results, reports, and measurements of operating parameters made on the engine-generator.

5) Information detailing the manufacturer's recommendations for maintenance and operation of the equipment and devices and a parts list with sufficient data for parts identification and ordering of renewal parts.
6) The operation section of the manual shall include a detailed description of the operation philosophy of the control system following the general guidelines described in paragraph 1.9, "Engine-generator Control Panel - Control Requirements".

E. Unit ventilation and combustion air requirements.

F. Location and description of the supplier's parts and service facility within a 100 mile radius of the project, providing on-call service on a 24 hours per day, 7 day per week basis.

G. Complete list of deviations from these specifications.

H. Warranty: Special warranty specified in this Section.

1.5 TRAINING

A. The training program shall consist of classroom lectures and field exercises involving actual operation of the engine-generator units. A training notebook bound in a 8-1/2 inch by 11 inch three-ring binder shall be provided and shall include:
1. Course outline, lesson plans, and fundamental operational theory.
2. Operation manual excerpts including machine cutaway diagrams, materials, etc.
3. Note paper and other materials as needed.

B. Training shall include:
1. Operational theory.
2. Periodic and demand maintenance, including overhauls.
3. Normal startup and shutdowns and normal operation (with hands-on demonstrations).
4. Emergency operating conditions and response with hands-on demonstrations.

C. Training notebooks and training shall be provided for a minimum of ten of the Counties personnel.

1.6 QUALITY ASSURANCE

A. The supplier of the generator set shall be an authorized representative of the manufacturer and shall be located within 100 miles of the installation. The supplier shall provide single source responsibility for warranty, parts, and service.

B. The engine-generator set shall be in compliance, where applicable, with National Fire Protection Association Standard No. 110, Emergency and Standby Power Systems.

C. Manufacturer of engine-generators, engine-generator auxiliaries, and engine-generator control panels shall specialize in manufacturing such equipment and shall have a minimum of 5 years experience manufacturing complete systems of the size specified herein.

1.7 MAINTENANCE ITEMS, SPARE PARTS, AND SPECIAL TOOLS

A. Furnish, tag, mark, securely pack and crate in a hinged-cover box or boxes suitable for shipment and long-term storage, the following items:
1. Three sets - Fuel oil filter elements and gaskets.
2. Three sets - Lubricating oil filter elements and gaskets.

3. Three sets - Air cleaner filter elements.
4. One set - Seals and gaskets for each coolant pump.
5. One set - V-belts for each engine.
6. Three exciter rectifier diodes.
7. One voltage regulator.
8. One lot - Indicating lamps (minimum of 10 percent).
9. One lot - Lamp lenses (minimum of 5 each color).
10. One lot - Low voltage fuses (10 percent of all ratings with a minimum of 3 each rating).
11. Three -Terminal blocks (12 point type).
12. One set - Special tools necessary for routine maintenance and service.
13. One solenoid valve for each type.
14. Three RTD for each type.
15. One jacket water pump and drive.
16. One oil pre-lube pump and drive.

B. Provide a list of spare parts recommended in addition to those specified. Include make, manufacturer, model number, and current price.

1.8 ENGINE-GENERATOR CONTROL PANEL - CONTROL REQUIREMENTS

A. The engine-generator control panel shall provide full control, protection and monitoring of the engine-generator equipment in all possible modes of operation.

B. With the control system in the manual mode, the design of the control system shall permit manual starting and manual stop of the engine-generator sets. Manual starting and stop of the engine-generator set shall be accomplished with a switchboard type start/stop switch spring returned to center position. With the control system in the automatic mode the engine-generators shall be automatically started as previously described.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Include acoustical enclosure,
2. Multiple warranties for individual system components will not be accepted.
3. Warranty Period: Five years from date of Project completion.

1.10 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Project completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The diesel engine-generator sets and accessories provided under this section shall be the product of:

1. Generac
2. Caterpillar
3. Cummins

2.2 GENERAL

A. Like Items of Equipment: Provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, replacement, and manufacturer's service.

B. Materials: Manufacturer's standard for the intended service unless otherwise specified herein.

C. Duty rating shall be standby.

2.3 SERVICE CONDITIONS

A. Location: Outdoor in sound attenuating housing.

B. Ambient Temperature: 25 degrees to 110 degrees F.

C. Altitude: 120 feet.

D. Fuel Sulfur Content: Maximum 0.5 percent by weight.

2.4 GENERATOR PERFORMANCE REQUIREMENTS

A. Continuous Standby Rating: 500 kW at 0.8 power factor, 480/277 volts.

B. Steady-State Voltage Regulation: Not to exceed 0.5 percent.

C. Frequency Regulation: Not to exceed 0.25 percent.

2.5 ENGINE

A. Diesel, turbocharged and aftercooled, 4-stroke cycle only.

B. There shall be one engine only for generator.

C. Horsepower output suitable for the specified generator performance requirements.

D. Engine Start System:
1. Provide an engine starting system employing 24 volt dc electric starting motors. All components shall be of high industrial quality, suitable for this specific application.
2. The system shall consist of a minimum of two starting motors located on the side of the engine, crank termination switch, two sets of high discharge capability batteries, 24 volt dc cables, two battery boxes sized sufficient to hold each set of batteries, and one battery charger. Motors shall be high torque type designed to allow a minimum of four consecutive start attempts consisting of 10 seconds cranking and 10 seconds rest periods.
3. Batteries must provide sufficient power to crank the engine to start with an ambient temperature of 28 degrees F.
4. The battery charger must be capable of limiting peak currents during the cranking cycle or be provided with a relay to disconnect the battery charger during the cranking cycle.

5. The starters shall be provided with engagement solenoids for automatic release when the engine starts.
6. Provide 120 volt battery case heater controlled by thermostat to maintain battery temperature within nominal operating range.

E. Fuel and Governing System and Fuel Transfer Pump:
1. The fuel system shall include an engine-driven fuel pump and primary and secondary filters which shall be easily accessible for servicing. Filters shall have replaceable elements.
2. Flexible connectors of all-metal construction shall be furnished for connection of fuel lines to engine. The connectors shall be no less than 18 inches long.
3. Provide an air-cooled return fuel cooler attached to the radiator with vibration isolators and factory piped with flexible hoses.
4. The fuel tank shall be UL labeled base mounted package-type system equal to Tramont, Simplex, Springfield Illinois and shall as a minimum consist of the following:
   a. 72 hr run time fuel capacity tank at full load.
   b. High- and low-operating level sensors.
   c. High-high and low-low alarm level sensors and indicators.
   d. Secondary containment tank with 150 percent capacity of the fuel tank. The secondary containment tank shall be equipped with a drain port and a ball valve.
   e. Containment system leak detection sensor, indicator, and alarm.
   f. Operating and alarm level systems shall be capable of operating solenoid valves. Note: No. 2 fuel oil will be supplied under pressure (75 psig maximum) to the base fuel tank.
   g. The interior of the tank shall be epoxy coated. The exterior of the tank shall be chemically treated to resist corrosion, primed and finish painted light gray. The top cover shall be blue.
   h. Tank fittings shall be a supply drop tube, siphon drain drop tube, overflow port, engine return port, extra pipe flange, tank vent port, manual fill port, float switch mounting/inspection port and emergency tank vent.
   i. Provide each tank full to 90 percent of the tank's holding capacity at the conclusion of the testing phase of the installation.
   j. Provide fuel tank control panel to provide the control functions. Control shall be mounted inside weatherproof generator 4 enclosure.
5. The governor shall be an electronic, governor/actuator and shall provide a regulation at any constant load from no load to full load of no greater than 0.25 percent. An overspeed trip shall be provided.
6. The governor shall be suitable for load sharing with other generator sets having equal or greater rating. The governor shall be isochronous with controls for adjustable droop operation to operate in parallel with future generators. Frequency adjustment shall be arranged for remote adjustment from raise/lower controls.
7. Governor shall be installed inside the engine-generator control panel.

8. Provide the engine with a return fuel oil cooler so fuel can be sent back to the fuel tank.

F. Cooling System: The jacket water cooling system shall consist of a radiator, engine driven jacket water pump, thermostatic valve, jacket water expansion tank, jacket water heater, and flexible connectors.
1. The engine shall be radiator cooled with coolant circulation and shall operate satisfactorily as stated under Service Conditions.
2. The radiator shall be engine mounted. It shall be fitted with a flanged duct outlet for connection to the sound insulating weatherproof housing.

3. Thermostatic valve shall bypass jacket water around the radiator as required to maintain the proper water temperature at the engine outlet.
4. Jacket water expansion tank shall be mounted on the engine-generator set and shall be provided with a level gauge.
5. Jacket water heaters shall be provided to maintain the water temperature in the engine at 100 degrees F at all times the engine is not running. Heaters shall be provided for each cylinder bank and shall be 208 volt, 3 phase, wired to a common junction box for supply connection.
6. Provide a high temperature shutdown if jacket water temperature exceeds the manufacturer's requirements for maximum water temperature.
7. The jacket water shall contain a 50 percent mixture of antifreeze with corrosion inhibitor as recommended.

G. Lubricating System:
1. The engine lubricating system shall be the full-pressure type with a device to shut down the engine through the engine control panel on low oil pressure. Provide an oil filter with replaceable element and a bayonet type oil level stick. Provide a valved oil drain extension from the crankcase to permit easy removal of used oil for changing oil.
2. Lubrication oil shall be cooled by a water-cooled heat exchanger utilizing jacket water.

H. Atmospheric Emissions:
1. Provide all necessary emission control equipment required to operate engine-generators at rated load without exceeding emission limits and emission control requirements set by the rules and regulations of the U.S. EPA.

I. Exhaust System:
1. The muffler shall be a critical grade silencer.
2. Exhaust pipe shall be Schedule 40 steel pipe conforming to ASTM A53/A53M Grade B. Fittings shall be carbon steel, ASTM A234/A234M Grade WPB, Schedule 40 butt welding type. Elbows shall be long radius. Gaskets shall be compressed asbestos JM60. Bolting shall be ASTM A193/A193M B8 studs with ASTM A194/A194M Grade 8 hexnuts.
3. Connection of the exhaust pipe to the engine shall be by means of a flanged, flexible, corrugated, stainless steel pipe designed specifically for diesel exhaust service.
4. Provide rain cap.

J. Air Intake System: The engine air intake shall be equipped with a dry type air cleaner with filter service indicator.

K. Engine Instrumentation: Instrumentation to be provided shall include an oil pressure gauge, coolant temperature gauge, tachometer, fuel pressure gauge, engine RPM gauge, vibration sensor test point, and running time meter. These gauges shall be installed on the engine-mounted instrumentation panel box.

L. Wiring for external connection to the engine-generator control panel shall be grouped in terminal strips as follows:
1. Alarm and Indication:
   a. Low Oil Pressure.
   b. Low Water Temperature.
   c. High Water Temperature.
   d. Overspeed.
   e. Low Battery Voltage.
   f. High Battery Voltage.

g. Excess Engine Vibration.
h. High Lube Oil Temperature.

2. Engine Shutdown:
   a. Low Lube Oil Pressure.
   b. High Lube Oil Temperature.
   c. Overspeed.
   d. High Water Jacket Temperature.
   e. Excess Vibration.

2.6 ENGINE-GENERATOR HOUSING AND FOUNDATION

A. The engine-generator enclosure shall be designed to provide weather protection to the engine-generator equipment and to reduce the full load noise level of the running generator to 80 dba at 10 feet and no more than 73 dba at 23 feet.

B. The enclosure shall be provided with four double doors for access to equipment. The doors shall be approximately centered with the generator terminal box and with the engine block. Each door leaf dimension shall be 3 feet wide by 6 feet 6 inches high. Doors shall be provided with a two-point latching mechanism and with locking provisions.

C. The engine-general enclosure, doors and hardware shall be constructed of stainless steel.

D. A duplex convenience receptacles shall be provided. Convenience receptacle shall be installed on the enclosure walls facing the engine-generator side.

E. The foundation shall be capable of supporting the machinery and accessories according to the manufacturer's recommendations and the Uniform Building Code.

2.7 GENERATOR

A. The generator shall be direct coupled, drip proof, self ventilated, two bearing, synchronous, brushless type with amortisseur windings, revolving field exciter, and permanent magnet generator (PMG) exciter, tropicalized, conforming to NEMA standards, suitable for direct connection to the engine. The generator shall have the following electrical characteristics:
   1. Voltage: 480/277 volts for the 500 kW unit.
   2. Phase: 3 phase, four-wire, with neutral brought out and grounded through a grounding resistor.
   3. Frequency: 60 Hz.
   4. Insulation: Class F.

B. Minimum continuous standby rating of 500 kw and shall be substantiated by manufacturer's standard published curves established in conformance with NEMA MG1. Special ratings for maximum ratings are unacceptable.

C. Minimum generator efficiency of 93 percent over range of 50 to 110 percent of nominal standby rating.

D. Stator and rotor with NEMA Class F insulation with full vacuum pressure 100 percent semi-rigid epoxy impregnation and overcoat of resilient insulating material to reduce possible fungus and abrasive deterioration; with temperature rise in accordance with NEMA MG1 Standards. The rotor shall be of the full, laminated, salient type, with amortisseur windings and high strength coil blocks bolted in place, all 100 percent epoxy-impregnated to prevent coil movement owing to centrifugal force during extreme overspeed conditions.

E. Stator: Stator frame shall be constructed of heavy ring and bar steel. Electrical steel lamination shall be precision stacked and skewed and welded onto the main frame to allow ample room for cooling air across both the inside and outside diameter of the lamination core. Stator coils are to be machine formed and insulated prior to installation in stator frame. End windings are to be braced and supported with end rings to withstand short circuit conditions. Six 100 ohm platinum resistance temperature detectors shall be installed in the stator windings of the 3,000 kw generators, equally spaced. R.T.D. leads (3-wire RTD) shall be brought out to a separate generator monitoring terminal box.

F. Permanent Magnet Exciter: A permanent magnet rotating exciter shall be used as the voltage regulator power supply and to maintain a 300 percent, 3 phase short circuit current on the alternator for a minimum of ten seconds. Isolation of generated R.F.I. shall conform to MIL-1-26600.

G. Exciter: Exciter shall be a high frequency revolving armature type with a short time constant, enabling fast recovery after load changes. The three-phase armature shall feed a full wave bridge rectifier consisting of six silicon power diodes mounted in two heavy duty aluminum heat sinks positioned in the air stream for maximum heat dissipation. Rectifier diodes shall be the avalanche type with a peak inverse voltage rating of six times the normal operating voltage. System shall also be equipped with surge protectors.

H. Generator Cooling: The cooling shall be by a shaft mounted axial flow fan, drawing air in through screened vents at the exciter end and discharging through the drive end of the generator. The maximum allowable temperature rise across the windings at 100 percent rated full load shall not exceed 95 degrees C based on a 50 degrees C ambient temperature.

I. Bearings: Generator shall be of two bearing design, installed at the exciter end and at the engine end. Bearings shall be anti-friction regreasable ball type and insulated to prevent stray shaft currents. Bearing R.T.D., 100 ohm platinum (3-wire RTD) shall be installed and wired to the generator monitoring terminal box.

J. Strip Heaters: Stator windings shall be provided with space strip type heaters (energized at 50 percent of the rated voltage) of the electrical resistance type of sufficient size to prevent any moisture condensing within the unit during shutdown and in the standby mode. Thermostats shall be included in the generator terminal connection box.

K. Voltage Regulator: The voltage regulator shall be the SCR type, volts-per-hertz circuitry and shall provide controlled excitation current to control the generator output voltage. The voltage regulator shall include automatic under-frequency protection to allow operating the generator at no-load, and less than synchronous speeds, for engine start-up and shutdown procedures. Voltage regulation shall be +/- 0.5 percent of rated voltage during steady state operation. Power supply to the voltage regulator shall be from the PMG. The voltage regulator shall be installed inside the engine-generator control panel. Voltage regulator shall be three-phase sensing type.

2.8 COMMON BASE

A. The engine and generator shall be mounted on a common steel base sufficiently rigid to maintain machine alignment.

2.9 TORSIONAL VIBRATION

A. The complete engine-generator set shall be so designed, constructed, and installed as to be free from objectionable vibration in any mode.

B. Freedom from torsional vibration shall be demonstrated by torsiograph records taken during the factory test of this or a similar unit.

2.10 CONTROL PANEL

A. Control Panel Enclosures:
1. The engine-generator control panel shall be of the metal enclosed, ventilated type, front access, meeting IEEE C37.20.1 requirements for enclosed control panels. The panel shall have a suitable framework of structural steel to provide a self-standing, rigid and stable structure. Adequate base shall be provided to allow anchoring to the switchgear outdoor enclosure metal floor.
2. The enclosure and framework of the structure shall be sufficiently rigid to support the equipment without vibration. The exposed exterior surfaces shall not be drilled or welded for the purpose of attaching wires or control panel devices if such holes or fastenings will be visible after installation.
3. The engine-generator control panel shall be fabricated of selected pieces of smooth sheet steel. Sheet steel shall not be less than 11 U.S. Standard gauge, forming structural shapes or having bent angles or channel edges, with all corner seams welded and ground smooth.
4. Each control panel door shall be hinged, equipped with suitable handle and a 3-point mechanical latch.
5. Each control panel shall be provided with a 1/4 inch x 1 inch copper ground bus located at the bottom of the panel.
6. Finish: The control panel structures shall be thoroughly cleaned of rust, welding scale and grease, and shall be treated to affect a bond between the metal and paint which will prevent the formation of rust under the paint. A priming coat shall be applied immediately after the bonding treatment and filled as necessary. Final finish shall consist of not less than two coats for all surfaces. Final exterior and interior finish color shall be light gray.

B. Meters, Annunciator and Control Devices: The engine-generator control panel shall be furnished by the same supplier of the engine-generator system. The engine-generator system's supplier shall closely coordinate the control devices required for manual and fully automatic operation of the standby engine-generator sets whether of not such devices were included in this Specification. Control power for the 3,000 kw engine-generator shall be 125V DC, and all control devices including control relays and timers shall be rated to operate in a 125V DC control system.
1. Meters: All metering devices shall be of the switchboard type, semiflush mounted on the control panel doors.
a. Indicating meters shall be approximately 4-1/4 inches square, back connected, dust proof with white dials, black markings, black pointers and scale arcs of approximately 250 degrees.
b. The accuracy of each instrument shall be within one percent of full scale. Each instrument shall be accurately calibrated for use with the associated instrument transformer and shall have a scale suitable for the application.
c. The following indicating instruments shall be furnished and installed, as a minimum, on the control panel:
1) 1 - Ammeter

2) 1 - KW meter, 3 phase, 3 wire
3) 1 - KVAR meter, 3 phase, 3 wire
4) 1 - Power factor meter, 3 phase
5) 1 - Frequency meter (59 to 61 scale)
6) 1 - DC ammeter (field)
7) 1 - Voltmeter
8) 1 - Running time meter (hour meter)

d. Acceptable indicating instrument manufacturers are General Electric type AB-40, Westinghouse type K241, Cromptom Instruments.
e. Digital RTD temperature meters shall be approximately 1.89 x 3.78 inches, rectangular, back connected with 3-1/2 digit led display. The accuracy of the meter at □1/2 count shall be 0.3 degrees C □ 0.2 percent R. The meter resolution shall be 1 degree C.
f. The RTD meter shall be suitable for operation with a 3 wire, 100 ohm platinum RTD.
g. The meter shall be provided with an integral dual-set point 10A relay control for external alarm and control connections. Input power to the meter shall be 120VAC.
h. Meter display range shall be as recommended by engine-generator supplier. RTD meter shall be “Newport” Q2000M or approved equivalent.
i. The following RTD temperature meters shall be furnished:
1) 2 - Phase A stator temperature
2) 2 - Phase B stator temperature
3) 2 - Phase C stator temperature
4) 2 - Exciter end bearing temperature
5) 2 - Engine end bearing temperature

2. The engine-generator system manufacturer shall furnish and install all other meters deemed necessary for the start-up, operation and shut-down of the engine-generator system.
3. The engine-generator annunciator shall be of the electronic type, AM sequence with integral power supply and logic cards rack. The annunciator shall be provided with push buttons to “Acknowledge”, “Test”, and “Reset” all annunciator alarm points.
a. The annunciator shall provide visual as well as audible indication of all abnormal system conditions. The individual annunciator points shall be provided with Form C contacts for remote indication.
b. The annunciator input power voltage shall be 125V DC.
c. The total number and type of alarm conditions shall be coordinated with the requirements of the engine-generator system. Minimum alarm requirements are indicated in the Contract Documents.
4. The engine-generator control panel shall be equipped with all devices necessary for the control of the engine and generator for manual and fully automatic standby operation. As a minimum the following control devices shall be furnished:
a. Electronic Governor:
1) The electronic governor shall be compatible with the type of actuator that it is to control. The engine-generator manufacturer shall establish the electronic governor requirements.
2) Electronic governor frequency (speed) control shall be capable of being manually adjustable through a motor operated potentiometer.
3) Approved manufacturer is Woodward Company, Model 2301A load sharing and speed control.
b. Automatic Voltage Regulator (AVR):
1) The automatic voltage regulator shall be volts-per-hertz and be compatible with the generator exciter and the generator PMG power supply.

2) The automatic voltage regulator shall have 3-phase sensing input.
3) The AVR must be capable of maintaining the generator voltage under steady-state conditions without hunting and within □0.5 percent of any voltage level between 95 and 105 percent of the rated generator voltage.
4) The AVR field voltage and current output control shall be capable of being manually adjustable through a motor operated potentiometer.
5) Approved manufacturer is KATO Engineering.

c. Motor Operated Control:
1) The motor operated control shall be of the potentiometer type driven by a motor powered from the 125V DC control supply source.
2) Approved manufacturer is Basler Electric MOC-2 series.

d. Manual Adjust Rheostats:
1) Rheostats shall be furnished as required for fine tuning all control devices and for establishing preset values.
2) Rheostats shall be the engine-generator control panel manufacturer's standard devices used in this type of application.

e. Control and Instrument Switches:
1) The control and instrument switches include such devices as breaker control switches, ammeter switches, voltmeter switches, selector switches, speed raise/lower and voltage raise/lower switches.
2) The control and instrument switches shall be of the rotary switchboard type rated for 600V AC or 250V DC circuits.
3) Contact shall be rated for not less than 20 amps continuous current and shall be of the silver plated type.
4) Each switch shall be provided with a black operating handle and escutcheon showing each operating position. Instrument switches for voltmeters and selector switches shall have round, knurled handles. Switches for circuit breaker control and speed and voltage raise/lower switches shall have pistol grip handle. Control switch shall be provided with red and green indicating lights to be installed above the switch.
5) Approved manufacturers are Electro Switch Series 24 and W-2, and General Electric SB1.

f. Push Buttons: Push buttons used for command functions shall be of the type that prevents inadvertent or accidental activation.

C. Terminal Blocks:
1. Terminal blocks shall be of high flame-retarding properties, high mechanical strength, and high dielectric properties.
2. Short circuiting type terminal blocks shall be General Electric Company's type EB-5.

D. Nameplates: Nameplates shall be of laminated phenolic resin, not less than 1/16 inch thick. Designations shall be machine-engraved in upper case letters and shall be centered on the nameplates. Letters shall be white on black background.

2.11 BATTERY AND CHARGER

A. 24 volt, minimum 320 amp hour rating for kw unit and minimum 200 amp hour rating for kw unit, lead acid type with rack and cable matched to accommodate battery location; rack conforming to CEC, capable of cranking engine for minimum of one and one-half minutes at rated ambient temperature.

B. Battery Charger: Current-limiting, float-equalize charger designed to automatically recharge batteries. Charger floats at 2.17 volts per battery cell and equalizes at 2.33 volts per battery

cell; include overload protection, silicon diode full wave rectifiers, voltage surge suppressors, DC ammeter, DC voltmeter and fused AC input and DC output. Provide AC input voltage of 120 volts single phase with minimum 10 amps output; wall-mounted in dead front, 14 gauge panelboard complying with NEMA PB1.

C. Battery Charger Dual Mode: High current charge rate immediately after engine cranking/starting; trickle charge at all other times.

D. Battery charger shall be furnished with alarm contacts to indicate:
   1. Battery charger high voltage.
   2. Battery charger low voltage.
   3. Charger failure alarm.
   4. Ground fault alarm.

2.12 SHOP/FACTORY FINISHING

A. The complete engine-generator set, including the instrument panel, shall be given a factory-applied primer and two finish coats of the manufacturer's standard heat-resistant paint. All areas damaged during shipment shall be touched up after installation.

B. Performance Tests:
   1. Following installation, the generator set shall be tested in accordance with the requirements of Part 5-13 of NFPA Standard 110. Recorded test data shall be submitted for review.
   2. A satisfactory performance test will be required prior to final inspection and acceptance of the work.

2.13 SOURCE QUALITY CONTROL

C. Factory Test: The engine-generator unit shall be tested at the manufacturer's plant before shipment. The test shall consist of a steady load run of at least 60 minutes duration at 100 percent full-rated load and power factor. Complete test reports shall be made which shall show the engine fuel consumption and kW output. Test results shall be reviewed by the County Representative prior to shipment.

PART 3 EXECUTION

3.1 GENERAL

A. Care during storage and procedures for installation, lubrication, and startup of the engine-generator set shall be in strict conformance with the manufacturer's instructions.

B. A complete set of manufacturer's instructions covering storage, installation, operation, and maintenance shall be available at the jobsite no later than the date the engine-generator set is received.

3.2 ENGINE-GENERATOR INSTALLATION

A. The engine-generator shall be installed, leveled, and grouted on the equipment pad in accordance with the manufacturer's instructions and recommendations.

3.3 SHOP TESTING ENGINE-GENERATOR SYSTEM

A. The engine and generator shall be shop tested to ensure proper assembly and performance. Tests shall be as described in the following text.

B. Engine-Generator Load Test:
   1. Provide a factory load test for each engine-generator unit utilizing appropriate load banks with 0.8 PF and including the following tests, as a minimum:
      a. Demonstrate that the engine-generator can be on-line within 10 seconds following a cold start signal with a block load of 50 percent @ 0.8 pf applied at the generator terminal. The voltage and frequency dip shall not exceed 15 percent of rated values.
      b. Gradual increase to 100 percent load increments followed by a gradual decrease to 0 percent load in the same manner. Allow 30 minutes of operation at each load setting and record all required parameters at each setting (both for increase and for decrease).
      c. One hour at 25 percent load.
      d. One hour at 50 percent load.
      e. One hour at 75 percent load.
      f. Two hours at 100 percent load.
   2. Record all required data for test steps c through f at 15 minute intervals.
   3. Data to be recorded for each test step shall include:
      a. Barometric pressure and ambient temperature at intake air inlet.
      b. Jacket water temperature,
      c. Lube oil temperature and pressure,
      d. Speed,
      e. Fuel flow rate, pressure, and temperature,
      f. Noise data in accordance with ANSI and OSHA guidelines. Noise shall be obtained on a 5 foot contour around the unit at approximately 5 foot elevation. All readings shall be corrected to free-field conditions,
      g. Generator winding temperature.
   4. Calculated variables to be recorded and reported for each test step shall include:
      a. Brake Mean Effective Pressure (BMEP).
      b. Brake Specific Fuel Consumption (BSFC) (engine-generator load tests steps c through f only).
   5. The supplier shall notify the State four weeks in advance of each test and shall provide a complete agenda with minimum one-half-day resolution covering each test. The supplier shall allow the witnessing of each shop test by the County Representative.
   6. Each test shall be reported to the County Representative in writing in accordance with the requirements of this Specification.
   7. The County Representative will consider minor modification to the test procedures as long as the essence of each test is maintained. Modifications must be obtained in writing from the County Representative at least 6 weeks in advance of the test. The responsibility for determining acceptability of modification shall rest solely with the County Representative.

3.4 SHOP TESTING GENERATOR

A. Testing: Prior to shipment from the factory, the generator manufacturer shall perform the following tests in accordance with IEEE-115, NEMA MG-2 or MIL-STD 705C. Certified copies of the test reports shall be provided and inspected prior to testing of the complete engine-generator unit.
   1. Resistance of all windings (cold).

2. Insulation resistance of all windings.
3. High potential of all windings.
4. Open circuit saturation.
5. Voltage balance on windings.
6. Current balance on windings.
7. Voltage transient at rated KVA.
8. Regulator range test.
9. Phase Sequence.
10. Inherent voltage regulation.
11. Mechanical balance.
12. Three phase build-up short circuit.
13. Circulating current (when applicable).

B. Provide (for each generator) static testing to include high potential test and other NEMA recommended factory tests in accordance with NEMA AND IEEE test procedures. Also, the Series A tests shall be performed in accordance with IEEE No. 115:
   1. Establish generator efficiencies, saturation curve, and impedance curve including the determination of armature and field I^2R losses, friction and windage losses, and stray load losses.
   2. Each test shall be reported to the State in writing in accordance with the requirements of this specification.

3.5 QUALITY CONTROL FOR COMPLETE ENGINE-GENERATOR UNIT (AT MANUFACTURERS' FACILITY)

A. Test the engine-generator set at the manufacturer's facility; demonstrate that engine-generator set satisfies the following tolerances, with respect to specifications.
   1. Corrected Power: within 3 percent
   2. Test power: within 1 percent
   3. Frequency Stability: within 0.2 percent
   4. Line-to Line Voltage: within 4 percent
   5. Test Voltage: within 1 percent
   6. Line Current: within 3 percent
   7. Overshoot: 107 percent maximum, High idle RPM
   8. Speed Droop: within 1 percent
   9. Voltage Stability: less than 0.5 percent, voltage droop
   10. Low Idle: within 50 RPM

3.6 ENGINE-GENERATOR CONTROL PANEL WIRING

A. The engine-generator control panel shall be completely wired by the panel manufacturer and shall clearly identify all external wiring connections. External wiring shall enter the control panel from the bottom.

B. Conductors shall not enter or leave a panel except through a terminal block. All secondary and control wiring or connections shall be made with a minimum size wire of No. 12 AWG, 65-strand, tinned copper switchboard wire, CEC type SIS, rated for 600 volts.

C. All annunciator spare alarm points shall be wired to terminal blocks for future connections.

D. Terminal blocks shall have marking strips showing the manufacturer's wire identification numbers. At least 20 percent of the terminals provided shall be spares.

E. Short circuiting type terminal blocks shall be provided for all CT connections and shall be of a type which will maintain firm contact with the shorting device when both terminal screws are removed.

3.7 ENGINE-GENERATOR CONTROL PANEL TESTS

A. The engine-generator panel wiring shall be given a point to point circuit continuity test. The control switches shall be checked for proper contact operation.

B. Device markings, nameplate markings, conductor identifications, and the scale of the meters and instruments shall be checked.

C. The annunciator shall be tested for correct operation.

D. Current, potentials and DC power shall be applied to the proper terminal for testing each position. Meters shall be checked for proper deflection and/or scaling.

E. Control logic shall be tested by simulating starting sequence conditions. Operation of all relays and timers shall be checked.

F. Certified copies of the test data shall be furnished at time of delivery.

3.8 FIELD QUALITY CONTROL

A. Field Tests: Running tests shall be carried out upon completion of the engine installation. The engines shall be operated for a period of not less than 2 hours each and all necessary adjustments made by a factory representative of the engine manufacturer. The test shall demonstrate the ability of the engine-generators to carry the specified loads. Upon completion of the tests, final adjustments shall be made to the equipment, fuel and oil filters shall be replaced, belt drive tensions checked, and the proper operation of all equipment demonstrated to the County Representative. County operation and maintenance personnel shall be instructed in the maintenance and operation of the equipment as designed under Training.

B. An emission source test shall be performed in accordance with AQMD requirements.

C. Manufacturers' Services and Certification:
   1. Provide technical services during delivery, installation, and startup by a qualified and factory-trained manufacturer's service representative. Provide a minimum of 20 days of service at the project site approximately allocated as indicated to the tasks defined below:
      a. A written report shall be provided to the County Representative for countersignature describing the condition of each piece of equipment identified by name, equipment number, and crate number. (Approximately 1 day.)
      b. Two installation progress review trips to be scheduled to approximately coincide with 30 percent and 90 percent completion of construction work stages. Each trip shall be scheduled to allow 2 working days spent at the site. The service representative shall review the installation to ensure that the equipment is being installed in accordance with the manufacturer's installation procedures and shall provide a concise written summary trip report for each trip.
      c. All reports are to be provided to the County Representative in accordance with the General Requirements no more than 2 weeks after completion of the specified service. (Approximately 4 days total time.)

d. Thorough prestartup inspection of the engine-generator installation including: (Approximately 3 days.)
   1) Checking of all fluid levels, expendables (filters, belts, etc.) and assisting in prestartup equipment calibration and tolerance adjustment.
   2) Issuance of a Manufacturer's Certificate verifying that the installation is correct and that the equipment is ready for startup and testing.
   3) Assistance in conducting initial engine "run-up".
   4) Verification of correct operation of all alarms, shutdown interlocks, and startup and shutdown control sequences.
   5) Provision of standard ANSI generator startup preparation tests/checks.
e. Assistance in conducting the field tests on each engine-generator set and control panel. (Approximately 5 days total.) If the unit does not perform as specified due to deficiencies in the unit, all time required of the service representative for additional tests shall be provided at no additional cost to the County.
f. Training of the Counties personnel in operation and maintenance of the engine-generators and equipment. (Minimum 6 days or 48 hours.)

3.9 CONTROL AND PROTECTIVE DEVICE TESTS AND ADJUSTMENT

A. All protective devices shall be set to settings on given tap, time dial, time setting, etc., as specified by the County Representative. Devices to be set shall include all auxiliary relays.

B. All control and protective devices shall be visually and mechanically inspected, adjusted, tested and calibrated in accordance with the manufacturer's instruction booklets. Tests shall include testing of each control and protective device for pickup, timing, contact action, restraint and any other pertinent characteristics necessary to ensure its proper calibration and operation.

C. Manually or electrically close each relay's contacts and verify that the proper breaker trip or close and the proper alarm is initiated.

D. Correct any errors in interconnecting wiring or internal equipment wiring as required or as directed by the County Representative to obtain the correct operation of all control and protective devices and associated breakers and/or alarms.

3.10 CONTROL SCHEME TESTING

A. All electrical controls shall be tested by trial operation of control equipment in the presence of the County Representative after all wiring is completed to see that each interlock and control function operates according to the schematic diagrams, the description of operation included in these Specifications, and the manufacturers' schematics and operating instructions.

B. The Contractor shall furnish all necessary labor, supervision, testing equipment, and tools required to locate the cause of any malfunction and shall make the necessary minor wiring or equipment corrections, deletions, or additions necessary to obtain intended operation.

C. All equipment damaged during testing shall be repaired or replaced and put in proper working order. Tighten all test disconnect links and terminal blocks just prior to energizing.

D. Manufacturer's Certificate(s):
   1. Provide manufacturer's certificate(s) in accordance with Section MANUFACTURER'S SERVICES of Division 1, GENERAL REQUIREMENTS.

a. Manufacturer's Certification of Proper Installation.
b. Field Performance Test Report.

3.11 SERVICE CALL

A. Approximately six months after project completion, a manufacturer's representative shall replace fuel and oil filters, adjust belt drive tensions, operate the unit, and recommend any additional maintenance or adjustments which may be necessary.

3.12 FOUNDATION INSTALLATION

A. The Contractor shall design and construct concrete foundation based on the engine-generator system dimensions, wet weight and as recommended by the equipment manufacturer. Foundation design shall conform to seismic Zone 4 loading. Structural calculations and drawings shall be signed and stamped by a structural engineer registered in the State of California.

END OF SECTION

SECTION 26 32 35

GENERATOR ALARM PANEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Generator Alarm Panel.

B. Related Documents and Sections
1. Section 26 05 00 - Common Work Results for Electrical.
2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
3. Section 26 05 29 - Hangers and Supports for Electrical Systems.
4. Section 26 05 34 - Outlet and Junction Boxes for Electrical Systems.
5. Section 26 05 35 - Raceway for Electrical Systems.
6. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. NEMA 250-2003 - Enclosures for Electrical Equipment (1000 Volts Minimum).

B. NEMA ICS 4-2005 - Industrial Control and Systems: Terminal Blocks.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Provide manufacturer's standard data for enclosure and cabinets.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.4 PROJECT CONDITIONS

A. Drawings
1. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned.

PART 2 PRODUCTS

2.1 HINGED COVER ENCLOSURE

A. Construction: NEMA 250, Type 1, 16 gauge steel enclosure.

B. Cover: Continuous hinge, held closed by flush latch operable by key.

C. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

D. Provide nameplate on enclosure face: “Generator Alarm Panel”

2.2 TERMINAL BLOCKS

A. Terminal Blocks: NEMA ICS 4.

B. Signal Terminals: Module construction type with closed back tubular pressure screw connectors, black, rated 300 volts; current rating 20 amps minimum.

C. Provide ground bus terminal block, with each connector bonded to enclosure.

2.3 ANNUNCIATION DESCRIPTION

A. Provide a L.E.D. indicating light and a nameplate for the following alarm conditions:
1. “Generator 1 Supplying Load”
2. “Generator 1 Derangement”
3. “Ground Fault”

B. Provide one audible buzzer (connected to sound at any alarm condition) and an override button (connected to bypass the audible signal) with a nameplate adjacent which reads: “Buzzer Silence”

2.4 ANNUNCIATION DEVICES

A. Provide “Red” L.E.D. indicating lights for each alarm condition. Provide all mounting hardware and accessories for a clean finished installation of L.E.D. indicators.

B. Provide speaker and amplifier as required for audible annunciation of alarm status. Speaker shall be mounted in hinged cover face with perforations. Audible signal shall be a “buzzer” type sound with an override button adjacent to speaker for manual silence of buzzer. Provide all mounting hardware and accessories for a clean finished installation of speaker and override button.

2.5 NAMEPLATES

A. Nameplates: Engraved three-layer laminated plastic, white letters on black background.

B. Letter Size
1. Use 1/8-inch letters for identifying individual alarm status.
2. Use 1/4-inch letters for panel identification.
3. Use all capital letters.

C. Nameplates shall be permanently affixed to panel face.

2.6 EXTRA MATERIALS

A. Provide three (3) L.E.D. light indicators.

B. Provide six (6) sets of keys to lockable cover.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions
   1. Verify that surfaces are ready to receive work.

3.2 INSTALLATION

A. Install Generator Alarm Panel plumb at central control.

B. Anchor to wall and structural supports at each corner.
   1. Support in accordance with Section 26 05 29.

C. Fit conduits in accordance with Section 26 05 33 and as indicated.

D. Connect low voltage wiring as indicated.

E. Identify wiring in accordance with Section 26 05 53.

F. Ground and bond in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

A. Site Tests
   1. Test each component for proper operation.

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Automatic transfer switch.

B. Related Documents and Sections
   1. Section 26 05 00 - Common Work Results for Electrical.
   2. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600V and Below).
   3. Section 26 05 34 - Outlet and Junction Boxes for Electrical Systems.
   4. Section 26 05 35 - Raceway for Electrical Systems.
   5. Section 26 05 53 - Identification for Electrical Systems.

1.2 SYSTEM DESCRIPTION

A. Provide an automatic transfer switch, complete, for connection between emergency power source and normal power source and load as shown.

1.3 REFERENCES

A. ANSI C37.90-1989 - Relays and Relay Systems Associated with Electric Power Apparatus.

   IEEE C37.90.1-2002 - GUIDE FOR SURGE WITHSTAND CAPABILITY (SWC) TESTS FOR RELAYS AND RELAY SYSTEMS ASSOCIATED WITH ELECTRIC POWER APPARATUS.

   NEMA ICS 1 - 109.

   NEMA ICS 1 - 109.05.

B. UL 1008-2002– Safety Transfer Switch Equipment.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Quality Assurance/Control Submittals
   1. Manufacturer’s Instructions Include instructions for storage, handling, protection and installation of product.

PART 2 PRODUCTS

2.1 GENERAL

A. Like Items of Equipment: Provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and service.

B. The automatic transfer switch shall have solid-state control functions.

C. Automatic transfer switches shall be UL listed per Standard 1008.

D. The transfer switch shall function as a system with the connected generator.

E. The transfer switch shall be provided with integral manual bypass.

2.2 RATINGS

A. The transfer switch shall be rated for total system load including inductive and resistive loads.

B. Withstand and closing ratings as determined from the short circuit studies.

C. Pickup voltage shall be adjustable from 85 percent to 98 percent of normal. Dropout voltage shall be adjustable from 75 percent to 98 percent of pickup setting.

D. Engine start time delay shall be 3 seconds, to avoid startups on momentary voltage dips and outages.

E. Main contacts shall be of silver composition with separate arcing surfaces.

F. The transfer switch utilizing molded-case circuit breakers, contactors, or part thereof shall be rated for continuous duty.

G. The transfer switch shall have a full rated neutral with lugs for normal, emergency, and load neutral conductors inside the enclosure.

H. All pilot devices and relays shall be of the industrial type rated 10 amps, with self-cleaning contacts.

2.3 OPERATION

A. On failure of the normal (utility) source, the transfer switch shall automatically transfer to the alternate (generator) source. Upon restoration of the normal source, the transfer switch shall automatically retransfer.

B. Provide mechanical interlock to prevent simultaneous closing of normal and emergency contacts.

C. The transfer switch shall obtain its operating current from the source to which the load is being transferred.

D. The switch shall transfer the load to emergency power after the generator set reaches proper voltage and frequency. Solid-state time delay transfer shall allow the generator to stabilize before application of load.

E. Solid-state time delay on retransfer shall allow the utility to stabilize and prevent power interruption if return of normal source is momentary.

F. Provide auxiliary contacts for functions indicated. Two minimum for each source.

G. Transfer actuator shall be energized only momentarily during transfer.

H. Provide permanently attached operating handles for manual transfer under load, for switches 1,000 amperes or less.

I. Components of the operating mechanism shall be insulated or electrically dead.

J. All accessories and equipment shall be front accessible for ease of maintenance or removal.

K. Control Functions: (Relays, switches, indicator lamps and equipment to be provided for complete automatic operation).
   1. Time delay in transfer to emergency to override momentary voltage disturbances (0.5 to 3.0 seconds).
   2. Time delay for retransfer (0 - 25 minutes).
   3. Time delay for engine cool down (0 - 10 minutes).
   4. Differential voltage sensing on each phase of normal power source; start engine and transfer load if any phase voltage (normal) falls below 80 percent of rated voltage. Retransfer when voltage (normal) on ABC phases has returned to 90 percent of rated voltage.
   5. Frequency and voltage sensing of emergency source to prevent transfer to emergency until voltage and frequency are within 90 percent of nominal frequency and rated voltage.
   6. Transfer of motor and transformer loads when both normal and emergency loads are energized:
      a. Synchronized transfer: within 15 degrees, or
      b. Time delay until voltage has delayed to 70 percent of rated voltage.
   7. Engine starting contacts to provide signal to engine generator. Provide one normally open and one normally closed contact for engine start signal.
   8. Test switch shall simulate loss of normal power for testing of generator set, including transfer of load.
   9. Reset button to manually by-pass time delay on retransfer to normal.
   10. Two indicating lamps (transformer type) indicating switch position.

L. Built-in control status indicators shall be provided for the following:
   1. Normal source available.
   2. Emergency source available.
   3. Transfer complete.
   4. Retransfer complete.

M. Transfer time in either direction shall not exceed 1/6 of a second.

N. Test switch shall simulate loss of normal power for testing of generator set, including transfer of load.

2.4 TESTS

A. Transfer switch and components shall be tested in accordance with UL-1008 for the ratings of each switch.

B. Control panel shall meet the voltage surge withstand capability in accordance with ANSI C37.90 and the impulse withstand voltage test in accordance with NEMA ICS 1-109.

C. Factory tests shall include dielectric strength test per NEMA Standard ICS 1-109.05, and the complete unit shall be tested to ensure proper operation of all components and sequence of operation.

D. Short circuit withstand tests to be conducted at full rated voltage in accordance with UL 1008. Transfer switch is to be rated for available RMS short circuit current as a circuit X/R ratio of 6.6.

E. Transient withstand test per IEEE C37.90.1.

F. Each unit shall be subject to a functional test in the field prior to operational testing. Each function shall be tested and demonstrated in the presence of the County Representative. After the functional testing has been completed, operational testing in conjunction with operational testing of the complete emergency generator system shall be conducted and demonstrated in the presence of the County Representative.

G. Submit detailed functional testing and operational test procedures for review by the County Representative prior to testing. Follow approved procedures in conducting field testing and demonstrating.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in strict accordance with manufacturers' recommendations.

B. Make conductor connections per manufacturers' recommendations.

C. After equipment is installed, touch up any scratches, marks, etc., incurred during shipment or installation of equipment. If required by the County Representative because of undue amount of scratches, repaint the entire assembly.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Interior luminaires and accessories.
2. Building mounted exterior luminaires.
3. Exit signs.
4. Luminaire accessories.
5. Security lenses.

B. Related Documents and Sections
1. Section 26 05 00 - Common Work Results for Electrical.
2. Section 26 05 34 - Outlet and Junction Boxes for Electrical Systems.
3. Section 26 05 35 - Raceway for Electrical Systems.
4. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

1.2 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data
1. Provide manufacturer dimensions, ratings, and performance data. Identify fixtures by luminaire schedule number. Show all required features and options; include data relative to lenses for security fixtures.
2. Submit lighting level performance data where indicated as required or where an approval of a listed fixture is requested. Provide all assumptions. Indicate whether calculated or measured.

C. Shop Drawings
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

D. Samples
1. Submit samples of security fixtures.

E. Quality Assurance/Control Submittals
1. Manufacturers' Instructions
   a. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
   b. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Closeout Submittals
1. Operation and Maintenance Data
   a. Submit under provisions of Division 1.
   b. Include replacement parts list.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Conform to requirements of CEC.
   2. Conform to requirements of CBC.
   3. Furnish products listed and classified by UL, or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.4 WARRANTY

A. Provide warranty under provisions of Section 01 78 00.

B. Warrant lenses in writing to County Representative to provide satisfactory performance for 20 years without objectionable discoloration.

1.5 MAINTENANCE

A. Extra Materials
   1. Provide 10 percent or four, whichever is greater, of each type of tempered glass lens.
   2. Provide 5 percent or two, whichever is greater of each plastic and other security lens type.
   3. Provide 10 percent or one case, whichever is greater, replacement lamp for each lamp installed.

PART 2 PRODUCTS

2.1 LUMINAIRES - GENERAL

A. Furnish products as specified in schedule.
   1. GENERAL: Lighting fixtures as hereinafter specified are identified by type as noted on drawings. Fixture specifications are based on construction and performance. Manufacturer's catalogue numbers are of general nature and indicate level of quality required, but do not necessarily reflect complete options as specified. Approval shall be based on description and specification of fixture as well as catalogue number indicated. See specifications for fixture, lens, lamp and ballast requirements. Verify fixture voltage requirements with circuitry indicated on drawings.
   2. LED fixtures with self-contained emergency battery packs to be U.L. labeled as "EMERGENCY LIGHTING UNITS".

B. Substitutions: Submit performance calculations for proposed substitutions.

C. Install drivers, and specified accessories at factory.

D. Provide all recessed fixtures with gaskets of rubber, fiberglass, or equivalent material to prevent light leaks around flush trim.

E. Provide standard plaster frame for all recessed lighting fixtures installed in plaster walls or ceilings.
   1. Design, finish and fabricate material to preclude possibility of rust stain in plaster.

F. Coordinate fixture types with ceiling construction.

G. Provide pendant fixtures with swivel hangers which will allow fixture to swing in any direction but will not permit stem to rotate.
   1. Provide hangers with enclosure rating (NEMA 1, 4, or 7) equal to enclosure requirements of area in which they are installed.
   2. Swivel hangers for fixtures in mechanical equipment areas: Shock absorbing type.

H. Pendant mounted LED fixtures, in continuous rows shall be supported by conduit and fasten fixtures to each other or mount on continuous metal channel similar to Unistrut. Provide reflector alignment clips on all industrial LED fixtures mounted in continuous rows.

I. Pendant mounted LED fixtures. Individually mounted to be stem mounted with swivel hangers; 2 for fixtures 1 foot wide and narrower, four for fixtures over 1 foot wide.

2.2 POWER SUPPLY UNIT (DRIVERS)

A. Luminaires shall be equipped with an L.E.D driver(s) that accepts the voltage as indicated on the “Luminaire (Lighting Fixture) Schedule”. Individual driver(s) shall be replaceable.

B. Driver(s) shall be UL8750 class 2 compliant for their intended purpose.

C. Total harmonic distortion (THD) for current: ≤ 20%.

D. Driver(s) shall be rated to operate between -30°C to 50°C minimum.

E. Individual driver(s) shall be equipped with surge protection (6kV minimum) in accordance with IEEE/ANSI C62.4.1. Driver shall be protected against damage due to either an open circuit or short circuit fault condition on the driver output.

F. Driver(s) shall have a minimum efficiency of 85%.

G. Drivers shall deliver full-range dimming from 0-10V control signal.

2.3 L.E.D. LIGHT SOURCE (LIGHT ENGINE)

A. Individual light engine(s) shall be replaceable.

B. L.E.D. light engine(s) shall have a minimum lifetime of 50,000+ hours at 40° C and shall have a minimum efficiency of 80 lumens per watt.

C. L.E.D dies shall be tested in accordance with I.E.S.N.A. LM-80-08 standards.

D. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps, or liquids.

2.4 SPARE PARTS

A. The Contractor shall furnish to the Owner at the completion of the project, a minimum of 5% spare L.E.D. driver assemblies. LED drivers shall be turned over to the Owner representative in their manufacturer’s protective packaging. LED drivers not in their protective packaging will not be acceptable.

B. The Contractor shall furnish to the Owner at the completion of the project, a minimum of 5% spare L.E.D. light engine assemblies. LED light engines shall be turned over to the Owner

representative in their manufacturer's protective packaging. L.E.D. light engines not in their protective packaging will not acceptable.

2.5 EXIT LIGHTS

A. Exit lights (signs) shall be universal mount and complete with factory installed light-emitting diodes (L.E.D.'s) mounted behind a red diffusing panel and with direction arrows as shown on the drawings.

B. Exit lights shall have wire guards where shown on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions
   1. Examine substrate and supporting grids for luminaires.

3.2 INSTALLATION - GENERAL

A. Install in accordance with manufacturers' instructions.

B. Mount lighting fixtures at heights indicated. Where not indicated mount:
   1. Exit lights - 90 inches above floor. Center in space over door frame where applicable.
   2. Bracket light above lavatory - 78 inches above floor.

C. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

D. Support luminaires larger than 2 foot x 4 foot size independent of ceiling framing.

E. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

F. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

G. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.

H. Install recessed luminaires to permit removal from below.

I. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

J. Install clips to secure recessed grid-supported luminaires in place.

K. Install wall mounted luminaires and exit signs at height as indicated on Drawings.

L. Install accessories furnished with each luminaire.

M. Connect luminaires, and exit signs to branch circuit outlets provided under Section 26 05 33 using flexible conduit as indicated.

N. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

O. Bond products and metal accessories to branch circuit equipment grounding conductor.

P. Maintain fire rating of ceiling where luminaire are installed.

Q. Where a switched fixture with battery backup is used, connect an unswitched lead to the emergency ballast.

3.3 INSTALLATION - SECURITY TYPE

A. In addition to the requirements elsewhere, the following requirements shall be met:
   1. Each maximum or medium security fixture to be attached to concrete structure shall be attached with six 3/8 inch Hilti Kwik Bolts or equivalent with a minimum embedment of 2 inches. Each bolt shall support a minimum of 3000 pound tension in 4,000 psi concrete.
   2. Each maximum or medium security fixture to be attached to concrete masonry security wall shall be attached with a minimum of six Hilti Kwik Bolts or equivalent, minimum 3/8 inch diameter, with a minimum embedment of 4 inches into the filled cell of the masonry unit. Do not install bolt at any other point in the masonry unit.
   3. Each minimum security fixture to be attached to concrete structure shall be attached with four 3/8 inch Hilti Kwik Bolts or equivalent with a minimum embedment of 2 inches. Each bolt shall support a minimum of 3,000 pound tension in 4,000 psi concrete.
   4. Each minimum security fixture to be attached to concrete masonry security wall shall be attached with four 3/8 inch Hilti Kwik Bolts or equivalent with a minimum embedment of 4 inch into the filled cell of the masonry unit. Do not install bolt at any other point in the masonry unit.
   5. Each security fixture attached to suspend ceiling system shall be attached with threaded bolt through ceiling to steel channel rigidly attached to ceiling suspension system. Number of bolts as specified by security level of fixture. Mount tight to ceiling.

3.4 FIELD QUALITY CONTROL

A. Site Tests
   1. Test under provision of Division 1.
      a. Operate each luminaire after installation and connection.

B. Inspection
   1. Inspect for proper connection and operation.

3.5 ADJUSTING

A. Adjust Work under provisions of Division 1.

B. Aim and adjust luminaires as indicated on Drawings as directed.

C. Adjust exit sign directional arrows as indicated.

3.6 CLEANING

A. Clean Work under provisions of Division 1.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.7 DEMONSTRATION

A. Provide systems demonstration under provisions of Division 1.

B. Provide minimum of two hours demonstration of luminaire operation.

3.8 LUMINAIRE SCHEDULE

A. Refer to lighting fixture schedule on drawings.

END OF SECTION

DIVISION 27
COMMUNICATIONS

27 30 00
TELECOMMUNICATIONS CABLING AND PATHWAY SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

B. The general conditions for contracts of construction, referred to in the contract documents as the General Conditions, together with the following articles of the Telecommunications Cable and Pathways Specification, that amend, modify and supplement various articles and provisions of the General Conditions, are made part of the Contract and shall apply to all work under the Contract.

C. All articles or parts of articles of the General Conditions not so amended, modified or supplemented by this Telecommunications Cabling Specification shall remain in full force and effect. Should any discrepancy become apparent between the General Conditions and the Telecommunications Cable and Pathways Specification, the Contractor shall notify the Architect, in writing, and the Architect shall interpret and decide such matters in accordance with the provisions of the General Conditions.

1.2 SPECIAL CONDITIONS

A. Standards, materials specifications, related drawings, cable schedules, industry guidelines, and codes referred to herein shall be considered part of these specifications and shall apply to the Work described or implied, herein.

B. All local fees, permits and services of inspection authorities shall be obtained and paid for by the Contractor, The Contractor shall cooperate fully with local utility companies with respect to their services.

C. It is the intent of these specifications for the Contractor to provide a complete, functional, standards-based cabling infrastructure for the County’s use, utilizing Category 6 and Category 6A cabling to support high speed data applications up to and in excess of 1000 Mb/s horizontally and up to ten gigabit Ethernet in the wireless and backbone network systems.

D. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the system design intent as presented, is to be considered as part of the Contract and required to be furnished and installed by the Contractor.

E. Any given item of equipment or material shall be the product of one manufacturer solution throughout the facility. Multiple manufacturers of any one item will not be permitted, unless specifically noted otherwise or approved in writing by the Designer prior to purchase and use.

F. This specification is an equipment and performance specification. Actual installation shall be as indicated on the Telecommunications Drawings and in the Specifications governing the

Work. Any discrepancies found between the Specifications and the Drawings shall be immediately brought to the attention of the Architect for interpretation.

G. Contract Documents and Drawings depict equipment installation and wiring in a diagrammatic fashion and indicate the general arrangement of equipment and wiring. The most direct routing for conduits and telecommunications pathways is not assured. Exact requirements shall be governed by architectural, structural and mechanical condition/features of the job. Consult all other drawings and specifications.

1.3 PRICING

A. Provide total cost and unit pricing as per the General Conditions and Bid instructions.

1.4 CONTRACTOR EXPERIENCE

A. The selected Contractor shall be fully capable and experienced in the telecommunications distribution system specified. To ensure the system has continued support, the County will contract only with Contractors having a successful history of sales, installation, service, and support.

B. During the bid evaluation process, the Customer may, with full cooperation of the Contractor, visit the Contractor's places of business, observe operations, and inspect records. The Contractor must have a minimum of five (5) years of continuous experience in the network cabling installation field and possess a C7 or C10 license in the State of California.

C. Contractor must be an approved Leviton Certified Installer in the Leviton Certified Network Installer program before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.

D. The Contractor must have a Registered Communications Distribution Designer (RCDD) on staff that will be ultimately responsible for this project in the Project Manager role. The RCDD must have sufficient experience in this type project as to be able to lend adequate technical support to the field forces during installation, during the warranty period, and during any extended warranty periods or maintenance contracts. A resume of the responsible RCDD must be attached to the Contractor's response for evaluation by the County. Should the RCDD assigned to this project change during the installation, the new RCDD assigned must also submit a resume for review by the County. If, in the opinion of the County, the RCDD does not possess adequate qualifications to support the project, the County reserves the right to require the Contractor to assign an RCDD who, in the County's opinion, possesses the necessary skills and experience required of this project.

1.5 WORK INCLUDED

A. The work covered by this Contract includes the construction described and implied, all labor required to perform and complete such construction, all materials required to perform and complete such construction, all services, facilities, tools and equipment required to perform and complete such construction, and coordination with the General Contractor and all other trades.

B. The scope of this work includes, but is not limited to:

1. Provision, installation, termination, identification, and testing of optical fiber backbone cable, and high pair count UTP copper between the BDF and all IDFs.
2. Provision, installation, termination, identification, and testing of inside plant UTP workstation cables between the IDFs/BDF and the workstations located in the building. This includes all termination components to complete the horizontal links to each workstation outlet.
3. Provision, installation and grounding of all telecommunications racks, cabinets, cables (as required), and all cable pathways requiring grounding under TIA standards and BICSI guidelines.
4. Provision of labeling and documentation of all cables, racks, grounding buss-bars, pathways and spaces, faceplates, patch panels and termination blocks installed under this Work.
5. Provision and installation of wire management components, ladder-type cable runway, any surface-mount raceways and miscellaneous “nuts & bolts” type components to provide a complete and working cable system.
6. Fire stopping of floor and rated wall penetrations specifically provided for the distribution of telecommunications cables. Required floor and wall ratings shall be maintained.
7. Preparation and submission of shop drawings, termination schedules, test results, as-built drawings, and component documentations described within this Specification.

1.6 RELATED WORK NOT INCLUDED IN THIS SECTION AND SPECIFIED ELSEWHERE, UNLESS OTHERWISE NOTED

A. Installation of conduits, pull-boxes and floor-boxes (provided under electrical Work).

B. Installation of workstation devices, computers, terminals and similar equipment (installed by County representatives and their additional representatives).

C. Installation, provisioning or supply of active data and telephone switch equipment is not included in this scope of work.

D. Provision and installation of AC grade or better plywood on the MDF and IDF walls, as indicated in the drawings. Plywood shall be at least ¾” thick and treated on all sides with at least two coats of fire-resistant paint, white color.

1.7 SITE VISIT & FIELD CONDITIONS

A. Since the work will be performed on new and existing structures, the Contractor shall visit and examine the site of the proposed work to determine the existing conditions that may affect the work. The Contractor shall be held responsible for any assumptions in regard thereto.

B. The Contractor shall verify all dimensions and distances in the field and document the cable lengths and materials to be furnished and installed. The provision and installation of non-specified miscellaneous components and hardware, i.e. drag lines, nuts, bolts and tie wraps shall also be the Contractor’s responsibility.

C. Existing site conditions, Contract Documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the work. All such documents shall be available through the General Contractor or Construction Management.

1.8 ABBREVIATIONS AND DEFINITIONS

A. The Work specified herein shall conform to the following codes, regulations, standards, and guidelines:

B. FCC:
   1. Part 15: Unlicensed Radio Frequency Devices
   2. Part 68: Terminal Equipment Certification Requirements

C. NEC 2008 or latest edition utilized by AHJ.

D. NESC 2008 or latest edition utilized by AHJ.

E. NFPA codes (latest edition utilized by AHJ).

F. State and Local Municipal Construction-Related Codes

G. Underwriters Laboratory (UL)

H. IEEE:

   1. IEEE 802.3: 10Base-T Ethernet Standard
   2. IEEE 802.12: 100Base-TX Ethernet Standard
   3. IEEE 802.3ab: 1000Base-T Ethernet Standard
   4. IEEE 802.3ae: 10Gb/s Ethernet Standard
   5. IEEE 802.3af: Power Over Ethernet Standard
   6. IEEE 802.3at: Power Over Ethernet (PoE+) Standard
   7. IEEE 802.11 All Wireless Ethernet Standard(s)

I. BICSI:

   1. TDMM: 2014, 13th Edition or later
   2. TCIM: 2002, 3rd Edition
   3. C-O OSP: 2006, 4nd Edition

J. TIA/EIA: (includes all related addenda to each standard)

   1. TIA/EIA 310-D: Racks, Panels and Associated Equipment
   2. TIA/EIA 455-13-A: Visual and Mechanical Inspection of Optical Fibers, Cables, Connectors and other Optical Devices.
   3. TIA/EIA 455-57-B: Optical Fiber End Preparation and Examination.
   4. TIA/EIA 455-59: Measurement of Optical Fiber Cable Point Defects with an OTDR.
   5. TIA/EIA 455-61: Measurement of Optical Fiber Cable Attenuation with an OTDR.
   6. TIA/EIA 455-95: Absolute Optical Power testing of Fiber Cables.
   7. TIA/EIA 4720000-A: Generic Specification of Optical Fiber Cables.
   8. TIA/EIA 472C000-A: Generic Specification of Optical Fiber Cables for Indoor Use.
   9. TIA/EIA 492AAAA: Specification for 62.5/125-µm Class1a Graded-Index Multimode Optical Fiber.

10. TIA/EIA 492AAAC: Specification for 850-nm Laser-Optimized 50/125-µm Class 1a Graded-Index Multimode Optical Fiber.
11. TIA/EIA 492CAAA: Specification for Class 1va Dispersion-Un-Shifted (Zero Water Peak) Single Mode Optical Fiber.
12. TIA/EIA 526-7: Optical Power Loss Measurement of Single Mode Optical Fiber Cable Plant.
13. TIA/EIA 526-14: Optical Power Loss Measurements of Installed MMF Cables.
14. TIA 568 C.0 Commercial Building Telecom Wiring Standard Part-0: Generic Requirements.
15. TIA/EIA 568-C.1: Commercial Building Telecom Wiring Standard Part-1: Commercial Cabling Requirements.
16. TIA/EIA 568-C.2: Commercial Building Telecom Wiring Standard Part-2: Balanced Twisted Pair Cabling Standard.
17. TIA/EIA 568-C.3: Commercial Building Telecom Wiring Standard Part-3: Optical Fiber Cabling Standard.
18. TIA/EIA 598: Color Coding of Optical Fiber Cables and Strands.
19. TIA/EIA 606-A: Administration Standard for Telecommunications Infrastructure within Commercial Buildings.
20. TIA/EIA 607-A: Commercial Building Grounding and Bonding Requirements for Telecommunication Systems.
21. TIA/EIA 758: Customer-owned OSP Telecommunications Cabling Standard.

K. ANSI/ICEA:
1. ANSI/ICEA S-83-596: Fiber Optic Premise Distribution Cable Technical Requirements. (1994)
2. ANSI/ICEA S-90-661: Standard for Individually UTP Cables for Use in Communications Wiring Systems (1997).

L. The installation shall comply fully with all National, State, and Local government authorities, laws and ordinances, as well as, all regulations, codes, and industry guidelines governing the work or interpreted to govern the work by the authority having jurisdiction (AHJ) at the site. This includes all Owner-specific standards and guidelines related to the Work.

M. Should any change in the current plans or specifications be required to comply with any Code, Regulation or Standard noted above, the Contractor shall notify the Designer and Architect in writing at the time of submitting the construction schedule.

N. All equipment and installation methods shall be equal to or exceed the minimum requirements of NEMA, IEEE, ASME, ANSI, TIA BICSI, and Underwriters' Laboratories, where applicable.

1.9 SUBMITTALS

A. Provide submittals in accordance with schedule and general requirements defined in the General Conditions.

B. Product Data:

1. Provide, as part of the bid, manufacturers' product data sheets for all material and equipment whose products are proposed. Only specified or accepted manufacturers or suppliers shall appear in the Product Data Submittal. Bid shall not be considered without a complete Product Data Submittal.

2. Approved suppliers of the structured cabling system are Berk-Tek and Leviton, or Berk-Tek Leviton Technologies. Approved supplier of the support infrastructure components is Chatsworth Products.

3. Provide, as part of the bid, manufacturer's product data sheets for all fire stopping materials proposed for use on the project.

4. Mark each copy to show applicable choices and options. Where product data includes information on several products, some of which are not required, mark copies to indicate the applicable information.

5. Requests for substitutions of equipment or materials must be made and approved prior to the bid submittal. Unapproved substitutions may constitute a non-compliant bid return.

C. Shop Drawings:

1. Provide, for Architect's action, shop drawings for the installation of the Work prior to beginning Work

2. Provide detailed plan views and elevations of all equipment racks, termination blocks, patch panels and cable paths, if the elevation and plan views are not identical to the T-series bid drawings.

3. Provide drawings to show evidence of coordination with other trades.

4. Acceptance of any submitted data or Shop Drawings for material, equipment apparatus, devices, arrangement and layout shall not relieve Contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality and installation details to perform efficiently the requirements and intent of the Contract. Such acceptance shall not relieve Contractor from responsibility for errors, omissions or inadequacies of any sort on submitted data or Shop Drawing.

5. All Shop Drawings shall be submitted sufficiently in advance of field requirements to allow ample time for review and re-submittal as may be required. All Submittals shall be complete and contain all required and detailed information.

6. All Shop Drawings shall contain job name/title and reference to the applicable Drawing and Specification article for reference by the reviewer.

7. Provide for County's documentation, a Finish Statement in form stipulated by the Architects, signed by the Contractor, stating that the Work was provided in compliance with the Contract Documents and that the installation was proper for the conditions of application and use.

D. Record Drawings – Submit for County's representative's documentation:

1. Provide Record Drawings annotated with the changes made during the installation of the Work so as to be a complete set of "as installed" plans. Drawings shall be in printed form and on compact disk in AutoCAD 2014 or earlier DWG format.

2. Provide County representative with two (2) sets of Operation and Maintenance Manuals including wiring diagrams, parts lists, shop drawings and manufacturers' information on all equipment and cables provided under this Work. Provide manuals in a high quality, 3-ring binder, completely indexed. Provide manuals to the County representative not more than 1 week after project completion.

1.10 QUALITY ASSURANCE

A. Contractor is solely responsible for quality control of the Work. Comply with any Quality Control requirements specified in the General Conditions.

B. All materials furnished shall be new and unused. All materials shall meet all applicable codes provided a standard has been established for the material in question.

C. At a minimum, fifty percent (50%) of Contractor-provided field technicians at any time shall be factory-certified within 12 months by the manufacturer of the telecommunications system components to install the Contractor-selected and Owner-approved system components. Proof of certification shall be available on site for review at all times for each field technician.

D. Contractor shall be in good standing with the selected manufacturer(s) of system components and be able to provide the Owner with the extended warranty for the installation offered by the manufacturer.

E. All work performed by the Contractor shall be available for observation and approval by the Manufacturer, the Owner, and the system Designer in order to verify the systems integrity and increase the performance of the system under the installation and performance guidelines described in the Contract Documents.

1.11 CODES, REGULATIONS & STANDARDS

A. The installation shall comply fully with all government authorities, laws and ordinances, regulations and codes applicable to the installation.

B. Should any change in plans or specifications be required to comply with governmental regulations, the Contractor shall notify the County representative and Architect at the time of submitting the construction schedule.

C. Local electrical and building codes may differ with national codes. Follow the most stringent code or recommendations. Where there are instances of ambiguity refer to the Architect for interpretation.

1.12 COORDINATION OF THE WORK

A. Carefully check space requirements and the physical confines of the area of work to insure that all material can be installed in the spaces allotted thereto, including conduits and cable supports.

B. Transmit to other trades in a timely manner all information required for work to be provided under the respective Sections in ample time for installation.

C. Wherever work interconnects with or contacts the work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment.

D. Due to the type of installation, a fixed sequence of operation is required to properly install the complete systems. Coordinate project and schedule work with the General Contractor in accordance with the construction sequence. Provide status of the installation to the General Contractor to allow them to update their project schedules.

E. The Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper compliance with the design intent.

1.13 DELIVERY, STORAGE AND HANDLING

A. Procedure: In Accordance with Division One, General Requirements.

B. Deliver materials (except bulk materials) in manufacturer's unopened container fully identified with the manufacturer's name, trade name, type, class, grade, size and color.

C. Store materials suitably sheltered from the elements, but readily accessible for inspection until installed. Store all items subject to moisture damage in dry spaces. Provide space requirements for storage in submittals list. The General Contractor shall assign storage space.

1.14 CERTIFICATION & WARRANTY

A. All work and all items of equipment and materials shall be warranted by the Contractor for a minimum period of one year from the date of acceptance of the work. Where a manufacturer's warranty is longer than one year, the Contractor shall acquire and provide the extended warranty. The Contractor shall, upon notification of any defective items, repair or replace such items within 24 hours without cost to County, all to the satisfaction of the Architect.

B. The installed passive network cabling components of the Work described in the Contract Documents shall be covered under a manufacturer-supported Limited Lifetime Warranty related to installed materials, supported applications and the installation workmanship. The Contractor shall be responsible for submitting all necessary applications, test results, and closeout data to the Manufacturer in order to register this project with the Limited Lifetime Warranty. This guarantee and extended warranty shall be supported in writing by both the connectivity and cable manufacturer and shall address and cover the following:

1. All defects in wire, cable, components and/or other materials in the Voice and Data Communication System.

2. All specification and performance parameters of system components as presented in the Construction Documents at the time of installation completion will be warranted/ guaranteed to provide performance margins as described in this document for all

frequencies swept from 1 – 500 MHz (as appropriate) for the published TIA/EIA 568C parameters for NEXT, PSNEXT, ACRF, PSACRF, and Return Loss performance standards as published in TIA/EIA.

3. All installed components of the data backbone system shall support ten (10) Gigabits per second Ethernet applications that use 850 nm transceivers for serial transmission in LOMMF (OM3) at distances up to three hundred (300) meters.

4. All workmanship associated with any warranty issues related to providing, installing, certifying and documenting the Work described in the Construction Documents shall be covered by this warranty.

E. Contractor shall respond to the Owners request and correct any problems, malfunctions, and warranty issues associated with the Work described in the Construction Documents without additional charge to the Owner within three (3) calendar days for the entire warranty period, as stated in the Warranty.

F. The Owner considers the Voice Data Communications System components a whole, complete system and requires an integrated component/cable warranty from both the cable manufacturer and the connectivity manufacturer for material and installation workmanship as described in the Construction Documents.

1.15 PROJECT CLOSEOUT

A. The installed Voice and Data Communications System will not be accepted until all work is complete and properly documented and all punch list items discovered are completed to the Designer and Owner's complete satisfaction.

B. The warranty will not begin until after a thirty (30) day acceptance period (See below for Acceptance Period information) to judge the performance of the installed Voice and Data Communication System. If during this thirty (30) day period the installed system does not perform adequately, the Trade Contractor must repair the installation within two (2) days to the satisfaction of the Designer and Owner and/or the Contract Documents and the thirty (30) days will restart from the date of the resolution.

C. The Trade Contractor's project manager must be available to answer questions about the installation and to attend site visits and meetings during the acceptance period.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Provide telecommunications cable and termination equipment with performance levels and capacities as noted herein.

B. Any item not specifically shown on the drawings or called for in this section of the project specifications, but normally required to conform to the system design intent, are to be considered as part of the Contract and shall be included in the Contractor's scope of work.

C. The Construction Documents define the minimum acceptable quality by designating a manufacturer's trade or brand name and part number, by describing attributes, performance, or other standards. It is the responsibility of the Contractor to verify that all Contractor-

proposed products and system components meet or exceed the minimum acceptable performance requirements outlined below, even for those listed in the “material” section(s).

D. All products designated as “or equal”, “or equivalent”, and “or acceptable substitute” indicate that an alternate product that equals or exceeds the product attributes may be substituted for that product so specified. The proposed alternate component(s) performance must be independently verified and documented. This independent verification documentation must be presented to the Owner or Designer for review and approval during the bid submittal process. The alternate product must be approved by the Designer and Owner prior to purchase, installation, and/or certification. Purchase and/or installation of any component without written approval of materials by the Designer and/or Owner is done at the Contractor’s own risk.

E. Any part numbers provided in this Specification has been coordinated with the manufacturers’ latest available product literature. Part numbers are subject to change without notice by the manufacturers. Where a specific part number is invalid, provide product meeting component description.

F. Contractor shall provide product submittals adequate to clearly demonstrate the conformance of the specific product to the attributes, performance, and standards set forth within the Construction Documents for all products prior to use after the bid submittal phase. Alternates proposed after the bid submittal phase are required to have written approval for use by the Designer.

G. All cable shall be rated and installed for the specific construction environment, unless otherwise noted in the Construction Documents. It is the responsibility of the Contractor to verify the installation environment prior to bid.

H. All products shall be new, unused, in perfect working condition, and in the original packaging containers upon arrival at the Project Site and also prior to installation. It shall be the Contractor’s responsibility to verify the status of the products and report, in writing to the Designer and Owner, any products that do not conform to the requirements described within the Construction Documents. Commencement of the Work described herein constitutes the Contractor’s acceptance of new, unused products as stated, being installed. Any products found to be non-conforming shall be replaced with conforming products by the Contractor at their expense immediately.

2.2 COMPONENT MANUFACTURERS

A. Subject to compliance with technical requirements of this section and the bid requirements provided in General Conditions, provide cable and equipment from the manufacturers as indicated herein as a complete connectivity and distribution “solution”.

B. Horizontal cables and terminations must be certified as a system. Manufacturers’ specifications and guarantees of system compliance must be provided for acceptance.

C. Approved suppliers of the structured cabling system are Berk-Tek and Leviton only. Approved supplier of the support infrastructure components is Chatsworth Products.

2.3 MATERIALS

A. Where specific items are called out in the specification or indicated on the drawings for a specific application, use those products or materials, or approved substitutes. Where no specific call outs are made use premium products and materials.

2.4 SUBSTITUTIONS

A. All products described by attributes and noted with the optional “or equal”, “or equivalent”, and “or acceptable substitute” indicate that an alternate product that equals or exceeds the specified product attributes may be substituted for that product so specified if approved by the Designer in writing prior to bid.

B. The alternate or equal designated products must be submitted for review and judgment to the Owner and Designer prior to inclusion in a Contractor’s bid. The Contractor-proposed alternate products or components that meet or exceed the specified attributes must be published and verified by two (2) independent sources within the past 6 months.

C. The Contractor shall submit a written request for Designer and Owner approval of their use fourteen (14) elapsed days after the first pre-bid meeting date. This request shall include the two (2) independent sources, the original product’s specification sheet, the proposed substitute product cut sheet, and a written request to review the substitute product that includes any cost impact (increase or decrease) associated with the request.

2.5 CABLE MEDIA

A. Category 6A 4-Pair Cable Unshielded Twisted Pair Plenum – CMP:

1. Category 6A cables made in the USA of solid annealed copper conductors, 23 AWG, with four individually twisted pairs in a single round cable sheath.

2. Characterized to 750 MHz, 250 MHz greater than the standard

3. Outer diameter 0.300" (7.6mm), CMP, typical

4. Colors as outlined in the T-series drawings.

5. Channel margin guarantees for ANSI/TIA 568-C.2 CAT6A and ISO/IEC 11801 Class EA (margin vs. ANSI/TIA-568-C.2 and margin guarantees are for a standard 2-connector channel).

a.	Insertion Loss	3%
b.	NEXT	2 dB
c.	PSNEXT	3 dB
d.	ACR-F (ELFEXT)	5 dB
e.	PSACR-F (PSELFEXT)	6 dB
f.	Return Loss	1 dB
g.	ACR-N	4 dB
h.	PSACR-N	5 dB

Approved Products:
Berk-Tek BLUE LANmark 10G2 Category 6A CMP cable #10130484 (1000’)

Berk-Tek BLUE LANmark 10G2 Category 6A CMR cable #10133700 (1000')

B. Category 6 Cable Unshielded Twisted Pair Plenum – CMP:

1. Category 6 cables made in the USA of solid annealed copper conductors, 23 AWG, with four individually twisted pairs in a single round cable sheath.

2. 100 ohm nominal impedance, UL Listed and independently verified as TIA/EIA Category-6 performance.

3. Characterized to 550 MHz, 300 MHz greater than the standard

4. Outer diameter 0.230" (5.8mm), CMP

5. Colors as outlined in the T-series drawings.

6. Channel margin guarantees for ANSI/TIA 568-C.2 CAT6 and ISO/IEC 11801 Class E (margin vs. ANSI/TIA-568-C.2 and margin guarantees are for a standard 2-connector channel).

a.	Insertion Loss	5%
b.	NEXT	6 dB
c.	PSNEXT	6 dB
d.	ACR-F (ELFEXT)	8 dB
e.	PSACR-F (PSELFEXT)	9 dB
f.	Return Loss	3 dB
g.	ACR-N	7 dB
h.	PSACR-N	8 Db

Approved Products:
Berk-Tek BLUE LANmark 1000 Category 6 CMP cable #10032094 (1000')
Berk-Tek BLUE LANmark 1000 Category 6 CMR cable #10032445 (1000')

C. Category 5e Cable Unshielded Twisted Pair Plenum – CMP:

1. Category 5e cables made in the USA of solid annealed copper conductors, 24 AWG, with four individually twisted pairs in a single round cable sheath.

2. 100 ohm nominal impedance, UL Listed and independently verified as TIA/EIA Category-5e performance.

3. Characterized to 350 MHz

4. Outer diameter 0.210" (5.3mm), CMP

5. Colors as outlined in the T-series drawings.

Approved Products:
Berk-Tek BLUE Hyper Plus 5e Category 5e CMP cable #10032227 (1000')
Berk-Tek BLUE Hyper Plus 5e Category 5e CMR cable #10032528 (1000')

D. Multi Pair Voice Riser Cable:

1. Physical Specifications: 100 twisted pair – 24 AWG, solid copper conductors, 100 ohm nominal impedance +/-15%.

2. Electrical characteristics: All pair counts must meet Category 3 transmission requirements.

3. Cable Construction: individually insulated conductors with standard UTP color code markings, a minimum of two twists per foot under a rated sheath.

   Approved Products:
   Berk-Tek # 10032111, 25-pr CMP, Gray.
   Berk-Tek # 10032396, 25-pr CMR, Gray
   Other multiples of 25 pairs are acceptable (50, 100, 200, 300pr as required)

E. Multimode Horizontal/Backbone Fiber:

1. Physical Specifications: Core Diameter 50 □m, Cladding Diameter 125µm Laser-Optimized Multi-Mode Fiber.

2. OM3 Optical Characteristics: maximum fiber loss 3.0 dB/km @ 850 nm & 1.0 dB/km @ 1300 nm, minimum modal Bandwidth 2000 MHz @ 850 nm, 500 MHz @ 1300 nm. Must be able to support 1 Gb/s at distance up to 1,000 meters for 850 nm and 600 meters for 1300 nm, and 10Gb/s up to 300 meters.

3. OM4 Optical Characteristics: maximum fiber loss 3.0 dB/km @ 850 nm & 1.0 dB/km @ 1300 nm, minimum modal Bandwidth 4700 MHz @ 850 nm, 500 MHz @ 1300 nm. Must be able to support 1 Gb/s at distance up to 1,200 meters for 850 nm and 600 meters for 1300 nm, and 10Gb/s up to 550 meters.

4. Armored Cable Construction: Cable shall be rated for use in plenum applications with fiber counts of 2 through 24 available. Cable shall consist of tight-buffered fibers with a dielectric strength member and be contained within an interlocking armor outer cover from end-to-end for protection.

5. Standard fiber Cable Construction: Cable shall be rated for use in plenum applications with fiber counts of 2 through 24 available. Cable shall consist of tight-buffered fibers with a dielectric strength member and aramid yarn for protection.

6. Cable shall be indoor/outdoor when installed outside buildings, with a Dry-Gel system of water block. Indoor/Outdoor tight buffered fiber is not suitable for aerial lashing.

   Approved Products:
   Berk-Tek 24-fiber indoor Plenum OM3 fiber, # PDP024EB3010/25
   Berk-Tek 24-fiber indoor Plenum OM4 fiber, # PDP024FB3010/25
   Berk-Tek 24-fiber Armored Plenum OM3 fiber, # PDPK024EB3010/25
   Berk-Tek 24-fiber Armored Plenum OM4 fiber, # PDPK024EB3010/25
   Berk-Tek 12-fiber Indoor/Outdoor Plenum OM4, PDP012FB3510/25-HE(BLA)

F. Single Mode Backbone Optical Fiber cable:

1. Physical Specifications: Core Diameter 8.3 µm, Cladding Diameter 125 µm. Low-Water Peak (OS2) singlemode fiber, complies with ITU-T G.652D.

2. Optical Characteristics: maximum fiber loss 0.70 dB/km @ 1310 nm & 0.70 dB/km @ 1550 nm.

3. Cable Construction: cable shall be rated for use in plenum applications with fiber counts from 2 to 24 available. Cable shall have a dielectric strength member for strength and be contained within a Plenum Tight Buffered Cable with Aluminum Interlock Armor from end-to-end for protection.

   Approved Products:
   Berk-Tek 24-fiber indoor Plenum Singlemode, # PDP024AB0707
   Berk-Tek 24-fiber Indoor/Outdoor Plenum Singlemode, PDP024AB0707-HE(BLA)
   Berk-Tek 24-fiber Indoor Plenum Singlemode Armored, PDPK024AB0707

2.6 TERMINATION HARDWARE

A. COPPER TERMINATION BLOCKS

1. Provide termination blocks for Backbone Cabling Systems that support up to Category 5e applications and facilitate cross-connection using twisted pair wiring.

2. The connecting hardware block shall support the appropriate Category 3 to 5e voice (non-VOIP) applications and facilitate cross-connection and/or inter-connection using cross-connect wire.

3. The cross-connect shall be Category 5e 110-style wiring bases, mountable to wall or backboard to provide 110 termination capable of supporting voice, security, and Category 5e data applications, including high megabit and shared-sheath applications when used with Category 5e rated cabling.

4. The components shall be UL listed and ANSI/TIA-568-C compliant. Bases shall support 50, 100 or 300 pair densities with provision for ANSI/TIA-606-B compliant labeling. Plastic bases and blocks shall be made of fire-retardant plastic rated UL 94V-0.

5. Cross-connect blocks shall be available in a variety of insulation displacement clips (IDC) with and without tails, and support wire sizes: Solid: Wire Ranges 22-26 AWG (0.64mm - 0.40mm).

   Approved Products:
   Leviton 110 Connecting Block, 100-pair w/legs # 41AW2-100
   Leviton Wire Manager w/legs, # 41A10-HCM

B. COPPER PATCH PANELS

1. Modular Insert Copper Termination Patch Panels shall exceed requirements for Category 6 and Category 6A described in ANSI/TIA-568-C.2 and Class E requirements described in ISO/IEC 1180 in a standard-density (24 ports per Rack Unit).

2. All copper termination panels shall be modular metal frame, flat, 2RU 48-port or 1RU 24-port, made of 16-gauge steel and powder-coated black with white silkscreened lettering that accept modular category-5e, 6 or 6A RJ45 jack inserts or blank inserts from the same manufacturer.

3. Panels shall utilize the same universal jacks as are used in workstation area outlets, and not a special purpose “panel jack”.

4. Modular jack inserts shall correspond with the colors outlined in the T-series drawings. Wiring scheme shall be T568B.

5. IDF Patch panel modular jacks shall match the outlet jacks at each workstation location (color, performance, and labeling).

   Approved Products:
   Leviton QuickPort® 2RU 48-port Patch Panel, # 49255-H48
   Leviton QuickPort® 1RU 24-port Patch Panel, # 49255-H24

C. Modular Connectors/Jacks:

1. Provide modular type 8-position/ 8 conductor (8P8C, RJ45-style) connectors (jacks) for network (data, voice, wireless, video, etc.) information outlets using 22-26 AWG copper cable. Connectors shall be individual snap-in style, and exceed compliance with TIA/EIA-568-C.2 specifications.

2. The connectors shall utilize a universal Keystone-style (QuickPort) insertion footprint as the manufacturer’s main “flagship” line of products. Jacks shall fit existing Leviton patch panels and faceplates to facilitate the County’s ongoing operations.
3. Jacks shall comply with FCC Part 68; UL listed and CSA Certified. Verified to exceed all channel performance requirements in TIA-568-B.2-10 from 1 MHz to 500MHz to support the IEEE 802.an standard for 10 Gigabit Ethernet over UTP Cable.

4. Every connector shall include polymer springs above the tines (“Retention Force Technology” or similar functionality) to promote return of tines to original position and protect against deformation due to stress of patch cords or inappropriate materials insertion.

5. Connector shall have Pair Separation Towers on IDC to facilitate quick, easy terminations without a complete untwist of each pair of conductors. Jacks shall employ 2 or more circuitry solutions for dampening of NEXT.

6. The connector shall be rear 110-type insulation displacement connectors (IDC) with solder-plated phosphor bronze contacts, configured in a 180° orientation such that the punch down field is in the back, allowing for rear termination.

7. All plastics used in construction of the connector bodies shall be fire-retardant with a UL flammability rating of 94V-0.

8. The connector shall provide a ledge directly adjacent to the 110-style termination against which the wires can be directly terminated and cut in one action by the installation craftsperson.

9. Connector wiring label shall provide installation color codes for both T568A and T568B wiring schemes on separate labels.

10. Category 6A (CAT6A) connectors shall support 10G and will feature an injection molded Cone of Silence™ technology to eliminate alien crosstalk (AXT).

    Approved Products:
    Leviton eXtreme CAT6A QuickPort Module # 6110G-R*6
    Leviton eXtreme CAT6+ QuickPort Module # 61110-R*6
    Leviton eXtreme CAT5e+ QuickPort Module # 5G110-R*5

    Where * = one of 13 colors. See drawings or check with County for application.

1. Wall Outlets & faceplates provide information outlets to the work area. Contractor shall provide and install single gang faceplate kits to allow up to six data or voice jacks as required for all work area outlets, workstation base feeds, and unused telecom backboxes and furniture openings.
2. Faceplates shall utilize a Quickport ("keystone"-style) footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
3. Faceplates shall support any connectivity media type, including fiber and copper applications, and shall be available in single-gang and double-gang configurations.

    Approved Products:
    Leviton QuickPort Single-Gang, plain, # 41080-#xP
    Leviton QuickPort Single-Gang with ID Windows, # 42080-#xS
    Leviton QuickPort Double-Gang with ID Windows, # 42080-#xP
    Leviton QuickPort Blank Inserts, pack of 10, # 41084-BxB
    Leviton QuickPort Surface-Mount Box, # 41089-#xP

    Where:
    # = number of ports: 1, 2, 3, 4, 6
    x = color: White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)
    Match colors and materials of the power wiring device plates

D. Fiber Termination Enclosures:

1. Shall provide cross connect, inter connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

2. Fiber enclosure shall be available in 1, 2 and 4RU versions to accommodate termination and splicing of fiber as outlined in the T-series drawings.

3. Enclosure depth shall be 17" and shall fit into a standard 19" rack. The combination shelf shall be able to support the terminations associated with the fiber cables and connectors as well as any splice cases required

4. Enclosure shall feature a sliding tray which removes completely, front or rear, from enclosure to facilitate field terminations and splicing.

5. Rack-mount enclosure shall have removable transparent hinged doors and slide away covers allow easy access during install and visibility of interior after install.

6. Fiber Adapter Plates (bulkheads) shall accept SC and/or LC connectors, MTP® adapters, and plug-n-play MTP modules/cassettes.

7. Fiber cable management for routing, storage, and protection shall accept patch cords, tight-buffer fiber, and backbone cables. Rear fiber cable management rings shall be stackable and configurable in ¼, ½, or full ring arrangements. Enclosure shall be constructed of 16-gauge steel with a powder-coated black finish and an optional locking door feature shall be available.

8. Enclosure shall support the use of splice cassettes in a standard adapter plate footprint.

   Approved Products:
   Leviton Opt-X Ultra Rack-Mount 1RU Enclosure, # 5R1UH-S03
   Leviton Opt-X Ultra Rack-Mount 2RU Enclosure, # 5R2UH-S06
   Leviton Opt-X Ultra Rack-Mount 4RU Enclosure, # 5R4UH-S12
   Leviton lock and key # 5L000-KAL
   Leviton armored cable ground kit, # DPGRD-KIT

E. Fiber Termination Panels and Modules:

1. The adapter plate shall be offered in LC, SC, and MTP styles in 6, 12, or 24 fiber configurations. The adapter plate shall be compliant to ANSI/TIA-568-C.3 (for performance) and respective ANSI/TIA-604-X (for intermateability) standards, and shall be made in the United States of America.

2. Adapter plates shall use zirconia ceramic sleeves and be offered in standard fiber type colors pursuant to ANSI/TIA-568-C.3 standards. The adapter and plate shall be integrated to eliminate “rattle” and loose fit.

3. Integrated Fiber pigtail fusion splice modules shall be offered in 12- or 24-fiber LC and 12-fiber SC configurations in OS2 (Singlemode) and OM3/OM4 fiber types. Construction of module shall be of 14-gauge aluminum for robustness and light weight.

4. Splice Modules shall be pre-loaded and routed with respective 3-meter, color-coded pigtail assembly. Individual pigtails shall have maximum insertion loss of 0.4 dB and 0.35 dB for OM3 and OS2 fiber types, respectively. Return Loss shall be greater than 25 dB (for OM3), and 55 dB (for OS2/UPC).

5. Splice Modules shall contain individual compartments which provide slack storage and bend radius protection for incoming backbone fibers, 900 µm tight-buffer fibers, and fusion-spliced fibers. Incoming 250 µm backbone fibers shall be protected by a braided mesh sleeve. Heat shrink style splice sleeves, braided mesh sleeve, and tie wraps shall be included with splice module.

   Approved Products:
   Leviton 12-strand Adapter Plate, LC, SM, #5F100-2LL
   Leviton 12-strand Adapter Plate, SC, SM, #5F100-2LC
   Leviton 24-strand Adapter Plate, OM3/4, #5F100-4QL
   Leviton Opt-X 12-Fiber Splice Module, SM, # SPLCS-12L
   Leviton Opt-X 12-Fiber Splice Module, SM, SC, #SPSCS-12L
   Leviton Opt-X 24-Fiber Splice Module, OM3, # SPLCS-24A

F. Equipment Racks:

1. 19” EIA-310 standard steel equipment rack, 7 ft. high, complete with vertical cable raceways and horizontal cable management panels. Suitable for mounting approved modular patch panels, wire management and active network equipment. Must be seismically rated and restrained.

2. Manufacturer: Chatsworth

G. Four Post Rack Frame:

1. 19” EIA-310 standard steel, 4-post equipment frame, 7 ft high, complete with vertical cable raceways and horizontal cable management panels (if indicated in the T-series drawings). Suitable for mounting approved modular patch panels, wire management and active network equipment. Must be seismically rated and restrained.

2. Manufacturer: Chatsworth Quadra Frame

H. Wall-Mount Cabinet:

1. 19” EIA-310 standard steel, internal 4-post reinforced frame, 3 ft high, complete with vertical cable raceway channels and horizontal cable management panels (if indicated in the T-series drawings). Suitable for mounting approved modular patch panels, wire management and active network equipment.

2. Chatsworth Cube-IT Plus Cabinet

2.7 MANAGEMENT HARDWARE

A. Cable Managers:

1. Rack mounted, Double sided Slotted MCS Master Cabling vertical cable manager.
   a. Manufacturer: Chatsworth Products. Inc.

2. Rack mount, Double sided 2 U 19” Horizontal Universal Wire Management Panel
   a. Manufacturer: Chatsworth

3. Four post frame- mounted, Single sided Slotted MCS Master Cabling vertical cable manager,
   a. Manufacturer: Chatsworth Products Inc.

2.8 CABLE PATHWAYS

A. EMT Steel Conduit for horizontal cable. (Installed by Others). The horizontal cable system will be totally enclosed. The cable will run in conduit and through junction boxes. The conduit system will extend from the station outlet box to the telecommunications Rooms.

B. Non-Continuous Cable Supports (Multi Tiered J Hook Assemblies) for cables not in conduit.

1. Multi- tiered non-continuous cable support assemblies shall be used to support telecommunications cables in accessible ceiling areas. Assemblies may be factory

assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; UL Listed.

2. Provide all necessary hardware for installing multi-tiered support brackets in accessible ceiling spaces. These spaces may include T-bar ceiling, threaded rod spaces, and or direct mounting to concrete wall or ceiling.
   a. Manufacturer: BLINE, CADDY or equivalent

C. Cable Runway Support and Pathway System.

1. All industry standard cable runway shall be manufactured with tubular steel rails twelve inches (12”), fifteen inches (15”), eighteen inches (18”) or twenty-four inches (24”) in width configures with industry standard on and on-half inch (1.5”) ladder cross bars positioned twelve inches (12”) on center perpendicular to the rails, as indicated in the Project Drawings.

2. Cable runway system shall include structural engineered and approved components to provide and install the necessary zon-4 seismic support system including end caps, wall angle support brackets, bonding straps, butt splice kits, junction splice kits, and rack-to-runway mounting kits.

3. The cable runway system shall include a corner section at each intersection that creates a radius “L”, “X”, and/or “T” formed when two (2) or more pieces of cable runway are connected together with a junction splice assembly.

4. The cable runway system shall include all components indicated in the T-series drawings to complete the system. These components shall be available from the same manufacturer and shall include, but may not be limited to:

   a. Cable runway bend radius drop assemblies (sized per runway section)
   b. Cable runway movable cross member assemblies to support cable runway bend radius drop assemblies (sized per runway section).
   c. Runway butt-splice kits
   d. Runway junction splice kits
   e. Cable runway corner brackets (sized per runway and site conditions)
   f. Swivel splice kits
   g. Rack-to-runway mounting plates (sized per runway section)
   h. Cable elevation kits (sized per site conditions)
   i. Wall angle support brackets (sized per runway section)
   j. Runway foot kits
   k. Threaded rod assemblies for attachment
   l. Slotted Support brackets for runway attachment to threaded rod assemblies
   m. Vertical wall brackets
   n. Cable retaining posts (6” as required)
   o. Runway grounding kits
   p. Protective end caps

5. All cable runway components shall be black in color, unless otherwise noted in the Project Drawings.

6. Cable Runway System Manufacturer
   q. Chatsworth Runway System and Components.

2.9 LABELS

A. Labels:

1. Laser printed self-adhesive, smudge resistant self-laminating labels for cables and faceplates. Labels shall be appropriately sized for cable diameter. Labels shall be appropriately colored for faceplate color contrast.

PART 3 EXECUTION

3.1 EXAMINATION

A. Contractor shall examine the site conditions and telecommunications spaces associate with the work and the conditions under which the Work would be performed prior to beginning work. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 METHODS AND PROCEDURES

A. Examine and compare the Telecommunications Drawings and Specifications with the Drawings and Specifications of the other trades. Report any discrepancies between them to the Architect, and obtain from them written instructions for changes necessary in the work. At time of bid, the most stringent requirements shall be included in the bid.

B. Install and coordinate the telecommunications cabling Work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interference in a manner accepted by the Architect. Any repairs or changes made necessary in the Contract Work, caused by the Contractor's neglect, shall be made by him at his own expense.

C. The Contractor shall maintain a complete file of Shop Drawings and other submissions, including the Project specifications and the drawings, at the job site at all times. Shop Drawings and all other submissions shall be made available to the Architect and County representative at their request.

D. The Contractor shall follow manufacturers' instructions for installing components and adjusting all equipment and telecommunications cables. Submit two (2) copies of such instructions to the Architect before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.

E. Perform all tests required by local authorities in addition to test specified herein.

F. Do not allow telecommunication cables to run parallel with electrical cables/conduits, unless they are separated by a minimum of 12 inches. Note: any telecommunications cables that must cross over electrical cables/conduits shall do so only at 90-degree angles.

G. Ensure that all telecommunications cable supports (conduits, support grips, J hooks) are fully installed before proceeding with cable installation. At no times shall cables be installed and left unsupported. At no times shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports. Do not bundle or tie-wrap the cables even within the approved cable supports.

H. For installation of Non-Continuous Cable supports (Multi-Tiered J Hook Assemblies), ensure cable is supported with a J Hooks every 4 to 5 feet. No cable shall remain unsupported for more than 5 feet.

I. Do not lay telecommunications cables unprotected on the floor at any time. If cables must be left on any floor, protect the cables so that they may not be walked on or have any material or equipment placed or rolled on top of them at any time.

J. Maintain manufacturers' recommended minimum bend radius of the cables, at all times (minimum bend radius may be as small as 2 inches for 4-pair UTP). Do not stretch, stress, tightly coil, bend or crimp the workstation cables during the installation or when leaving them out of the way of other trades during the staging work. The Contractor, at the Contractors expense, shall replace all abused or stressed cables.

K. Keep all items protected before and after installation, with dust and waterproof barrier materials as necessary. The Contractor shall be responsible to ensure the integrity of the protective measures throughout the life of the project.

L. Clean up and remove all debris generated by installation activities. Keep the telecommunications areas free of debris at all times.

M. Deliver to County's representative two sets of all special tools specifically needed for proper operation, adjustment and maintenance of cable and cable termination hardware installed under this Contract.

N. Upon project completion, provide as-built drawings and documentation as defined herein.

O. Craft personnel shall be qualified to perform the work activities and be knowledgeable of the following:

1. Color coding of standard UTP cables.

2. Bonding and grounding of cable tray and equipment racks.

3. Testing conductors for electrical continuity.

4. Testing of copper conductors for wire mapping, attenuation and worst case near end cross talk and other tests as required by ANSI/EIA/TIA 568-C.1 and C.2

5. Termination or connectorization of unshielded twisted pair cable on all specified connectors and termination.

6. Generally accepted industry standards, as well as manufacturers written installation instructions, will be used for in-process quality control and final acceptance of the work installation.

P. Check actual job conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system in accurate before proceeding with the installation. The Contractor will be responsible for inspecting the previously performed work of other trades, and commencement of work will serve as evidence of the acceptance of this work as suitable for the work to follow. Notify in writing the Owner and Designer of any discrepancies that will impact the telecommunications system prior to commencement of said work. Examples of work which must be checked include, but are not limited to:

1. Electrical requirements (conduit installation and capacity)

2. The telecommunications rooms are the size shown on the Project Drawings.

3. Adequate clearances of doors, riser spaces and ceilings for all component of the telecommunications system.

3.3 INSTALLATION

A. Equipment Racks and Cabinets

1. Provide, as shown on drawings, rack and cabinets in the respective IDF rooms or termination locations for the mounting of termination panels and IT equipment. Bolt each rack to the floor slab and attach the cable runway system overhead via cable runway elevation kits per the manufacturer's recommended installation instructions. Bond each individual rack and cabinet directly to the grounding busbar located within the room/space.

B. Termination Components:

1. Provide fiber combination shelf in rack mount frame for mounting into racks and cabinets as indicated in the project drawings with a minimum of 48 port capacity. Provide and install correct adapters for fiber termination, complete with designation strips & any required cable managers.

2. Provide Wall Outlets & faceplates containing 8-pin 8-conductor modular connectors, non-keyed (8P8C), typical "RJ45" style; complies with ANSI/EIA/TIA-568-C.2 – Category 5e, 6, and 6A performance specifications as determined by application. Outlet wired with standards compliant T568-B pinning. Coordinate faceplate color and jack color with T-series drawings.

   a. WIRELESS ACCESS POINTS (WAP): Install (2) CAT6A cables per WAP location.
   b. VIDEO CAMERAS: Install (1) CAT6A cable per location.
   c. WORK AREA OUTLETS: Install (3) CAT6 cables to each WAO in New Building Construction. Install (4) CAT5e cables to WAO in existing CAT5E buildings.

3. Provide IDF modular termination jacks at patch panels as 8-pin modular connectors, non-keyed (RJ45) connectors; complies with ANSI/EIA/TIA-568-C.2 – Category 5e, 6, OR 6A performance specifications as appropriate to match cable and jacks at both ends. Wired with standards compliant T568-B pinning. Coordinate jack colors with T-series drawings. Install black colored blank modular inserts into unused patch panel ports.

4. Provide required amount of patch cords for connectivity as specified above.

C. Cable Media:

1. Install riser UTP cable in accordance with this Specification in quantities indicated in the project drawings and terminate all UTP cable pairs (except the 25th pair in each binder group – coil for future use) on patch panels as indicated in the T-series drawings. Comply with the manufacturers' recommendations, and the Telecommunications Distribution Plan Drawings.

2. Install riser fiber cable in accordance with this Specification in quantities indicated in the T-series drawings from each IDF and to the BDF. Comply with the manufactures recommendations, and the Telecommunications Distribution Plan Drawings.

3. After dressing the cable to its final location, remove only enough sheath to allow the conductors to be splayed and terminated in a neat and uniform fashion. Every effort will be made to maintain sheath integrity by removing only as much sheath as is practical, to accomplish termination. For UTP cables, maintain the manufacturers twisting of the wire pairs through to the point of termination, with a maximum untwist of 1/8".

4. There shall be no splices or mechanical couplers installed between the cable points of origin and termination for the inter-building and intra-building cable.

D. Cables:

1. For standard type outlets, provide 4-pair Category 6 cables from each workstation telecommunications outlet location to the respective termination location as indicated in the project drawings. Cables to be color-coded consistent with T-series drawings. For additional workstation types as indicated on the telecommunications drawings route the correct amount of Category-rated cable from each workstation telecommunications outlet location to the respective termination location. Utilize the cable tray system for the routing of cables whenever possible. Terminate all cables onto 8-pin modular connectors at the outlet location. Terminate the four-pair cables onto rack mounted, metal modular data jack insert patch panels.

2. Where telecommunications outlets are wall mounted inside enclosed offices, route cables overhead from the termination location (IDF) via the overhead cable tray network to the outlet area, and down a conduit stub-up to a junction box at the bottom of the conduit. Mount outlets with an appropriate faceplate.

3. Where workstation outlets are mounted in drywall partitions to support seating in the common areas, route cables from the termination location (IDF) to the accessible ceiling area within the commons area and down a conduit stub-up to a junction box at the bottom of the conduit. Mount outlets with an appropriate faceplate.

E. Cable Runway and Non-Continuous Cable Supports (Multi-Tiered J Hook Assemblies):

1. Provide cable runway and associate runway components in the IDF, BDF and termination locations as shown on the T-series drawings. Mount cable runway overhead at the indicated height following manufacturer's installation instructions at all times.

2. Provide threaded rod ceiling support assemblies spaced 5' on center, wall angle support kits, or triangular support brackets to support the cable runway over head (where required) as indicted in the T-series drawings.

3. Ground each cable runway section to the next. Ground each cable runway to the nearest grounding bus-bar located within the respective rooms. Provide waterfall pieces for the gradual transition from end of cable runway or whenever cables exit the cable runway.

F. Identification:

1. Provide label identification on all outlet faceplates installed under this Work. Labels should be machined-generated labels with the outlet ID as per EIA/TIA-606A, and approved by the Owner prior to use.

2. Provide on all termination panels installed under this Work, machine-generated designation strips with the cable ID and pair number, in uppercase lettering.

3. Provide on all patch panels installed under this Work, machine-generated label with the cable ID, and fiber strand number in uppercase lettering.

4. Provide on all telecommunications cables installed under this work a machine-generated label with the cable ID, in black uppercase lettering on a permanent adhesive, white label stock, covered with permanent water resistant sealer. Labels shall be placed on both ends of the cable and no more than 6” from the point at which the cable is broken out into individual copper pairs or strands from the connector or termination block or patch panel. Labels shall be placed parallel with the cable. All labels shall be readily visible.

5. Hand lettered label stock will not be accepted for final installation. Hand lettered stock is only acceptable for use with temporary labeling required during construction phases.
6. If at any time during the project, the label becomes illegible or removed, the Contractor shall immediately replace it with a duplicate preprinted label.

7. All cable IDs shall be both physically and visually accessible upon completion of the project.

3.4 COPPER CABLE TESTING AND VERIFICATION

A. Verify and test all Category 5e, 6 and 6A cables with a Fluke DTX series Level IV tester or newer, that has been properly calibrated by the manufacturer within the prior 12 months. Verification and documentation of latest factory certification must be provided by the Contractor prior to testing.

B. The tester interface adapters shall be PM06 universal permanent link adapters and must be in new condition with the adapter cable and assembly not indicating any twisting or kinking resulting from coiling and storing of the tester interface adapters.

C. Baseline accuracy of the copper test equipment must exceed TIA Level IIIe, as indicated by independent laboratory testing.

D. Copper Test equipment must be capable of verifying Category 3, Category-5e, Category-6 and Category-6A links or channels independent of termination hardware configuration (IDC or 110-style) for levels of performance.

E. Copper Test equipment shall be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

F. The testing device shall be provided by the Trade Contractor and approved by the Designer, and Owner prior to use. It is the responsibility of the Trade Contractor to get written authorization from the Designer and Owner to commence testing with their proposed device. Failure to gain approval is at the Trade Contractor's risk and expense.

G. All Category 5e, 6 and 6A cables shall be tested for, and comply with, TIA/EIA 568-C.2 standards related to the following:

1. Wire Map
2. Continuity
3. Length
4. Attenuation/Insertion Loss
5. Near End Cross Talk (NEXT)
6. Power Sum (PS) Next
7. PS Next to 100Mhz
8. Equal Level Far End Cross Talk (ELFEXT) Loss
9. PS ELFEXT Loss
10. Return Loss
11. Propagation Delay
12. Delay Skew
13. Attenuation to Cross Talk Ration (ACR)
14. PS ACR
15. Proper Labeling
16. Others as may be noted in the Contract Documents

H. Category-3 testing of every copper cable pair shall be tested for, and comply with, TIA/EIA 568-C.2 standards and must include each of the following:

1. Wire Map
2. Length
3. Opens
4. Shorts
5. Continuity
6. Polarity, or Pair Reversals

3.5 FIBER CABLE TESTING AND VERIFICATION

A. All optical fiber cables/strands must be tested in the end-to-end, completed system with a Fluke Opti-fiber Tier-2 optical fiber testing device and appropriate fiber mandrel that provides the following:

1. Measuring insertion loss
2. Analyzing the OTDR trace
3. Grading the connector end face
4. End face image of connector(s) embedded into certification report.

B. All tested fiber strands must meet the FOTP requirements put forth by TIA/EIA 526, TIA/EIA-455 (method-B), TIA/EIA 492AAAC, TIA/EIA TSB-63, and TIA/EIA TSB-140 requirements and the TIA/EIA 568-C.3 standard. Any optical fibers failing to meet these standards or the

more stringent performance requirements stated above, must be removed and replaced, at no cost to the Owner, with fibers that prove, in additional testing, to meet or exceed the performance standards set forth.

C. Optical fiber splices, fusion or mechanical, shall not exceed a maximum optical attenuation stated in section 2, above, when measured in accordance with field testing procedures
D. The system loss measurements shall be provided at 850 and 1310 nanometers for multimode fibers and 1310 and 1550 nanometers for single-mode fibers.

E. The testing of all optical fiber cables shall include bi-directional, end-to-end tests using both a hand-held Optical Time Domain Reflectometer (OTDR) and a light power meter testing device. The signature trace of the cable must include each of the following:

1. Attenuation per kilometer
2. Attenuation uniformity
3. End-to-end integrity
4. Total length of each strand
5. Total insertion light loss
6. Insertion loss at each incident throughout the cable path

F. After Optical fiber verification testing in one (1) direction has been completed and certified, all optical fiber strands are to be measured in the opposite direction. All test parameters shall be indicated for both directions on each strand in the test documentation.

G. All fiber test results shall include an image of both connector end faces embedded into the final test report (hard and soft copy) for a baseline reference of each connector.

H. The allowable loss budges shall be as follows:

1. MMF: (All cable loss per km)(km of fiber in link) + (0.35dB LOMMF)(number of connectors) = maximum allowable loss
2. Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.
3. Any link not meeting the requirements of the standard shall be brought into compliance by the contractor at no charge to the Owner.

I. Any installed component in the TIA/EIA fiber-related and/or industry standard verifications testing parameters found to be below performance standards for that particular channel and/or link, testing procedure, and manufacturer specified performance criteria shall be immediately replaced and retested by the Trade Contractor at no additional cost to the Owner until all deficiencies are rectified to the satisfaction off all testing procedures.

3.6 TEST DOCUMENTATION

A. A complete set of test results shall be presented to the Designer and Owner at least one (1) week before the placement of active electronics in the IT spaces. The Trade Contractor shall identify the types of cable tester(s) used during the testing and verification when presenting the results for each type of cable and each test procedure, unless otherwise indicated.

B. All verification and test results shall be submitted to the Designer and Owner in both paper and electronic formats printed directly from the testing device software application. Paper results must be neatly presented in a three (3) ring binder and sectioned according to floor

and cable type, OSP, category-6A, category-6, category-5e, category-3, and optical fiber cables must be divided into separate sections with each floor. Electronic results must be presented on CD-ROM disc(s) in the testing device's native file type with a copy of the electronic software used to generate the test results for review by the Owner, Designer and the contractor selected connectivity and cable group representative(s).

C. Trade Contractor shall warrant in writing that one hundred percent (100%) of the installation meets requirements specified under subsections above. Owner reserves the right to conduct, using Trade Contractor equipment and /or labor, a random re-test of up to five (5) percent of the cable plant to confirm documents results. Complete (100%) random re-testing, if performed, shall be at the expense of the Owner, using standard labor rates if no failures are found. If any failures are found in the 5% verification testing performed by the Owner, the re-testing expense shall be the Trade Contractor's. Any failing cabling shall be re-tested and restored to a passing condition. In the event more than two percent (2%) of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the Owner.

3.7 FIRE STOP – PENETRATION SEALANT

A. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall or floor ceiling penetrations. Material must be properly classified and meet all national and local codes.
All penetrations through fire rated floors and walls shall be sealed to prevent the passage of cold smoke, fire, toxic gas or water through the penetrations, before, during or after a fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code.

B. No flammable material may be used to line the chase or hole in which the firestop material is to be installed.

C. All damming materials to be left in place after the seal is complete shall be non-flammable.

D. The sealant shall remain resilient and pliable to allow the removal and or addition of cable without necessity of drilling holes. It shall adhere to itself perfectly to allow any and all repairs to be made with the same material. It shall allow for vibration, expansion and/or contraction of anything passing through the penetration without affecting the seal, or cracking, crumbling and spalling.

E. When sealant is injected into a penetration, the material shall expand to surround all the items within the penetration and maintain pressure against the walls of the penetration as well as the pass-through items. The material shall cure within five minutes and be fire resistant at that time. No heat shall be required to further expand the material to prevent the passage of fire and smoke or water.

F. The materials shall have been subjected to fire exposure in accordance with standard time-temperature curve in the Standard, UL ASTM E 119 and NFPA 251. The fire stop material shall have also been subjected to the hose stream test in accordance with UL 10B.

3.8 AS BUILT DRAWINGS AND CABLE LIST

A. The Contractor shall provide the following “As-Built” drawings to the owner. These as-built drawings shall include all work described within this specification section, including, but not limited to the following:

1. A complete backbone connectivity diagram showing backbone interconnection and cable routing. Each cable type and routing shall be noted.
2. Finalized, detailed elevations of the Voice and Data MDF illustrating all punch-down locations and rack elevations.
3. Finalized, detailed elevations of the IDF(s) illustrating punch-down locations and equipment rack locations
4. Finalized equipment rack elevations illustrating vertical location of termination hardware (e.g. fiber boxes, patch panels, etc.) within all telecommunications areas.
5. Finalized outlet layout floor plans including room/area numbers, outlet numbers and the corresponding cable identification numbers.

3.9 MANUFACTURER’S LITERATURE

A. Where the Specifications and/or Project Drawings call for an installation to be made in accordance with the Manufacturer’s recommendations, a copy of such recommendations shall always be kept on the job site, and shall be available to the Owner.

B. Contractor shall follow manufacturer’s instructions where they cover points not specifically indicated on Project Drawings and Specifications. If said instructions differ from the Project Drawings and Specifications, it is the responsibility of the Contractor to obtain clarification from the Owner in writing before commencing work.

3.10 TRAINING

A. Provide training for the Owner-appointed employees to operate and maintain the installed technology utility system. Training will include two (2) full day sessions that include, but are not limited to: a description of the system, a tour of the facilities, and a manufacturer-provided tutorial on using the cable testers and documentation software.

3.11 ACCEPTANCE

A. The installation will not be accepted until all work is complete and properly documented, as noted above and in the Project Drawings and not until all punch list items discovered are completed to the Owner’s satisfaction and after the successful completion of the Acceptance period.

B. Following the completion and compliance of all requirements noted above and in Division One, the Owner will issue a Notice of Completion confirming that the Technology Portion of the project is complete. A forty-five (45) day Acceptance period will begin immediately following the issuance of this Notice of Completion

C. During the acceptance period, the Voice Data Communication System, as described herein and in the Project Drawings, must be up and operational. If there is a major system failure, the Acceptance period will begin again, once the failure is resolved and the system is back up and running. Major system failures are defined as failures that impact 10% or more of the user connections.

D. This Acceptance period shall be considered outside any Warranty period provided by the Contractor or Manufacturer. Once the forty-five (45) days Acceptance period has successfully passed, the Warranty period shall begin.

E. The project manager must be available to answer questions about the installation and to attend site visits and meetings during the acceptance period, as deemed necessary by the Owner.

END OF SECTION

DIVISION 28
ELECTRONIC SAFETY AND SECURITY

SECTION 28 05 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Part 1 Includes:
   1. Related Documents
   2. Summary and related sections
   3. References
   4. Definitions
   5. System Description and General Responsibilities
   6. Coordination
   7. Quality Assurance
   8. Submittals
   9. Delivery, Storage, and Handling
   10. Site Conditions
   11. Sequencing and Scheduling
   12. Warranty
   13. Extra Materials

B. Part 2 Includes:
   1. Product Options and Substitutions
   2. Materials and Equipment
   3. Equipment Modification
   4. Fabrication
   5. Source Quality Control
   6. Firestopping/Sealant Materials

C. Part 3 Includes:
   1. Examination
   2. Installation
   3. Field Quality Control
   4. Cleaning
   5. Training

D. Related Sections:

1. 28 05 13 Conductors and Cables
2. 28 05 14 Raceways and Boxes
3. 28 05 26 System Signal Grounding
4. 28 05 27 Cabinets, Enclosures and Racks
5. 28 09 00 Electronic Components
6. 28 13 00 Access Control System
7. 28 15 00 Intercom System
8. 28 23 00 Video Surveillance (CCTV) System
9. 28 26 00 Duress Alarm System
10. 28 41 33 MATV System
11. 28 46 13 Integrated Sequences of Operation
12. 28 46 19 PLC Integrated Control System

1.3 REFERENCES

A. Codes compliance - Comply with the established project edition of the following codes as applicable:

1. California Electrical Code (NFPA 70) CEC
2. National Fire Alarm Codes (NFPA 72) NFAC
3. California Building Code CBC
4. All State or County codes and ordinances

B. Standards Compliance - Comply with the following standards as applicable:

1. American National Standards Institute ANSI
2. American Society for Testing and Materials ASTM
3. Electronics Industry Association EIA
4. Electrical Testing Laboratories ETL
5. Factory Mutual FM
6. Federal Aviation Agency FAA
7. Federal Communications Commission FCC
8. Institute of Elect. and Electronics Engineers IEEE
9. National Electrical Contractors Association NECA
10. National Electrical Manufacturers Association NEMA
11. National Fire Protection Association NFPA
12. Occupational Safety Health Act OSHA
13. Underwriter's Laboratories UL

1.4 DEFINITIONS

A. By Others or By Other Trades: By persons or parties other than the Division 28 Contractor. In this context the words “by others or by other trades” shall not be interpreted to mean “not in contract (NIC)”.

B. Certified: Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards and found to be safe for use in a specified manner; production is periodically inspected by a nationally recognized testing laboratory; and it bears a label, tag, or other record of certification.

C. Concealed: Not visible or readily accessible such as, embedded in masonry or other construction installed behind wall furring with double partitions or above hung ceilings, in crawl spaces, in shafts.

D. Conveniently Accessible: Capable of being serviced without climbing or crawling under or over obstacles, and with adequate working clearance both front and back.

E. Damage: Visible or invisible abuse that negatively affects performance or appearance and creates defective materials or workmanship.

F. Defective Materials or Workmanship: Operational failures, performance below minimum requirements, evidence that the system will not be reasonably maintainable, errors in documentation, abnormal operations, unsafe conditions, or similar unsatisfactory performance.

G. Contractor: Company holding the contract or agreement with the Owner or its representative. The Contractor may, when permitted, sub-contract Work described in this Section to which the term contractor may apply.

H. Exposed: Not concealed.

I. Failure: Any deviation from intended system operation and performance, as determined by the Contract Documents and subsequent submittals and the Owner's Representative.

J. Furnish: Purchase and deliver to the Project site complete with every necessary appurtenance, support, and accessory required for operation.

K. Install: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the Project.

L. Labeled: Equipment embodies a valid label, symbol, or other identifying maker of a nationally recognized testing laboratory such as Underwriters' Laboratories, Inc., the laboratory makes periodic inspections of the production of such equipment, and the labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

M. Listed: Equipment is mentioned in a list which is published by a nationally recognized laboratory which makes periodic inspection of the production of such equipment or states that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

N. Nationally Recognized Testing Laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

O. Provide: Furnish and install, completely ready for use, including all accessories required for operation.

1.5 SYSTEM DESCRIPTION AND GENERAL RESPONSIBILITIES

A. The work to be performed under this contract includes the furnishing of all labor, materials, and equipment for the Electronics Controls Systems. Work shall include all provisions of new electronics controls systems, including fire alarm, door/gate control and alarm monitoring, intercom, duress alarm, video surveillance (CCTV), MATV, programmable logic controllers, and all software development/PLC programming.

B. Combined Prescriptive and Performance Design Requirements

1. Division 28 includes a combination of prescriptive and performance specifications. Compliance with the performance specifications, as well as coordination and integration of the prescription requirements, will require substantial design work on the part of the Contractor.
2. The performance requirements are intended to establish overall system performance requirements, satisfy the operational requirements, and establish the inter-coordination requirements for the Division 28 systems.
3. The prescriptive requirements establish the minimum quality, characteristics, and types of components, equipment, and materials to be used to achieve the stated system performance requirements. The Contractor is advised, however, that prescriptive specifications have not been provided to satisfy all of the specified performance requirements.
4. The Contractor shall carefully consider all of the requirements for each of the Division 28 systems when preparing its bid. Any questions regarding the intent of these requirements, the scope of the systems or their coordination requirements must be submitted in writing prior to bidding in accordance with the Instructions to Bidders. The Contractor shall have no claim for either extra compensation or extra time on the grounds that it did not understand the scope or the requirements of the Division 28 work, and/or the coordination requirements of the Division 28 work with the work of the other Divisions.
5. IMPORTANT: Section 28 46 13-3.02 – Sequence of Operations describes the MINIMUM performance requirements necessary for the scope of the project. Any equipment, wiring, raceways, and programming necessary to meet the operational performance as described under Section 28 46 13-3.02 shall be the responsibility of the Contractor, regardless if such entities are not specifically identified in the Drawings and Specifications herein. Any conflicts in performance requirements to other Specification Sections and Drawings shall be brought to the attention of the Owner during preparing for bid, otherwise the stringest (most costly) requirement will take precedence.
6. Compliance with the project requirements will be progressively monitored and adjusted through the submittal process, Shop Test, Performance Test and Continuous Operational Test.

C. Drawing Interpretation

1. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or detail drawings. The Drawings utilize riser, block, installation and schematic diagrams and symbols to outline the Work to be provided. These drawings do not have any dimensional significance nor do they delineate every item required for the intended Work. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete Work are excluded.
2. The Work shall be provided in accordance with the intent expressed on the Drawings and Specifications, and in conformance with the actual building architectural and

structural conditions. When in conflict, field conditions take precedence over the Contract Documents.

3. The meaning of abbreviations shall be the same whether in lower case letters or without periods.
4. The use of words in the singular shall not be considered as singular where other indications denote that more than one item is referred to.
5. Details that appear on the Contract Documents which are specific with regard to the dimensioning and positioning of the Work, are intended only for the purpose of establishing general feasibility. They do not replace engineering or field coordination by the contractor for the Work.

D. Provide all parts and equipment for a complete and operational system for the Work of Division 28 as described herein and shown on the drawings.

E. Furnish and install all trenching and backfill, duct banks, conduits, raceways, sleeves, boxes, gutters, shelves, enclosures, shelf and enclosure supports, backboards, pull ropes (in unused or spare conduits) required to make all systems fully operational, including components not shown on the Drawings, but necessary for fully operational systems.

F. Furnish, install, terminate, test, dress, and identify all wire and cable required to make systems fully operational, including all wire and cabling not shown on the Drawings, but necessary for fully operational systems.

G. Recognize that the Work entails a considerable amount of custom integration between individual systems, as well as the design and implementation of many system and component interfaces. Take full responsibility for the complete design, installation, and performance of the total integrated system, including integration between systems and various interfaces, in order to achieve the specified operational features and system performance requirements.

H. Recognize that the Work entails a considerable amount of custom-written and custom-tailored software, both high-level language applications and hardware-specific drivers. Take full responsibility for the performance of the total software suite, including the software embedded in manufactured equipment, in order to achieve the specified operational features and system performance requirements.

I. Fully test the systems, demonstrate their satisfactory operation, and train maintenance and operating personnel, as specified in this Section and the Sections governed by this Section.

1.6 COORDINATION

A. Coordinate with the Owner and all other trades as required to ensure that the entire Work of this Project will be carried out in an orderly, complete, and coordinated fashion.

B. Coordinate installation of lighting and ventilation in all equipment rooms and control stations to avoid any possible interference and to enhance system function.

C. Coordinate with the Work of all applicable Divisions and Drawings for the required electrical and mechanical control interfaces to the work of this section.

D. If applicable, provide coordination drawings of security device plate mounting templates and internal frame conduits to the hollow metal frame manufacturer/supplier to facilitate frame

preparation for electronic devices. Rework all frames for which device mounting has not been coordinated at Contractor's expenses.

E. If applicable, obtain product data and wiring schematic information from the Division 8 and 11 Contractors/manufacturers for all approved locking and door monitoring hardware. Coordinate with the Contractors to properly wire, terminate and test all electrically controlled and monitored door/gate hardware.

1.7 QUALITY ASSURANCE

A. Division 28 requires contractors with similar work experience and specific licenses and certifications to perform the work of this section. Specific requirements are identified in the related sections and are summarized in Schedule 28 05 00B. Contractors must be certified or licensed at the time of bid where Manufacture certification or licensure is required. Required licenses and certifications shall be submitted within 3 days of being selected as the apparent low bidder.

B. The Division 28 contractor shall have had experience in the design and installation of similar systems of similar project sizes and similar integration as this project to be considered qualified.

C. The Contractor shall be responsible for all costs incurred including costs incurred by the Owner and its representatives for failure to provide the experience and key personnel as specified.

1. Deductive change orders may be issued as a result of the failure to properly engineer the work prior to construction or improperly installed work that results in costs incurred to the Owner. Examples of incurred costs are rejection of submittals for failure to follow specifications or failure to properly engineer the work; re-inspection of rejected work.

D. The Division 28 contractor shall maintain a local service center with qualified service technicians for the duration of the Warranty.

E. The Division 28 Contractor shall have a California Contractors License C-10 or C-7 for the respective work.

F. Key Project Personnel must have work experience with projects of similar size and complexity. Systems experience shall be demonstrated for the Key Project Personnel. Résumés of prospective key personal shall be submitted within 30 days of contract award.

1. Project Manager Qualifications

a. Bachelors of Science Degree from ABET accredited college in Construction Management or related engineering field or,

b. Five years experience with projects of similar size and complexity.

2. Project Engineer Qualifications

a. Licensed Professional Electrical Engineer or,

b. Bachelors of Science Degree from ABET accredited college in Electronics Engineering field and two years experience with systems to be provided, or

c. Technical Trade School Degree, Associate of Science Degree, or Bachelors Degree and a minimum of six years of demonstrated experience with the systems to be provided.

3. The approved Project Manager shall represent the Contractor at all times in all project

matters and shall be responsible for the administrative work including but not limited to, the following:

a. Representation at all project meetings.

b. Progress schedule and progress reporting.

c. Payment schedule of values and pay requests.

d. Representation and management of all employees and sub-contractors.

e. Conduction of on-site performance and acceptance testing.

4. The approved Project Engineer shall be qualified and shall be responsible for technical work including but not limited to, the following:

   a. Preparation and signature of all engineering, shop drawings, and product data submittals.

   b. System fabrication, field installation work, and testing.

5. Consider all qualification and experience materials submitted as binding. Obtain the Owner's approval in writing prior to any deviations from the minimum requirements in organization, personnel, work plan, quality control plan, procurement plan or other declaration within the qualification submittal. Key project personnel substituted prior to or during the Work must meet the specification requirements and obtain the Owner's approval.

G. Regulatory Requirements and Standards:

1. References to the California Electrical Code (CEC) and National Fire Alarm Code (NFAC) are a minimum installation requirement standard. Drawings and Specifications shall govern in those instances where requirements are greater than those specified in the CEC and NFAC.

2. Obtain and pay for all permits and inspections required by all legal authorities and agencies having jurisdiction for the Work. The certificates of all such permits and inspections shall be delivered to the Owner.

1.8 SUBMITTALS

A. Submit under provisions of Division 1, Submittals.

B. Contractor is advised that approval or acceptance of product data or shop drawing submittals does not release the contractor from providing all necessary documentation per submittal requirements, nor does it obviate contractor from additional design and coordination throughout the project.

C. Work Plan

1. Submit a work plan for all work to be performed in the existing facility within 15 days of the Notice to Proceed.

D. CPM Schedule

1. Submit a Critical Path Method Schedule within 30 days of the Notice to Proceed.

2. At a minimum show tasks by area such as by building, by floor or other appropriate designations.

3. Include tasks that are not part of the work of this section but that may affect this section such as work by other trades or contractors or Owner review time.

4. Include tasks that are not part of the work of this section but that may affect this section such as work by other trades or contractors or Owner review time.

E. Submittal Matrix

1. Prepare a matrix of submittals by type vs. section of all submittals to be made by the Division 28 contractor within 30 days of the Notice to Proceed.
2. Utilize the list of required submittals listed at the end of this section as a starting point. Add columns for expected delivery dates and each specification section. If a listed submittal is not required for a specific section, indicate such with an “N/A” or other means in the column and row cross point.

F. Schedule of Values

1. Submit a Schedule of Values (SOV) based on the CPM schedule and Submittal Matrix that reflect the value of the systems and installation of work for this Division.
2. That approved SOV will be used as a basis for progress payments.

G. Product Data:

1. Product data is required for all materials and equipment. Include complete bill of materials for each section with the product data submittal.
2. Cross-reference submitted items to the Specifications using their related sections and paragraph numbers.
3. Submit complete product data for the all system components in a single, bound submittal of one or more volumes. Provide a table of contents and labeled divider tabs for each section. Partial submittals for individual sections will be returned without review.
4. Include descriptive literature, catalog cuts, illustrations, schematics, technical data sheets, and test data necessary for the Owner’s Representative to ascertain that proposed equipment and materials comply with specification requirements. Include manufacturer’s name, model, catalog or part numbers. Catalog cuts shall be legible and shall clearly identify equipment being submitted.
5. Include required calculations, I/O points lists, system zone schedules, and other tabular data as necessary to clarify system sizing and configuration. Do not, however, consider such submittals as a substitute for complete shop drawings.
6. Disclosure of Product Deviations: Specifically identify and tabulate any and all deviations from the contract documents including all system functions and features. Reference the corresponding specification sections and paragraph/article numbers. All variances and deviations will be reviewed for acceptance or rejection. It will be the Contractor’s sole responsibilities to comply with all other contract requirements not revealed in the disclosure of product deviations.

H. Shop Drawings:

1. Shop drawings are required for all systems and component assemblies.
2. AutoCAD “.dwg” files of the Contract Drawings may be made available upon request. These files may be used as a first step in the preparation of shop drawings. Do not consider the drawing plots from such files as a substitute for the shop drawings that are to be prepared by the contractor.
3. Shop drawings will not be accepted or considered unless they are submitted as a complete package for each specification section. Partial submittals covering less than a whole system or with incomplete interfaces to other systems will be rejected.

4. Standard manufacturer's drawings may not be used as shop drawings unless specifically modified for use on this project.
5. Each drawing requires a unique drawing number and revision level. Revisions shall per be dated and referenced per submittal number. Delta numbers and clouds on the drawings shall be used in all instances where changes have been made to the pervious submittal.
6. At a minimum, include the following shop drawings:
    a. Floor Plans: Scaled drawings showing equipment and device locations in plan view. Include wire and cable types and quantities, raceway sizing and routing. Routing information shall indicate where rated assemblies are penetrated. Separate into as many plan series as needed to prevent overlapping information. These drawings shall be fully coordinated with other trades prior to submittal. Show relationships to adjacent surrounding structures.
    b. Equipment and Control Room Plans and Elevations: Scaled, dimensioned drawings showing security equipment layouts in security equipment rooms, electrical/security closets, and control rooms. Include electrical J-boxes and receptacles, power, conduit sizing and routing, metal gutters, wiring ducts, cable trays, and supports. Indicate all other non-security cabinets, enclosures, and equipment within the room.
    c. Cabinet, Enclosure, and Rack Elevations: Scaled, dimensioned drawings for each system equipment cabinet, enclosure, and rack showing component and equipment mounting, wire and cable routing and separation, connector and terminal block locations and labeling, and all necessary fabrication details.
    d. System Block Diagrams: Single line block diagrams showing the general relationship between system components and the interconnection between systems. Use these drawings as a reference for the Single line diagrams and point-to-point diagrams by cross-referencing the shop drawing number of those diagrams on these drawings.
    e. Single Line Diagrams: Interconnection diagrams for the riser and trunk wiring between equipment cabinets, enclosures racks and major components. Use the same equipment designations as the floor plans and block diagrams.
    f. Point-to-Point Diagrams: Drawings which show the wiring of each component or device of each individual system. Include details of power supply, grounding, shielding, shield grounding, surge protection, fusing, connector pin-outs, terminal assignments, and similar wiring and connection details. Use the same component and device designations as the floor plans and other shop drawings.
    g. Schematic Diagrams: Drawings which show the component wiring of a system to include but not limited to resistors, diodes, transistors, relays, etc. Required for all custom systems and modified commercial products.
    h. Device Installation Diagrams: Details which show the installation and wiring termination of each field device in each individual system. Include settings for dipswitches, jumpers, addresses, port assignments, etc. of all devices.
    i. All other shop drawings necessary to install, fabricate, locate, identify, test, service, and repair the systems provided.
7. Shop drawings approved by the Owner's Representative OR by the Consultant Engineer is not a release from Contract requirements as defined by the Drawings, Specifications, and governing codes and regulations.

I. Samples:

1. Field Samples:
   a. Wires and Cables: Submit a one (1) foot sample length of each wire and cable type to be used with the cable identification clearly shown.
   b. Submit all required samples along with the product data submittal for review and approval prior to installation.
   c. If all wire samples can not be submitted at the same time, submit samples with a complete list of all cables to be used noting samples which have been submitted. Update the list with each subsequent sample submittal.
2. Devices/Equipment:
   a. Submit sample assemblies of each of the following devices or equipment along with the product data submittal for review and approval by the Owner's Representative:
      1) Substituted products if requested by Owner.
      2) Custom component, board, equipment or assembly.
3. Disposition: Submitted samples become property of the Owner and will not be returned.
4. Approval of any custom or modified assemblies shall be required. Submit technical information with samples.

J. Test Procedures:
1. Initial Performance Testing: Submit test procedures, forms, and checklists for point-by-point testing. Include a listing for each individual system, each control station and control panel, each equipment room, and each major system component. At a minimum, forms shall include columns for operational/non-operational status, remarks, workmanship, and date corrected. Submit a sample format for approval by the Owner's Representative a minimum of 20 days prior to testing.
2. Performance Testing: Submit test forms which are identical to or similar to the accepted Initial Performance Testing forms. Obtain approval from the Owner's Representative for any changes in test procedure or forms.
3. Continuous Operational/Functional Testing: Submit a detailed test procedure for the continuous functional testing described generally in this Section. Submit for approval by the Owner's Representative a minimum of 15 days prior to testing.

K. Test Results:
1. Initial Performance Testing: Submit completed test results for point-by-point testing to the Owner's Representative five days prior to scheduled Performance Testing.
2. Performance Testing: Submit completed test results prior to or with the request to begin the Continuous Operational Test.
3. Continuous Operational Test: Submit completed test results prior to or with the request for Substantial Completion.

L. Record (As-Built) Documents:
1. Maintain a current record set of as-built drawings on the job and as construction and installation progress, show the actual installed location of all items, material, and equipment.
2. Accurately record actual routing of all conduits including sizes and types.
3. The as-built drawings shall be available to the Owner's Representative for review and will be required for evaluation of progress payments.

4. Submit as-built shop drawings created from the approved shop drawings and updated from the site as-built drawing set and any other drawings required to depict the as-built conditions of the installed work.

M. Operational Manuals:

1. Submit the required quantity of identical manuals, which shall contain the Theory of Operation, start up, shut down and emergency procedures, and the manufacturer's operating instructions.
2. Subdivide the manual by section with tab dividers. Provide a table of contents which identifies each section and the contents therein.
3. Submit an electronic copy.

N. Maintenance Manuals:

1. Submit a complete set of maintenance documents as described in this Section. For documents of sizes greater than 11 x 17 inches, prints and electronic copy shall be furnished.
2. Manuals shall include the following as a minimum requirement:
   a. Technical system description.
   b. System schematics.
   c. Detailed wiring diagrams to identify cabling, termination, and routing.
   d. Panel assembly drawings to identify location of components, terminal strips, and equipment as required to correlate with system drawings.
   e. Descriptions and drawings as required to maintain equipment from the board to the component level.
   f. Description of software and user programmable functions. Procedures for user programmable functions shall be included.
   g. A complete printout of each unique system program.
3. For systems where the program resides on electronic media or other similar storage medium, furnish a copy of the media, or similar medium, to the Owner's Representative.
4. Where multiple systems are combined into a single integrated system, documentation shall include a description of the integrated system and the details of the interfaces between systems.
5. Provide a list of current telephone numbers and addresses of all material vendors and equipment manufacturers who have supplied components in this Project. Include separate service telephone list and purchasing telephone list cross-referencing with each component.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect all materials and equipment from damage during storage at the site and throughout the construction period. Protect equipment and materials during shipment and storage against physical damage, dirt, dust, moisture, cold, rain, and any foreign substances that may damage the equipment.

B. Prevent damage from rain, dirt, sun and ground water by storing the equipment on elevated supports and covering them on all sides with securely fastened protective rigid or flexible waterproof coverings.

C. Protect conduit by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation.

D. Protect all fabricated and/or installed materials and equipment against dust, dirt, moisture, physical damage, metal debris, and any foreign substances that may damage the equipment.

E. Protect painted surfaces with removable heavy Kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.

1. Replace equipment determined by the Owner's Representative to be damaged. Repaint and finish damaged paint on equipment and materials with the same quality of paint and workmanship used by manufacturer so that repaired areas are not obvious.

1.10 SITE CONDITIONS

A. Site Investigation

1. Prior to submitting a bid, the Contractor shall perform a site survey of all related existing systems and submit any potential problems of the design documents that may increase the installation cost of the project.

2. Survey all locations where work is to be performed and verify existing conditions prior to shop drawing submittals.

B. Coordination with Security Personnel

1. This is an existing detention facility with controlled access and movement 24 hours a day, 7 days a week. Expect delays due to facility events. The owner will assign a contact person for the contractor to coordinate day to day activities and access into areas. Coordinate all system interruptions and scheduled down time with the contact person. The contractor shall include in his bid all premium time to which it may be subjected to working.

2. Contractor shall abide by all facility rules.

C. Security Requirements

1. Special security requirements will be provided by the facility. See Division 1.

2. Special requirements may include limited access to the work area by area or time, background checks of on-site personnel, restrictions of equipment and tools to include tool counts.

1.11 SEQUENCING AND SCHEDULING

A. General Requirements:

1. Do not begin the project without the Owner's acceptance of proposed key project personnel for the Division 28 Work.

2. Prepare, review, and coordinate with the Owner's Representative an approved construction (CPM) work schedule. Schedule work in areas and at times that will not interfere with scheduled activities as defined by the Owner's Representative.

3. Do not procure any equipment without accepted product data submittals. Do not perform any field installation without accepted shop drawings. Do not begin any extensive software development or programming without accepted system, operational narratives, the required Owner's coordination, and user's requirements.

4. Pre-assemble control electronics, control panels, racks, and cabinets off-site as most practical.
5. Install system control equipment, control panels, cabinets, racks, and consoles only after major construction in the area in which they are to be installed has been completed and areas have been cleaned, painted, and sealed.
6. After systems installation and prior to point-by-point performance testing, thoroughly pre-test all devices and device wiring for proper performance. Then, thoroughly pre-test each system function in each state or condition under every operating mode.

B. Coordinate all work in the existing facility with the facility contact person.

1.12 WARRANTY

A. The Contractor is to provide a warranty of the work provided under this contract (including, but not limited to, software, hardware, and peripheral equipment) as a system, including interfaces to work by others for one year from the date of Acceptance of the Work. Specific Division 28 sections may require longer warranty periods. Divisions of work among various suppliers, vendors, installers, subcontractors, and other parties will not be recognized or accepted.

B. Extended Warranty: Provide itemized pricing for an Extended Service and Warranty for each year after the initial warranty period up to five (5) years. Describe whether all parts and labor are included in this offering.

C. Guarantee to repair and replace defective materials or workmanship during the warranty period including labor and materials.

D. An emergency maintenance (Warranty) request shall be defined as a system or portion of a system failure that affects building safety, security, and operation of critical components. Failure of a single component (i.e., smoke detector, intercom station, camera, or monitor) is not considered an emergency maintenance request.

E. Respond within four hours to an emergency maintenance request. Provide a twenty-four hour telephone contact number (24 hours per day, 365 days per year). Service response time is defined as the period between the placing of a service request and the arrival of a qualified technician capable servicing the problem on-site.

F. Maintain a sufficient parts inventory at the project during the warranty period to meet the guaranteed system repair times.

G. Repair and make operational any defective materials or workmanship resulting from an emergency maintenance request within an 8-hour period from the time of the initial arrival of service personnel at the site. Correct non-emergency defective materials or workmanship within four (4) calendar days of receiving notice of the defect.

H. Where the equipment manufacturer's warranty covers a longer time period than that required by these Specifications, the manufacturer's warranty shall govern.

1.13 EXTRA MATERIALS

A. Prior to Acceptance of the Work, deliver to the Owner all spare parts and extra materials required in each Section. All spare parts and extra materials shall be brand new in their original shipping boxes or packages and shall have one year material warranty remaining at the time of delivery. Extra materials shall be available to the Contractor to use as immediate

replacements during the warranty period. All extra materials used for the warranty requirements shall be replaced by the Contractor.

B. Special Tools:

1. Provide three of each type of security screw bits used.
2. Provide minimum of one of any specialty tools used.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with the General and Supplementary Conditions and Division 1 Specifications.

B. The products named in this section and the sections governed by this section establish minimum qualities that substitutions must meet to be considered acceptable. The specified products have also been used in preparing the drawings and specifications, and therefore establish the basis for equipment sizing, wire and cable design, power consumption, and other design parameters.

C. Substitution requests, if permitted, will be considered only if submitted in strict accordance with the followings:

1. Cross-reference submitted items to the Specifications using their related Section and paragraph number.
2. Submit complete product data, descriptive literature, catalog cuts, illustrations, schematics, technical data sheets, and test data necessary for the Owner's Representative to ascertain that proposed equipment and materials comply with specification requirements. Include manufacturer's name, model, catalog or part numbers. Catalog cuts shall be legible and shall clearly identify equipment being submitted.
3. Disclosure of Product Deviations: Specifically identify and tabulate any and all deviations from the contract documents including all system functions and features. Reference the corresponding specification sections and paragraph/article numbers. All variances and deviations will be reviewed for acceptance or rejection. It will be the Contractor's sole responsibilities to comply with all other contract requirements not revealed in the disclosure of product deviations.

D. The Contractor shall take full responsibility for all design, coordination, and cost associated with substitutions including, but not limited to:

1. Its integration into the total system including physical mounting space, electrical interconnection, signal wiring, power, quality, electromagnetic interference, communication protocols, and similar design considerations.
2. Any additional materials, equipment, components, accessories, items required for equivalent system operation and performance.
3. Any necessary changes to branch power circuits, circuit protective devices, and the Work of other trades.
4. Any modifications to wire, cable, and raceway design.

2.2 MATERIALS AND EQUIPMENT

A. All equipment and materials required for installation under these Specifications shall be new and without blemish or defect.

B. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacturing of such items, for which replacement parts are available. Specifications are prepared long in advance of project construction; the contractor is to use the newest model of the specified products available at bid time.

C. All material and equipment shall be listed, labeled, or certified by Underwriters' Laboratories, Inc., where such standards have been established. Equipment and material which are not covered by UL Standard will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe will be considered, if inspected or tested in accordance with national industrial standards such as NEMA or ANSI.

D. All parts of a system shall be the product of one manufacturer. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer. Constituent parts which are similar shall be the product of a single manufacturer.

E. All components of an assembled unit need not be products of the same manufacturer; however, all components must be acceptable to the Owner's Representative. Components shall be compatible with each other and with the total assembly for the intended service.

2.3 EQUIPMENT MODIFICATIONS:

A. When standard manufactured equipment is modified from its original condition or factory options have been exercised identify the changes as noted below.

1. Clearly identify the modifications on the shop drawings.
2. Clearly identify each piece of modified equipment with a label, which states, "This unit has been modified..." and identify the modification or reference. Locate the label so that a service technician or factory service personal will be able to determine the equipment in use is non-standard and that modifications are required for service, testing and replacement.
3. Identify and describe the modifications on the Record Documents.

B. Equipment modification labels are not required for jumper or switch settings.

2.4 FABRICATION

A. Fabricate enclosures to easily accommodate interconnecting cables entering from above or below through the use of auxiliary gutters, cable trays, and conduits. Protect all metal cabinet edges where conductors cross and conduit ends with protective covering or bushing.

B. Group wires and cables by types, boards and modules, and maintain National Electrical Code clearances throughout the installation, including Class 1, Class 2, communications, and branch circuit power separations. Maintain sufficient and proper separation between microphone-level audio, line-level audio, high-level audio, and video cables.

C. Uniformly organize equipment and cable routing throughout all enclosures, racks, and cabinets. Provide wiring ducts, wireways, wire posts, D rings, wire saddles to route and

secure factory and field wiring. Provide routing for all wiring from point of entry to point of termination to maintain required separation, access to all components, and general organization to the wiring. Neatly dress, route and secure wiring.

D. Mechanically fasten cabinet raceways and cable clamps to enclosure rear panels, rack members, console members, or to other system components. The use of adhesive fasteners (without mechanical fastener) is not permitted. Furnish and install cable support posts where necessary to properly support cables.

E. No splices are permitted in cabinet raceways. Exception: Splice to cable shield when within two inches of cable termination is permitted.

F. Furnish and install metal grounding type outlet strips in each equipment cabinet, enclosure, and rack. Leave a minimum of two unused receptacles at each location for future expansion. Neatly shorten and dress power cords from individual equipment to the outlet strips.

G. Provide protection from accidental contact of all terminals or exposed conductors over 25 volts within enclosures that contain Class 2 wiring. Use non-conductive barriers, heat shrink or other acceptable methods. Tape of any kind is not permitted.

H. Provide an isolated ground bus within each equipment cabinet, enclosure, and rack for single point termination of audio and data shields and grounds.

2.5 SOURCE QUALITY CONTROL

A. Shop Inspections:

1. The Owner's Representative shall have the right at all times to inspect or otherwise evaluate the Work performed or being performed and shall have access to the premises in which the Work is being performed.

2. The Owner's Representative may verify the inspections or re-inspect any item. The Owner reserves the right to reject materials and workmanship found unacceptable during inspections.

B. Shop Test and Demonstration

1. Shop Test and Demonstration shall be a major milestone that shall commence only after all shop assembly, system integration, and software development and programming is complete. Owner's approval of the integrated shop test shall be obtained before any system components are shipped to the site for installation.

2. Perform a point-by-point system demonstration of the Integrated Security System including CCTV system, Duress Alarm System, Integrated Sequences of Operation, PLC system, control panels, Intercom, and Public Address system to show all systems functioning and communicating as a single integrated system.

3. Each input and output point, operational sequence, control panel, and PLC network will be tested. Provide sample field devices, approved mock up devices and jumpers to simulate actual field operation conditions. In addition, simulated system failure, response time, reset and boot up time, and other tests will be conducted as directed by the Owner.

4. Sample field devices including, but not limited to are, intercom stations, paging speakers, microphones, cameras, CCTV monitors, locks, and door position monitoring devices.

5. Notify the Owner a minimum of 15 working days prior to demonstration so that the Owner may witness the demonstration.
6. Conduct the demonstration in strict accordance with the test procedure accepted by the Owner. Demonstrate full compliance with the required operating modes and sequences of operation under all operating modes. Record demonstration/ test results on a report which shall include a list of all personnel witnessing the demonstration, test methods used, and a record of each specific test made.
7. If demonstration results are not in compliance with requirements, make necessary hardware and software changes, corrections, repairs, or adjustments at no additional cost to the Owner. If corrections cannot be made during the scheduled Shop Test and another shop test is required, the Contractor shall pay for all transportation, lodging and expenses of the Owner's representatives' (maximum seven people) attending the additional tests. This process shall continue until the systems are acceptable to the Owner.

2.6 FIRESTOPPING/SEALANT MATERIALS

A. Firestop and seal all penetrations of fire walls with minimum three hour sealant or Fire Stop Putty(FSP). This includes but is not limited to all raceway, conductor, sleeve and cable tray penetrations where penetrating device does not completely seal the hole.

B. Accepted Products: International Protective Coatings Corp. FlameSafe FSP 1100, Nelson FSP, Domtar Fire-Halt or approved equal from other manufacturers.

PART 3 EXECUTION

3.1 EXAMINATION

A. Carefully inspect the installed Work by other trades and verify that all such Work is complete to the point where installation of the Work of this division may properly commence.

B. In the event of discrepancy, immediately notify the Owner's Representative. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

C. Install all equipment in accordance with all pertinent codes and regulations, the accepted design, and the referenced standards.

3.2 INSTALLATION

A. Equipment Identification:
1. Install a nameplate on each individual equipment rack, enclosure, boxes, cabinet, and significant equipment item.
2. Use identifiers and abbreviations defined in the Drawings whenever possible. Use plan designation for labeling, unless indicated otherwise.
3. Nameplates shall be laminated black phonemic resin with a white core and engraved lettering, a minimum of 1/4" high. Use fasteners to install nameplates. Do not fasten with adhesives.
4. Engrave using upper case letters of uniform height; centered on device, cover plate, or enclosure; with all characters made clearly and distinctly.
5. All equipment shall have the manufacturer's name, address, model number and rating on a name plate securely affixed in a conspicuous place. All equipment shall bear labels

attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service.

6. Identify all field terminals and relays with device identification. Lettering shall be 3/16" high minimum.

B. Equipment Installation:

1. Install all equipment in accordance with the manufacturer's recommendations, and accepted shop drawings.
2. Install all equipment in compliance with CEC requirements, NECA's "Standard of Installation", and recognized industry practices.
3. If requested, submit structural and seismic mounting load calculations demonstrating adequate support and bracing for seismic zone 4.
4. Do not attach electrical materials to roof decking, removable or knockout panels, or temporary walls and partitions unless indicated otherwise. Use hangers and other supports to support the equipment and materials, intended for this purpose.
5. Locate equipment as close as practical to the locations shown on the Drawings.
6. Maintain minimum 3-foot working clearances on each side of equipment or equipment racks where access is required to inspect, service or adjust.
7. Check equipment against available mounting space indicated on the drawings. Coordinate location of equipment with existing devices to minimize interference. Bring all conflicts or clearance problems to the attention of the Owner's Representative during the preparation of shop drawings.
8. Where the Owner's Representative determines that equipment installation is not conveniently accessible for operation and maintenance, remove and reinstall equipment in a conveniently accessible manner at no extra cost.

C. Grounding and Shielding:

1. Comply with Section 28 05 26.

D. Surge Suppression:

1. Comply with Section 28 05 26.

3.3 FIELD QUALITY CONTROL

A. Initial Performance Testing:

1. Initial Performance Testing is to be conducted by the Contractor.
2. Point-by-point testing shall include the sequential operation of each system and control function in each of its operating modes. All tests are to be conducted and recorded per the accepted procedure and test forms.
3. Notify the Owner's Representative five days in advance that this activity will be occurring.

B. Performance Testing:

1. Performance Testing is to be conducted by the Contractor and witnessed by the Owner's Representative.
2. Schedule point-by-point performance testing only after Initial Testing has been satisfactorily completed and all necessary corrections have been made. Provide the

Owner's Representative with a minimum of 5 working days notice with a request to schedule Performance Testing. Submit Initial Performance Test records prior to the scheduled Performance Test. Failure to submit test results as specified shall be cause to re-schedule testing.

3. Point-by-point testing shall include the sequential operation of each function in each of its operating modes, in addition to completion of all required performance testing and measurement.
4. Conduct point-by-point testing in the presence of Owner's Representative. Record test results on the accepted test checklist which shall include a list of all personnel witnessing the tests. If test results are not in compliance with requirements, make necessary changes or adjustments at no additional cost, and arrange for another test. This process shall continue until the systems are acceptable to the Owner's Representative.
5. Failure of any part of the system which precludes completion of system testing, which cannot be repaired in four (4) hours, shall be cause for terminating the test. Repeated failures which result in a cumulative time of eight (8) hours to effect repairs, shall cause the system test to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the Owner.
6. Performance Testing will also include inspections for contract document compliance, codes and standards compliance, and workmanship.

C. Continuous Functional/Operational Testing:

1. After completion and Owner Representative's approval of the Performance Testing, conduct a 14-day operational test in order to demonstrate continuous system performance. The systems will not be accepted until they operate for 15 continuous days without a system failure. Restart the test period from the beginning after every confirmed system failure.
2. The Owner will provide staff to man and operate all control points during continuous operational testing. The Owner's test personnel will simulate staff movement, generate alarms, and otherwise randomly operate as many functions as practical on a nearly continuous, 8-hour-shift basis. Provide jumpers and simulation programs to test alarms and other conditions that cannot be readily performed by test personnel. The test staff will record all suspected problems and provide these reports to the test committee.
3. The Owner's Representative will make the final determination for all disputed problems.
4. System failure is defined as any portion of the system that fails to operate as intended and can not be corrected within 24 hours of the failure. Individual device failure such as a single camera or a single intercom station will not be a cause for system failure.

3.4 CLEANING

A. Comply with Division 1 requirements.

B. Protect equipment during installation against entry of foreign matter on the inside. Vacuum clean all equipment both inside and outside before testing, operating and painting. Clean electrical connections with a suitable solvent prior to assembly.

C. Remove from the premises and dispose of all packing material and debris on a daily basis.

D. Upon completion of the Work, remove excess debris, materials, equipment, apparatus, tools and the like and leave the premises clean, neat and orderly.

E. Thoroughly polish all bright metal or plated Work and remove any pasted labels, dirt or stains from the equipment.

3.5 TRAINING

A. Provide on-site, project-specific training sessions for system operations, maintenance, and programming with designated total hours as follows:

	Operational	Maintenance	Programming
1. Electronic Components	1	2	0
2. Video Surveillance (CCTV) System	4	4	8
3. Duress Alarm System	1	1	2
4. MATV	1	2	2
5. PLC Integrated Control System	1	8	8
6. HMI Control Stations	4	2	8
7. Intercom System	4	4	8

B. All classroom training is to occur on site at a location provided by the Owner.

C. All training is to review the existing systems as they apply to the equipment and systems provided under this contract. All personnel being trained are expected to have basic experience for the existing systems.

D. Operational Training:

1. Train security staff in the operation of the System. Operational training shall include how to monitor and control the systems provided under this contract and how to respond to system events.

E. Maintenance Training:

1. Train Owner's personnel in the basic user level maintenance and trouble shooting of the System. Structure training to identify the equipment and systems that can be serviced or reset by the on duty building engineer, how to identify systems that have failed or not working, and emergency shut down procedures.
2. Provide a combination of classroom sessions supported by audio/visual aids, and field sessions with personnel participating in hands-on preventative, corrective maintenance and reactive maintenance.

F. Programming Training:

1. Train Owner's personnel in the site-specific programming and software trouble shooting of the System. Training will also include all user programmable features. Conduct training sessions using instructors who have been actively involved throughout construction and who are certified in writing by the manufacturers of the specific systems.
2. Provide a combination of classroom sessions supported by audio/visual aids, and field sessions with personnel participating in hands-on for programming changes, software uploading/downloading, trouble shooting, etc.

G. Submit an estimated training schedule 15 days prior to training for approval by the Owner's Representative. Estimate classroom and hands-on hours required for all three types of

training (operational, maintenance, and programming). Include a syllabus for each class session.

H. All training materials including Operational and Maintenance (O&M) Manuals shall be reviewed and approved prior to conducting the specific training.

END OF SECTION

SCHEDULE 28 05 00 a

SAMPLE LIST OF DIVISION 28 SUBMITTALS

1. CPM Schedule
2. Submittal Matrix
3. Schedule of Values (SOV)
4. Licenses and certifications
5. Key Project Personnel
6. Product Data
7. Shop Drawings
    a. Floor Plans
    b. Enlarged Control / Equipment Rooms and Elevations
    c. Rack and Cabinet Elevations
    d. Block Diagrams
    e. Single Line Diagrams
    f. Point- to-Point Diagrams
    g. Schematic Diagrams
    h. Installation Diagrams and Details
8. Calculations; UPS, Data
9. Sequence of Operations
10. Samples
11. Test Procedures
12. Test Results
13. Record Documents
    a. Drawings
    b. O&M Manuals
    c. Warranty
14. Extra Materials

SCHEDULE 28 05 00 B

SUMMARY OF REQUIRED LICENSES AND CERTIFICATIONS

This list is provided for the convenience of the Contractor only.

I. Section 28 05 00 Integrated Systems Contractors
   1. California State Contractor's License C-10 (high voltage) or
   2. California State Contractor's License C-7 (low voltage)
   3. Key Personnel Degree or equal

SECTION 28 05 13

CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wire and cable.
2. Wiring connectors and connections.

B. Related Sections:

1.	28 05 00	Common Work Results for Electronic Safety and Security
2.	28 05 14	Raceways and Boxes
3.	28 05 26	System Signal Grounding
4.	28 05 27	Cabinets, Enclosures and Racks
5.	28 09 00	Electronic Components
6.	28 13 00	Access Control System
7.	28 15 00	Intercom System
8.	28 23 00	Video Surveillance (CCTV) System
9.	28 26 00	Duress Alarm System
10.	28 41 33	MATV System
11.	28 46 19	PLC Integrated Control System
12.	28 46 19	Integrated Sequences of Operation

1.3 SYSTEM DESCRIPTION

A. Provide wiring and cables as described herein, shown on the drawings or as recommended by the manufacturer. When in conflict, the more stringent or greater requirements will take precedence as determined by the Engineer-of-Record.

B. Wires, cables, harnesses and connectors specifically described in another section or provided by or manufactured by a manufacturer in that section shall be provided by that section.

C. Wire size and features are minimum requirements, specific applications or manufacturers may have more stringent requirements which are to be provided at no additional cost to Owner.

1.4 SUBMITTALS

A. Comply with Section 28 05 00.

1.5 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

B. NEC Compliance: Comply with Article 725 (Class 2 Power-limited Circuits).

C. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years documented experience.

1.6 PROJECT CONDITIONS

A. Conductor sizes are based on copper.

B. Aluminum conductors shall not be used.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.7 COORDINATION

A. Coordinate Work with other trades.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide materials from listed manufacturers or approved equal.

B. Approved cable manufactures:
   1. Belden
   2. Berk-tek
   3. Commscope/General Instrument
   4. General Cable
   5. Mohawk
   6. Optical Cable Corporation.
   7. VersaLAN
   8. West Penn

2.2 CONNECTORS

A. Terminal Blocks:
   1. Type: DIN-rail-mounted, modular, screw terminals.
   2. Provide fused terminals where required or indicated.
   3. Accepted Manufacturers: Entrelec, Phoenix Contact, Weidmueller, or approved equal.

B. CCTV Video Connectors:

1. Type: 75-ohm, commercial crimp-on, 3-piece BNC connectors.
2. Body: Zinc outer piece and nickel center.
3. Contacts: Nickel/gold plating.
4. Accepted Products: Cambridge CPMC-78 series, AMP or approved equal from other manufacturers.

C. Data Connectors:

1. Type: Deluxe plastic, 9-pin, D sub-miniature hoods
2. Accepted Products: Cambridge HX series, AMP or approved equal from other manufacturers.

2.3 WIRES AND CABLES

A. Cables installed below grade (even in conduit) shall be rated for use in wet locations.

B. Listings and Markings: UL listed and marked for flame resistance as follows:

1. General purpose: CEC Type CM
2. Riser: CEC Type CMR
3. Plenum: CEC Type CMP

C. Communication and Control Cables:

1. Conductors: Stranded bare copper, size as indicated.
2. Insulation level: 300 VRMS.
3. Temperature level: 75° C.
4. Paired cables shall be twisted.
5. Shield: 100% coverage aluminum polyester foil with drain wire.

D. Coaxial Cables:

1. Nominal impedance: 75 ohms.
2. Conductor: Stranded bare copper.
3. Dual shield: 100% coverage aluminum polyester tape with 95% coverage tinned copper braid.
4. Maximum attenuation at 10 MHz: 0.87 dB per 100 feet.
5. Insulation: Foam polyethylene, 300 VRMS.
6. Minimum temperature level: 75° C

E. Data Grade Cables:

1. Type: Twisted individually shielded pairs, quantity and size as indicated.
2. Conductors: Stranded bare copper.
3. Insulation level: 300 VRMS.
4. Minimum temperature level: 75° C
5. Maximum capacitance between conductors: 25 pf per foot.

6. Shield: 100% coverage aluminum polyester foil with drain wire.

F. Category 6 UTP
   1. UL listed NEC type CM as defined in NEC Article 800
   2. Complies with UL 1581 Test
   3. Meets and Exceeds TIA/EIA 568-B.2 Specifications

G. Category 3 UTP
   1. High pair count unshielded 24-AWG solid conductor twisted-pair core with a metallic sheath ARMM riser rated shall meet or exceed the TIA/EIA-568B Commercial Building Standards for CAT3. The cable will be riser or plenum rated as dictated by National, State and Local Electrical and Building Codes.

H. Optical Fiber Cable – Multimode
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Berk-Tek; a Nexans company.
      b. Belden CDT Inc.; Electronics Division.
      c. CommScope, Inc.
      d. Corning Cable Systems.
      e. General Cable Technologies Corporation.
      f. Mohawk; a division of Belden CDT.
      g. Superior Essex Inc.
      h. SYSTIMAX Solutions; a CommScope Inc. brand.
   2. Description: Multimode, 50/125 micrometer, 24 fiber, nonconductive, tight buffer, optical fiber cable.
      a. Comply with ICEA S-83-596 for mechanical properties.
      b. Comply with TIA/EIA-568-B.3 for performance specifications.
      c. Comply with TIA/EIA-492AAAA-B for detailed specifications.
      d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
         1) General Purpose, Nonconductive: Type OFN or OFNG.
         2) Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
         3) Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
         4) General Purpose, Conductive: Type OFC or OFCG.
         5) Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
         6) Riser Rated, Conductive: Type OFCR or OFCP, complying with UL 1666.
      e. Conductive cable shall be aluminum armored type.
      f. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
      g. Minimum Modal Bandwidth: 2000 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
   3. Jacket:

a. Jacket Color: Aqua for 50/125-micrometer cable.
b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

I. Optical Fiber Cable – Single Mode
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Berk-Tek; a Nexans company.
b. Belden CDT Inc.; Electronics Division.
c. CommScope, Inc.
d. Corning Cable Systems.
e. General Cable Technologies Corporation.
f. Mohawk; a division of Belden CDT.
g. Superior Essex Inc.
h. SYSTIMAX Solutions; a CommScope Inc. brand.
2. Description: Single-mode, 12 fiber, nonconductive, tight buffer, optical fiber cable.
a. Comply with ICEA S-83-596 for mechanical properties.
b. Comply with TIA/EIA-568-B for performance specifications.
c. Comply with IEC 60793-2-50 Type B.1.1.
d. Comply with TIA/EIA-492CAAA for detailed specifications.
e. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
1) General Purpose, Nonconductive: Type OFN or OFNG.
2) Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
3) Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
4) General Purpose, Conductive: Type OFC or OFCG.
5) Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
6) Riser Rated, Conductive: Type OFCR or OFCP, complying with UL 1666.
f. Conductive cable shall be aluminum armored type.
g. Maximum Attenuation: 0.7 dB/km at 1310 nm; 0370 dB/km at 1550 nm.
3. Jacket:
a. Jacket Color: Yellow for all Single-mode cable.
b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

J. Optical Fiber Cable Hardware
1. Manufacturers: Subject to compliance with requirements, provide products by one of the

following:

a. ADC.

b. Belden CDT Inc.; Electronics Division.

c. CommScope, Inc.

d. Corning Cable Systems.

e. Hubbell Premise Wiring.

f. Leviton Voice & Data Division.

g. Panduit Corp.

h. Siemon Co. (The).

i. SYSTIMAX Solutions; a CommScope Inc. brand.

2. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

   a. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

3. Patch Cords: Factory-made, duplex-fiber cables in 36-inch (900-mm) lengths.

4. Cable Connecting Hardware:

   a. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

   b. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

   c. Type SFF connectors may be used in termination racks, panels, and equipment packages.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Section 28 05 00.

B. Comply with manufacturer's recommendations, procedures, and standards for the assembly, programming, and operation of the alarm system.

C. Coordinate closely with the door and frame contractor for proper installation of all door position sensors per manufacturer’s recommendations.

D. Mount individual components to removable rear panels in wall-mounted cabinets using DIN rails, snap track or stand off-mounted PC boards, or properly sized mounting hardware.

E. Fuses: Provide over-current protection for control relay outputs and associated wiring.

F. Power Distribution:

1. Hardwire each system power supply circuit to a line voltage transient voltage surge suppresser at its point of supply.

2. Coordinate with the electrical contractor for power capacities and circuit assignments in the electrical panel schedules and drawings for the alarm systems. Notify the Owner if

additional power or circuits may be required.

3.2 WIRE TERMINATION, DRESSING, AND IDENTIFICATION:

A. Terminate or join all wires and cables with specified terminal blocks or connectors submitted and accepted for the specific termination. Acceptable termination and junction methods include:

1. Equipment or device terminal blocks (provided with equipment or device): Direct connection with stripped conductors.
2. Equipment or device screw terminals (provided with equipment or device): Two-crimp, spade lug on stripped conductors.
3. Device lead wires (provided with device): Two-crimp, insulated wire nut over conductors.
4. Equipment or device connector (provided with equipment or device): Provide mating connector.
5. Junctions and/or splices where indicated: Provide terminal blocks for control and communication cables and specified connector types for others.

B. Use the specific cable stripper for each cable and wire type. Use a 3-step-cut coax cable stripper on coaxial cables, a jacket stripper on jacketed cables, and the proper size stripper for individual conductors. Do not strip with a knife, scissors or other improper tool.

C. Use the proper crimping tool for each cable / connector combination. For example, crimp coaxial cables using a full-cycle ratchet crimp tool with the specific size hexagonal steel die for the cable type. Crimp D-subminiature connectors using a specific D-sub crimp tool, and so on.

D. For multi-pin connectors use the appropriate pin insertion and extraction tool.

E. Dress wires and cables to provide a neat and orderly appearance within all enclosures, equipment racks, cabinets, consoles by routing in snap-cover, plastic wiring duct or other acceptable method. In locations where wiring duct is not feasible, organize by cable clamping, dressing and tie-wrapping.

F. Relieve strain on all loose wire bundles using tie-wrap supports fastened with machine screws or bolts. Do not use self-adhesive type supports.

G. Neatly form cable ends and apply shrinkable tubing to shielded cables or where necessary to secure the insulation against fraying or raveling.

H. Individually identify all conductors with a unique number located within 1-1/2-inch from its termination at both ends. Impress the number on a fixed length of white shrinkable tubing with a heat impression stamping machine, or other acceptable method.

I. Cross reference the interconnection diagrams of the record drawings with the installed cable identification numbers.

J. Route from source to termination in a uniform manner through raceways, cabinets, and equipment housings without breaking the insulation or deforming the cables. "Flying splices", meaning splices in wire bundles, raceways, or pull boxes are specifically prohibited. Splice only at junction box locations shown on the Drawings.

K. Obtain Owner’s pre-approval for all exposed cable runs.

L. Maintain separation between Class 1, Class 2, communications, and branch circuit power wire and cable in accordance with the CEC. Do not route microphone-level audio, line-level audio, or high-level audio in the same conduit or cable group.

M. Do not exceed the following cable pulling tensions:

1. 24 AWG conductors: 4 lbs. per conductor.
2. 22 AWG conductors: 7 lbs. per conductor.
3. 20 AWG conductors: 12 lbs. per conductor.
4. 18 AWG conductors: 19 lbs. per conductor.
5. 16 AWG conductors: 30 lbs. per conductor.
6. 14 AWG conductors: 48 lbs. per conductor.

N. Use a scale to measure tensions for typical cable pulls. If tensions are exceeded even momentarily or if cables are damaged, remove the cables. Install new cables either using an acceptable anti-friction agent or adding pull boxes to the run.

O. Install edge protection materials ("cat track") on the edges of holes, lips of ducts of any other point where wires or cables cross sharp metallic edges.

3.3 FIELD QUALITY CONTROL

A. Performance Testing:

1. Comply with Section 28 05 00, Performance Testing for:
   a. Initial Performance Testing.
   b. Performance Testing.

3.4 TRAINING

A. Provide training in accordance with Section 28 05 00, Demonstration.

END OF SECTION

SECTION 28 05 14

RACEWAYS AND BOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Rigid Galvanized Steel Conduit (RGS).
   2. Electrical Metallic Tubing (EMT).
   3. Rigid Non-metallic Conduit (PVC).
   4. Flexible Metal Electrical Conduit.
   5. Liquid-tight Flexible Metal Conduit.
   6. Gutters, Wireways and Troughs.
   7. Cable Trays
   8. Fittings, Couplings, and Connectors.
   9. Supporting Devices.
   10. Sealant.
   11. Outdoor Outlet Boxes.
   12. Indoor Outlet Boxes and Small Junction and Pull Boxes.

B. Related Sections:
   1. 28 05 00 Common Work Results for Electronic Safety and Security
   2. 28 05 13 Conductors and Cables
   3. 28 05 26 System Signal Grounding
   4. 28 05 27 Cabinets, Enclosures and Racks
   5. 28 09 00 Electronic Components
   6. 28 13 00 Access Control System
   7. 28 15 00 Intercom System
   8. 28 23 00 Video Surveillance (CCTV) System
   9. 28 26 00 Duress Alarm System
   10. 28 41 33 MATV System
   11. 28 46 19 PLC Integrated Control System
   12. 28 46 19 Integrated Sequences of Operation

C. REFERENCES
   1. ANSI C80.2 Rigid and Steel Conduit.

2. ANSI C80.3 Electrical Metallic Tubing - Zinc Coated.
3. ANSI 870 Wireways, Auxiliary Gutters, and Associated Fittings.
4. NECA Standard of Installation.
5. NEMA FB 1 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit
6. NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
7. CEC California Electrical Code
8. UL 1 Flexible Metal Conduit.
9. UL 5 Surface Metal Raceways and Fittings.
10. UL 50 Cabinets and Boxes.
11. UL 360 Liquid-Tight Flexible Conduit.
12. UL 514A Metallic Outlet Boxes.
13. UL 514B Fittings for Conduit and Outlet Boxes.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Raceway Size: Use a minimum conduit inside diameter of 3/4-inch. Size conduit and raceway for a maximum cross-sectional fill area of 40%.
2. Gutter, Wireway and Trough Size: Size for a maximum cross sectional fill area of 20%.
3. Raceway Support: For each support and group of fasteners provide strength equal to the maximum weight of the present load plus all future raceways for which the support provides space, times a safety factor. Except as otherwise indicated, use a safety factor greater than four where necessary to provide a minimum safety allowance of 200 lbs. Provide additional support strength where required to prevent distortion of raceway during wire pulling.
4. Equipment Ground Conductor (Green): Where indicated, shown or required, raceway sizes shall be adequate to include the circuit conductors, an equipment ground conductor and a neutral conductor in accordance with percentage of fill requirements as specified.

1.4 SUBMITTALS

A. Conform to the requirements of Section 28 05 00.

B. Product Data: Submit manufacturer's technical data for all items to be used including specifications, installation instructions and general recommendations.

C. Shop Drawings: Submit scale plan and elevation drawings of raceway systems showing layout and size of raceways, pull boxes and junction boxes within three feet of equipment to be installed by this contract.

D. Record Drawings: Provide shop drawings showing as-built conditions of all raceways, termination boxes, junction boxes, pull boxes and installed equipment.

1.5 SITE CONDITIONS

A. Conduit routing shown on the Drawings is approximate, actual routing will depend on site conditions and code requirements.

B. Coordinate with the Owner for approved locations of conduit and equipment installation is the existing facility.

PART 2 PRODUCTS

2.1 RACEWAY (FOR INDOOR USE ON EXPOSED SURFACES)

A. Acceptable Product: Wiremold (Steel Surface Raceway System): V500, V700, & 700WH

B. Wiremold (Steel Surface Raceway System): 3000

2.2 RIGID GALVANIZED STEEL CONDUIT (RGS)

A. Rigid steel conduit zinc coated shall conform to ANSI C80.2.

2.3 ELECTRICAL METALLIC TUBING (EMT)

A. EMT, zinc coated shall conform to ANSI C80.3.

2.4 RIGID NON-METALLIC CONDUIT (PVC)

A. Rigid non-metallic conduit shall be Schedule 40 PVC conduit manufactured in compliance with NEMA TC-2. PVC conduit shall be U.L. listed. Joints shall be solvent cement type.

B. Provide PVC elbows, bends, fittings and adapters as required for a complete installation. Provide solvent cement as recommended by the conduit manufacturer.

2.5 FLEXIBLE METAL ELECTRICAL CONDUIT (GREENFIELD)

A. Flexible metal electrical conduit shall conform to UL 1.

2.6 LIQUID-TIGHT FLEXIBLE STEEL CONDUIT

A. Liquid-tight flexible steel conduit shall conform to UL 360.

B. Sizes 1.25 inches and smaller: Provide with a continuous copper bonding conductor wound spirally between convolutions.

C. Sizes 1.5 inches and larger: Provide with an internal grounding conductor and grounding bushings.

D. Also known as Seal Tight flexible conduit.

2.7 GUTTERS, WIREWAYS AND TROUGHS

A. Use NEMA Type 12.

B. Use 14 gauge bodies and covers.

C. Use above and below wall-mounted enclosures and cabinets for the collection of field device conduits, wires, and cables.

D. Do not use in inaccessible locations.

2.8 FITTINGS, COUPLINGS AND CONNECTORS

A. Fittings for conduit and outlet boxes shall conform to UL 514B.

B. Surface metal electrical raceways and fittings shall conform to UL 5.

C. Use fittings listed and equally acceptable for specific conduit or raceway system used; e.g.: Use PVC coated fittings with PVC coated conduit.

D. For threaded rigid steel conduit, do not use threadless or compression type fittings.

E. For EMT, provide steel or malleable iron "concrete-tight" or "rain-tight" couplings and connectors. Use compression, set screw or stainless steel multiple locking type bodies. Do not use indentation type fittings.

F. Bushing and connectors shall be insulated type which maintain continuity of conduit grounding system. Insulating material shall be molded or locked into metallic body of the fitting. Bushings made entirely of nonmetallic material will not be allowed.

G. Set screw connectors and couplings body shall have wall thickness at least equal to wall thickness of conduit used. Couplings or conduit trade size ¾-inch through 2 inch shall have two set screws per fitting and 2.5-inch through 4-inch shall have four set screws per fitting. Set screws shall be case hardened steel with hex head and cup point.

H. Provide flexible metal conduit fittings made of steel or malleable iron. Insulate with one of the following types:

1. Wedge and screw type having an angular wedge fitting between the convolutions of the conduit.
2. Squeeze or clamp type having a bearing surface contoured to wrap around the conduit and clamped by one or more screws.
3. Steel, multiple point type, for threading into internal wall of the conduit convolutions.

I. Liquid-tight flexible metal conduit shall incorporate a threaded grounding cone, a steel, nylon or equal plastic compression ring and a gland for tightening. Fitting shall be steel, or malleable iron with insulated throat, with male thread and locknut or male bushing with or without "O" ring seal.

J. Expansion fittings shall be hot-dipped galvanized malleable iron with a packing ring to prevent entrance of water, a pressure ring, a grounding ring and a separate external copper bonding jumper.

K. Inferior material such as "pot metal" shall not be used for any type of fitting.

L. All locknuts shall be the bonding type with sharp edges for digging into the metal wall of an enclosure.

2.9 SUPPORTING DEVICES

A. General: Provide supporting devices with manufacturers standard materials, designed and constructed in accordance with published product information, for a complete installation.

B. Raceway Supports: Provide manufacturer's standard supports including clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze, wall brackets and spring steel clamps.

C. Corrosion Resistance: Provide all supports, support hardware and fasteners hot-dipped galvanized or cadmium plated.

D. Fasteners: Provide fasteners as required by the type of wall or ceiling construction and the equipment to be supported by the fastener.

E. U-Channel Strut Systems: Provide minimum 12 gauge U-channel strut system for mounting and supporting electrical equipment. Fittings shall mate with the U-channel.

F. Fittings for Strut System: Galvanized steel end caps, conduit clamps, conduit hangers, U-bolts.

2.10 OUTDOOR OUTLET BOXES

A. Conform to NEMA FB 1, for fittings, cast metal boxes and conduit bodies.

B. Provide electrical boxes and fittings which are UL-listed and labeled, and conform to UL 50, UL 514A, UL 514B, and UL 514C.

C. Select covers for boxes of types appropriate for each use and location.

D. Provide gaskets for covers of boxes in damp locations.

E. Corrosion resistance: Provide galvanized or other equally acceptable corrosion resistant finish for all boxes, accessories and fittings.

2.11 INDOOR OUTLET BOXES AND SMALL JUNCTION- AND PULL-BOXES

A. Conform to NEMA OS 1 for sheet-steel outlet boxes, device boxes, covers and box supports. Provide minimum 4-inch square by 1.5-inch deep, one piece, deep-drawn, galvanized steel, outlet boxes for general use. Provide square cornered, straight sided gang boxes wherever required by CEC or more than two wiring devices are indicated in the same location. Provide boxes of increased depth where required by the project conditions.

B. Furnish with stamped knockouts in the back and sides.

C. Provide threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.

D. Accessories: Provide outlet box accessories as required for each installation, including plaster covers, mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.

2.12 FIRESTOPPING/SEALANT MATERIALS

A. Accepted Products: International Protective Coatings Corp. FlameSafe® FSP 1100, Nelson FSP, Domtar Fire-Halt® or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Penetrations:

1. Firestop and seal all penetrations of fire walls and floors with minimum three hour sealant or Fire Stop Putty(FSP). This includes but is not limited to all raceway, conductor, sleeve and cable tray penetrations where penetrating device does not completely seal the hole.

2. Provide a suitable caulk for purposes of speech privacy and air flow restriction where a fire rated seal is not required.

B. Raceways and Fittings:
   1. Comply with CEC, for application, size, location and installation of each type of raceway.
   2. Where not specifically shown on the drawings or specified, use the following guidelines for the selection of raceway types:
      a. RGS – Exposed exterior and wet locations. Areas subject to physical damage or vandalism.
      b. EMT – Concrete encased. Interior dry exposed locations.
      c. PVC –. Below grade or under concrete slab. Use metal risers.
      d. Flexible Metal – Use to connect to equipment that must be mechanically isolated or shifted to final position in indoor dry locations only. Use where conduit must be fished in building voids. Do not use in corrosive atmosphere.
      e. Liquid-Tight Flexible Metal – Use when flexible metal is required in wet or outdoor locations.
   3. Install no more than the equivalent of three 90-degree bends between boxes.
   4. Conduit and EMT runs shall be mechanically and electrically continuous from service entrance to all outlets. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.
   5. Keep conduit at least 6 inches away from parallel runs of steam and hot-water pipes.
   6. Level and square raceway runs.
   7. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
   8. Provide supports for raceways as specified.
   9. Prevent foreign matter from entering raceways; use temporary closure protection.
   10. Make bends and offsets so the inside diameter is not effectively reduced.
   11. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
   12. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.
   13. Run raceways with a minimum number of bends. All bends shall have the longest possible radii.
   14. Install exposed raceways parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours.
   15. Run exposed, parallel or banked raceways together.
   16. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs where they can be installed parallel.
   17. Join and terminate raceways with fittings designed and equally acceptable for the purpose of the raceway system and make up tight.

18. Where the installation is such that joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system.
19. Make the set screws of threadless fittings up tight; do not use pliers. Compression fittings shall be tightened with two wrenches.
20. Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts so that the dished part is against the box.
21. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder.
22. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed. Running threads are not allowed.
23. Install nylon pull strings in empty raceways. Leave not less than 12 inches of slack at each end of the conduit.
24. Horizontal cross runs of conduit or EMT may be installed in partitions only where explicitly permitted. Exposed horizontal runs, where permitted, shall be installed close to ceiling or ceiling beams.
25. Conduits and EMT connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.
26. Conduits and EMT shall not be run through beams, except where clearly indicated on drawings or where permitted.
27. Conduits and raceways above suspended ceilings may be supported from the floor construction above or from the main ceiling support members, however, the finished installation shall not interfere with the removability of ceiling panels.
28. At building expansion joints, provide expansion fittings and cross at right angles to joint.
29. Provide conduits stubbed up through or from concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Where no equipment connections are made, install screwdriver-operated threaded flush brass plugs in conduit end.
30. Provide expansion fittings for all rigidly fastened conduits spanning a building expansion joint and if not otherwise provided, for all runs 1.5 inches or larger, exceeding 150 feet in length.

C. CABLE TRAY INSTALLATION

1. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
2. Remove burrs and sharp edges from cable trays.
3. Fasten cable tray supports to building structure and install seismic restraints.
    a. Design each fastener and support to carry load indicated by seismic requirements.
    b. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
    c. Support bus assembly to prevent twisting from eccentric loading.
    d. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.

e. Locate and install supports according to NEMA FG 1.

4. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
5. Make cable tray connections using standard fittings.
6. Workspace: Install cable trays with enough space to permit access for installing cables.
7. Install barriers to separate cables of different systems, such as power, communications, and data processing.
8. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

D. BOXES AND FITTINGS:

1. Coordination: Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work, and with general construction work.
2. Weatherproof: Provide weatherproof outlets for all interior and exterior locations exposed to weather or moisture.
3. Knockout Caps: Provide knockout closures to cap unused knockout holes where blanks have been removed.
4. Anchoring: Support and fasten boxes securely per CEC.
5. Sizes: Provide boxes of sizes adequate to meet CEC volume requirements, but in no case smaller than sizes indicated.
6. Do not use sectional (gangable) boxes.
7. Do not use device plates as covers for boxes in exposed locations.
8. Do not use round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surface.
9. Threaded Hubs: Use threaded hub type boxes with gasketed weatherproof covers in all exterior locations; where installed on unfinished walls, columns or plasters; where exposed to moisture laden atmosphere; or where indicated.
10. Extension Rings: Where extension rings are required on existing outlet boxes, drill new mounting holes in the rings to align with the mounting holes on the existing boxes.

E. PULL AND JUNCTION BOXES:

1. Conform to CEC.
2. Locate junction and pull boxes in accessible locations.
3. Do not locate boxes in finished areas UON.
4. Supports: Provide in each box sufficient clamps, grids, or devices to which cables are secured in neat and orderly fashion permitting ready identification and so that no cable will have an unsupported length of more than 30 inches.

F. RACEWAY SUPPORTS:

1. Compliance: Install hangers, sleeves, seals, U-channel supports and fasteners as indicated and in accordance with manufacturer's written instructions. Comply with requirements of CEC and American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA) for installation of supporting devices.

2. Provide individual and multiple (trapeze) raceway hangers, and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly, and for securing hanger rods and conduits.
3. Arrange for grouping of parallel runs of horizontal raceways to be supported together on trapeze type hangers where possible.
4. Support individual horizontal conduits and EMT 1.5 inches in size and smaller by either one-hole pipe straps or separate pipe hangers. Use separate pipe hangers for larger sizes. Spring steel fasteners may be used in lieu of pipe straps or hangers for sizes 1.5-inch and smaller in dry locations. For hanger rods with spring steel fasteners, use 0.3-inch diameter or larger threaded steel. Use steel fasteners that are specifically designed for supporting single conduits or EMT. Unless otherwise indicated, do not use wire as a means of support. Use spring steel conduit supports only for lighting system branch circuit raceway in suspended ceilings in dry locations.
5. Except as otherwise indicated, space supports for metallic and non-metallic raceways in accordance with the requirements of this Section and the requirements of the CEC.
6. Provide support for exposed or concealed raceway as close as practical to and not exceeding 12 inches from an unsupported box or access fitting. In horizontal runs a support at a box or access fitting may be omitted when the box or access fitting is independently supported and the raceway termination is not made with a chase nipple or threadless box connector.
7. In vertical runs provide such support that the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway termination's or conductor terminals.

G. MISCELLANEOUS SUPPORTS:

1. Provide supports for all miscellaneous electrical components as required to produce the same safety allowances as specified for raceway supports above. Provide metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes etc.
2. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an equally acceptable type fastener not more than 24 inches from the box. When penetrating reinforced-concrete members, avoid cutting any reinforcing steel.
3. Wood backing shall not be used for mounting any equipment except as required for temporary power or telephone terminal strips or unless noted otherwise on drawings. Only steel frame work or strut type channels shall be used for equipment mounting.
4. In hollow masonry, tile, plaster or gypsum board, use toggle type bolts to secure equipment, conduit runs and outlet boxes in place.

H. FASTENERS:

1. Unless otherwise indicated securely fasten all electrical items and their supporting hardware including, but not limited to, conduits, raceways, cables, busways, cabinets, panelboards, wall-mounted transformers, boxes, disconnect switches and control components to the building structure.
2. Fasten by means of wood screws or screw-type nails on wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine

screws; welded threaded studs, or spring-tension clamps on steel work. Do not weld conduits or pipe straps to steel structures. In partitions of light steel construction use sheet metal screws.

3. Do not use powder charged devices or Ramsets to attach fasteners (unless otherwise approved by the Owner).
4. Holes cut to a depth of more than 1.5 inches in reinforced concrete beams or to a depth of more than 3/4 inches in concrete joints shall not be allowed. Notify the District if such penetration is needed.
5. Loads applied to any fastener shall not exceed one-fifth of the proof test load. Use vibration and shock-resistant fasteners.

3.2 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways at all outlet, junction and pull boxes, remove burrs and obstructions.

B. Run a swab or mandrel to remove dirt and blockages. Raceways which are deformed and prevent the passage of a mandrel shall be replaced.

C. Remove dirt and construction debris from all outlet, junction and pull boxes.

END OF SECTION

SECTION 28 05 26

SYSTEM SIGNAL GROUNDING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Provide a separate signal and communications grounding system. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Provide an isolated ground bus within each equipment cabinet, enclosure, and rack for single point termination of audio and data shields and grounds. Do not loop or series each ground bus.

C. Related Sections:

1. 28 05 00 Common Work Results for Electronic Safety and Security
2. 28 05 13 Conductors and Cables
3. 28 05 14 Raceways and Boxes
4. 28 05 27 Cabinets, Enclosures and Racks
5. 28 09 00 Electronic Components
6. 28 13 00 Access Control System
7. 28 15 00 Intercom System
8. 28 23 00 Video Surveillance (CCTV) System
9. 28 26 00 Duress Alarm System
10. 28 41 33 MATV System
11. 28 46 19 PLC Integrated Control System
12. 28 46 19 Integrated Sequences of Operation

1.3 SUBMITTALS

A. Comply with Section 28 05 00.

1.4 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Grounding Conductors, Cables, Connectors, and Rods:
   a. Apache Grounding/Erico Inc.
   b. Boggs, Inc.
   c. Chance/Hubbell.
   d. Copperweld Corp.
   e. Dossert Corp.
   f. Erico Inc.; Electrical Products Group.
   g. Framatome Connectors/Burndy Electrical.
   h. Galvan Industries, Inc.
   i. Harger Lightning Protection, Inc.
   j. Hastings Fiber Glass Products, Inc.
   k. Heary Brothers Lightning Protection Co.
   l. Ideal Industries, Inc.
   m. ILSCO.
   n. Kearney/Cooper Power Systems.
   o. Korns: C. C. Korns Co.; Division of Robroy Industries.
   p. Lightning Master Corp.
   q. Lyncole XIT Grounding.
   r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
   s. Raco, Inc.; Division of Hubbell.
   t. Robbins Lightning, Inc.
   u. Salisbury: W. H. Salisbury & Co.
   v. Superior Grounding Systems, Inc.
   w. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."

B. Material: copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Grounding Electrode Conductors: Stranded cable.

E. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B 3.
   2. Assembly of Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.

F. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 16 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

G. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

PART 3 EXECUTION

3.1 APPLICATION

A. Install a 1/0 AWG, THWN, stranded copper bonding jumper from each equipment cabinet ground bus to the single-point ground bus in the security equipment room and elsewhere as indicated. Do not loop or series each ground bus.

B. Use the signal grounding system as the system signal reference voltage by connecting the isolated secondary common of each low-voltage power supply and equipment item to the system at only one point. Also use the system as the shield ground by connecting the source side of all shields to the system at only one point. Ground all other equipment per manufacturer's recommendation.

C. Other than its single connection to site ground, isolate this signal grounding system from all other metallic objects. Maintain complete isolation from the safety grounding system which shall be used to ground all equipment cabinets, enclosures, racks, conduits, equipment chassis, and other metallic objects from hazardous line voltages. If 60 Hz hum is found in the system add circuits or transformers within equipment to provide positive isolation between signal and safety/chassis ground, thereby eliminating all ground loops.

D. Grounding Bus

1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

3.2 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care

not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.3 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

C. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

D. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.4 FIELD QUALITY CONTROL

A. Comply with Section 28 05 00.

END OF SECTION

SECTION 28 05 27

CABINETS, ENCLOSURES AND RACKS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Free-standing Equipment Cabinets, Enclosures or Racks.
2. Wall-mounted Equipment Cabinets or Enclosures.
3. Wall-mounted Equipment Racks.

B. Related Sections:

1.	28 05 00	Common Work Results for Electronic Safety and Security
2.	28 05 13	Conductors and Cables
3.	28 05 14	Raceways and Boxes
4.	28 05 26	System Signal Grounding
5.	28 09 00	Electronic Components
6.	28 13 00	Access Control System
7.	28 15 00	Intercom System
8.	28 23 00	Video Surveillance (CCTV) System
9.	28 26 00	Duress Alarm System
10.	28 41 33	MATV System
11.	28 46 19	PLC Integrated Control System
12.	28 46 19	Integrated Sequences of Operation

1.3 REFERENCES

A.	ANSI/EIA RS-310-C	Rack mounting standards.
B.	NEMA 250	Enclosures for Electrical Equipment 1000 V Max.
C.	NFPA 70	National Electrical Code - application, and installation of electrical cabinets and enclosures.
D.	UL 50	Cabinets and Boxes.

1.4 SUBMITTALS

A. Conform to the requirements of section 28 05 00, General Requirements.

B. Product Data: Submit manufacturer's technical data for all items to be used including specifications, installation instructions and general recommendations.

1.5 SITE CONDITIONS

A. Cabinets shown on the Drawings are in approximate locations, actual location within the same room may depend on site conditions and Facility approval.

PART 2 PRODUCTS

2.1 GENERAL

A. Types: Provide NEMA type 12 cabinets and enclosures.

B. Materials: Provide cabinets and enclosures as follows:

1. Provide electrical cabinets and enclosures which are UL listed and labeled, and constructed in conformance with UL 50 "Cabinets and Boxes."
2. In normally dry interior locations, provide sheet steel with corrosion resistant fasteners.
3. Outdoors and in damp interior locations, provide galvanized sheet steel with stainless steel fasteners.
4. At constantly wet locations or corrosive atmospheres, provide stainless sheet steel with stainless steel fasteners

C. Rail Mounts: Full enclosure length rack angles shall be installed and have ANSI/EIA RS-310-C mounting standards with 10-32 tapped mounting holes in each enclosure

D. Shelf: Provide a shelf or other suitable mounting plate for all non rack mountable equipment

E. Painting: In addition to galvanizing or priming coat, all inside and outside surfaces of trim and doors shall be given a factory finish coat of paint.

F. Grounding:

1. Comply with Section 28 05 26.
2. Provide cabinets and enclosures with provision for cabinet grounding without penetrating exterior wall of the enclosure.

2.2 SLIDE OUT RACKS

A. Provide slide out 19” racks to provide rear access to wiring and components. Custom build unistrut support to accommodate slide out rack. Provide the following or approved equal from other manufacturers.

1. Middle Atlantic Products……..SRS Series

B. Provide key-locking latches for doors.

2.3 FREE-STANDING EQUIPMENT CABINETS, ENCLOSURES OR RACKS

A. Provide free standing enclosures/racks. Racks in Security Electronics Room need not be fully enclosed or lockable. Provide the following or approved equal from other manufacturers:

1. Hoffman…….…….Proline Series

B. Modular free standing equipment racks, overall size shall be 78x23x23 inches.

C. Provide modular enclosure components including, but not limited to, the following:

1. Solid lockable front and rear solid doors, all keyed alike.
2. Solid sides on all enclosure sides not directly joined to another enclosure.
3. Rack joining kits.
4. Cover and fan.
5. Filtered air inlet.
6. Keyboard slide tray for each keyboard.
7. Base for each enclosure with wire management provisions.

2.4 WALL-MOUNTED EQUIPMENT CABINETS OR ENCLOSURES

A. Provide wall-mounted cabinets/enclosures from the following or approved equal from other manufacturers:
   1. Hoffman…….Concept Wall-Mount Series

B. Provide removable doors.

C. Provide removable internal mounting panel for component installation.

D. Provide handle operated, key-locking latches for doors.

E. Provide multiple doors where required. Individual door width shall be no greater than 24 inches.

2.5 WALL-MOUNTED EQUIPMENT RACKS

A. Provide wall-mounted, double-hinged racks. Racks in Security Electronics Room need not be fully enclosed or lockable. Provide the following or approved equal from other manufacturers:
   1. Hoffman…….Industrial E-DH Series

B. Provide key-locking latches for doors.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mounting: Mount cabinets at a uniform height, nominally 6 feet to the top of the enclosure above finished floor, except as otherwise noted or physically not practical. Mount cabinets with fronts straight and plumb.

B. Bracing: Brace or anchor all free-standing/wall-mounted cabinets using Uni-strut or other approved method to building structure.

C. Flush Cabinets: Set flush cabinets in finished spaces flush with adjacent walls. Mount cabinets with fronts straight and plumb.

D. Painting: Touch up all welds, scrapes and other mars in the enclosure finish with a rust inhibiting paint.

E. Front Access: Locate with minimum of 36 inches clear space in front of each cabinet or rack.

F. Other Access: Provide minimum 36 inches clear space to each side of enclosure which requires access for inspection or service.

END OF SECTION

SECTION 28 09 00

ELECTRONIC COMPONENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes

1. Door/Gate Monitoring and Control
2. Power Supplies (24 VDC, UPS)
3. Terminal Blocks, Fuses, and Snubbers
4. Relays
5. Security Screws
6. Tone Generators
7. Call Made Light
8. Intercom/Pedestal
9. Connectors
10. Loop Detectors
11. Intercom/Camera/Card Reader Pedestal
12. Site Vehicle Gate Intercom

B. Related Sections:

1. 28 05 00 Common Work Results for Electronic Safety and Security
2. 28 05 13 Conductors and Cables
3. 28 05 14 Raceways and Boxes
4. 28 05 26 System Signal Grounding
5. 28 05 27 Cabinets, Enclosures and Racks
6. 28 13 00 Access Control System
7. 28 15 00 Intercom System
8. 28 23 00 Video Surveillance (CCTV) System
9. 28 26 00 Duress Alarm System
10. 28 41 33 MATV System
11. 28 46 19 PLC Integrated Control System
12. 28 46 19 Integrated Sequences of Operation

1.3 SYSTEM DESCRIPTION

A. Door/Gate Position Alarm Monitoring

1. Provide low voltage power to door/gate position and latch monitoring switches as indicated on the Drawings. All door position and bolt monitoring switches at each door are to be connected in series such that an open at any one of the switch contacts shall break the circuit to the control electronics and provide an unsecured door indication on the designated operator interface. Losing the indicating signal power by cutting the circuit (circuit failure) shall also initiate an unsecured door.

B. Door/Gate Remote Control

1. Provide remotely controlled operating power to all electric locks, deadbolt locks, electro-mechanical locks, electric deadbolts and door/gate operating devices as indicated on the Drawings.

C. Power Supplies

Provide power supplies as required for each system.

Low voltage systems shall operate on 24 VDC or 24 VAC or as determined by each section. Size all power supplies to maintain Class 2 ratings and operation of each system at 150% of the maximum loaded condition.

Unless otherwise indicated, 24 volt door hardware including locks, strikes, and latches shall be supplied by external power supplies with over-voltage and short circuit protection.

Acceptable products: Power One, Lamda, or approved equal from other manufacturers.

D. Uninterruptible Power Supplies (UPS)

1. Provide UPS back up for all Security Electronics, and computer CPU's where shown on the drawings.
2. Size the security equipment UPS with sufficient capacity to support and maintain all added security equipment and devices for a minimum of 20 minutes after the loss of power. Provide (1) UPS per group of racks in the Security Electronics Room.
3. Submit UPS power calculations indicating power consumption by each major equipment component.

E. Terminal blocks, Fuses and Snubbers

1. Provide DIN mounted terminal blocks for field and miscellaneous wiring.
2. Provide fused terminal blocks for power distribution circuit protection.
3. Provide circuit snubbers at all electric strike door locks for EMF protection.

F. Relays

1. Provide relays for use as interposing relays, timer relays, audio relay, one shots, or other applications as shown on plans.
2. Provide EMF circuit protection diode across all relay coils.

G. Security Screws:

1. Submit various types of security screws for approval.
2. Screws shall be suitable for outdoor locations.

H. Tone Generators

1. Provide 24 VDC solid state piezoelectric alarms.

2. Provide one tone generator for each tone or a multi-tone unit. Provide a tone generator for each tone required at each control panel Refer to the Software Development Section for tone types.

I. Call Made Light

1. Provide an amber light at each intercom pedestal which will illuminate when the loop detector is activated.

J. Intercom Pedestal

1. Provide a pedestal for the card reader and intercom as shown on the drawings.

K. Provide all necessary interconnecting wiring and terminations including, but not limited to, junction boxes, terminal strips, lead wires, internal contacts, connectors, etc., from new or existing terminations to the new terminations in the control electronics cabinets.

1.4 SUBMITTALS

A. Comply with Section 28 05 00, General Requirements.

B. Calculations

1. DC power supply sizing.
2. AC power supply sizing.
3. UPS system load and battery sizing.

C. UPS installation drawings: Show UPS size and physical mounting. Design and show power source, and branch circuit and load wiring to/from UPS units.

1.5 QUALITY ASSURANCE

A. Comply with Section 28 05 00, General Requirements.

1.6 EXTRA MATERIALS

A. Deliver the following spare parts:

1.	DC power supply	1 each size used.
2.	AC power supply	1 each size used.
3.	Relays	5 each type used.
4.	Tone Generators	5 each type used.

PART 2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS

A. Provide equipment and components including but not limited to the following or approved equal from other manufactures. All products shall have the features described herein. The materials listed below establish the minimum quality and standards that are to be met:

1.	Power Supplies	Altronix, Pelco, Rauland, IDEC. Lambda
2.	Uninterruptible Power Supplies	APC, Best, TOPAZ, Exide
3.	Electrical Relays	IDEC RU Series

4. Audio Relays	IDEC RY22S Series
5. Fuses	Phoenix, Entrelec
6. Snubbers	Square D, Rifa
7. Terminal Blocks	Phoenix, Entrelec
8. Tone Generators	Floyd Bell (Columbus, OH)
9. Call Made	Industrial Traffic Solutions
10. Pedestal	Talk-A-Phone ETP-PM, Custom

2.2 POWER SUPPLIES

A. DC and AC Power Supplies

1. Power supply outputs to integrated circuit devices shall be regulated to within +/- one percent of the rated voltage output
2. Size as required for each location with a capacity of 150 percent of the intended maximum load.
3. Class 2 power supplies shall be power limited to 100 watts with over-voltage and short circuit protection.
4. Where required provide power supply with battery backup. The power supply shall include battery-charging circuit, power loss switching circuit, low battery, trouble and power loss output contact. Size battery to accommodate calculated load for the specified time period.

2.3 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. Provide solid state inverter/charger and static bypass switch with less than 1/4 cycle, static transfer time, and frequency stability of 60 Hz + 1 Hz, voltage regulation of +8%, total harmonic distortion less than 5% and minimum output capacity and voltage as indicated in the drawings.

B. Provide sealed lead/acid type batteries.

2.4 ELECTRICAL RELAYS

A. Rate relays appropriate for the application or as shown on plans.

B. Provide relay sockets for ease of replacement.

C. Provide mounting hardware (i.e. bracket, DIN rail, etc.) UON.

2.5 AUDIO RELAYS

A. The audio switching relays shall connect intercom stations to intercom amplifiers.

B. Relay switch contacts shall be DTDT bifurcated gold plated contacts, rated for 2 amperes inductive and operate on 24 volts DC.

C. The relays shall be rated for at least 1 million operations.

D. The relays shall be removable socket mounted on DIN rail. All field terminations shall be landed on screw terminals rated to accommodate the required field wires.

E. Provide mounting hardware (i.e. bracket for rack mount, DIN rail, etc.) UON.

2.6 TONE GENERATORS

A. Solid State Piezoelectric

B. Screw or quick connect terminals.

2.7 CALL MADE LIGHTS

A. Provide waterproof polycarbonate housing

B. LED light source.

C. View angle shall not be less than 30 degrees.

D. Operating temperature shall be between 0 deg F to 165 deg F.

2.8 SOURCE QUALITY CONTROL

A. Comply with Section 28 05 00, General Requirements.

B. Provide components as required for Shop Testing and Demonstration

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Section 28 05 00, General Requirements.

B. Comply with manufacturer's recommendations, procedures, and standards for each product.

C. All Class-1 wiring, and their conduits shall only be routed to the designated Class-1 gutter or duct. All Class-2 wiring, unless otherwise noted, and their conduits shall only be routed to the designated Class-2 gutter or duct.

D. Provide sufficient quantity of power supplies of CEC Article 725, Class 2 capacity, to power the associated equipment. Furnish power supplies with over voltage and short circuit protection.

E. Mount individual components to removable rear panels in wall-mounted cabinets using DIN rails, snap track or stand off-mounted PC boards, or properly sized mounting hardware.

F. Fuses: Provide over-current protection for control relay outputs and associated wiring.

3.2 WIRE AND CABLE INSTALLATION:

A. Comply with Section 28 05 13.

3.3 WIRE TERMINATION, DRESSING, AND IDENTIFICATION:

A. Comply with Section 28 05 13 and Section 28 05 00.

3.4 FIELD QUALITY CONTROL

A. Comply with Section 28 05 00.

3.5 TRAINING

A. Comply with Section 28 05 00.

END OF SECTION

SECTION 28 13 00

ACCESS CONTROL SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access Control Server.
2. Access Control System.
3. Readers and Cards.
4. Door Position Sensors (DPS).
5. Power Supplies.

B. Related Sections:

1. 28 05 00 Common Work Results for Electronic Safety and Security
2. 28 05 13 Conductors and Cables
3. 28 05 14 Raceways and Boxes
4. 28 05 26 System Signal Grounding
5. 28 05 27 Cabinets, Enclosures and Racks
6. 28 09 00 Electronic Components
7. 28 15 00 Intercom System
8. 28 23 00 Video Surveillance (CCTV) System

1.2 SYSTEM DESCRIPTION

A. Access Control System:

1. The access control system will restrict access to controlled areas of the facility, notably administration areas and other support areas to persons with authorized photo ID key cards. Devices including proximity card readers at selective building entrances and exits and internal doors are to maintain separation of public, administrative, and security staff and to provide authorized access by area based on staff's security levels and classification. Cameras will be integrated to record unauthorized entry where applicable.
2. System administrative programming functions including the addition and removal of employee cards, time schedules, activity reports, etc. will be restricted to password protected access and specific computer locations. Multiple levels of programming access and programming locations will be provided based on areas of responsibility.
3. The Access Control System will typically be stand-alone and limited to the Administrative areas of the facility. Some doors, however, will require remote control by the PLC as well as local control through a card reader. In these cases, the Access Control System will provide input signals to the PLC to allow such doors to be opened or unlocked.
4. Photo ID key cards will be created and enrolled through a dedicated computer station with photo badging software, photo ID camera, printer, and card reader.

B. Door/Gate Position Status and Alarms:

1. Provide low voltage power to the various switches which combine to indicate the secure or nonsecure status of position monitored doors/gates (i.e., hinge position, latch position, bolt position, limiting switches, etc.).
2. Provide door/gate position and latch monitoring as indicated on the Drawings. If the DPS or latch monitor becomes unsecured, electronically indicate door status and/or alarm at the HMI Control Station at Central Control. Wire door position switches (DPS) and all other alarm detection devices to, and monitor them with, system inputs at their designated access control panels.
3. All door position/bolt monitoring switches in a hardware group shall be connected in series with each others so that an open at any one of the switch contacts shall break the 24VDC circuit to the monitoring electronics and provide a real time unsecured door status and/or alarm indication on the designated Access Control computers. Losing the indicating signal power by cutting the circuit (circuit failure) shall indicate an unsecured door and/or initiate a door alarm.

C. User Programming Functions

1. The system operation shall be completely programmable by the Owner for service and maintenance. Programming shall be possible from the Access Control System Server, Owner provided workstations, or a stand-alone computer with the proper access codes. Database partitioning on a single server will be possible.

D. Door Operation – General

1. For card reader locations, presenting a valid card across the proximity card reader shall allow access through the door for a programmable time initially set for four seconds and then relock.
2. Upon valid access, the proximity card reader shall alarm shunt to signal authorized access through the door. The alarm shunt shall be a programmable time initially set for thirty seconds.
3. When the door closes the lock shall automatically relock.
4. Locks shall unlock and remain unlocked when the unlock input signal is active.
5. If desired, selective access controlled doors shall be capable of remote release from The Access Control Server and Owner provided Workstations.
6. Selective electrified doors in egress pathways shall unlock and remain unlocked during a fire alarm. Coordinate and obtain a signal from the fire alarm contractor.

1.3 SUBMITTALS

A. Comply with Section 28 05 00.

B. Shop Drawings: Submit manufacturer’s wiring schematics integrated with all related security control and monitoring functions for each door/lock position hardware and other electric hardware device showing all terminal and connector pin assignments.

1.4 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

B. CEC Compliance: Comply with Article 725 (Class 2 Power-limited Circuits).

1.5 COORDINATION

A. Obtain hardware information and coordinate all technical requirements, interfaces, installation, and testing with the door/gate hardware suppliers.

B. Coordinate all door frame/jamb device rough-in, mounting, and wiring requirements with door frame Supplier.

C. Coordinate with the Owner for all programmable system functions and features using matrix forms to gather user's inputs. Make all necessary program changes at no additional cost prior to final acceptance.

1.6 EXTRA MATERIALS

A. Deliver the following spare parts to the Owner at a location to be designated:
   1. (1) card readers.
   2. (1) door position switches.
   3. (1) of each type of system modules used (single RIM, ISC, ICM, OCM).
   4. (1) power supplies.
   5. (2) of each type of relays.
   6. (2) of each type of fuses and fused terminals.
   7. (100) proximity smart cards.

B. Number in parenthesis denotes quantity required.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Firms regularly engaged in the design and manufacture of Access Control and Alarm Monitoring System's components and accessories, of types, sizes, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. The below equipment and components including, but not limited to, the following materials shall be used, or approved equal:
   1. Access Control Programming Laptop……..Hewlett Packard, Dell, IBM
   2. Access Control Software…….. Lenel
   3. Intelligent System Controller (ISC)…….. Lenel LNL-500
   4. Input Control Module (ICM)……..... Lenel LNL-1100 U
   5. Output Control Module (OCM)……. Lenel LNL-1200 U
   6. Single Reader Interface Module (SRIM)..... Lenel LNL-1300 U
   7. Dual Reader Interface Module (DRIM)…….Lenel LNL-1320 U
   8. Field Hardware Power Supplies…….. Lenel
   9. Star Configuration Splitters……. Lenel LNL-8000
   10. Proximity Card Reader…….. HID iClass
   11. Proximity Card Reader (mullion mount)…… HID RP15 multiCLASS
   12. Photo ID Proximity Smart Card…….…….. HID iClass

13. Door Position Sensor……..……. Sentrol 1078W
14. Photo Badging Station……Lenel
15. Photo Badging Printer…….. Magic Card

2.2 SYSTEM OVERVIEW

A. The software package shall be used in conjunction with the multiNODE-2100 range of intelligent controllers to provide an integrated security management system for access control and alarm monitoring.

B. The software shall be used with Windows 2000® or Windows XP® operating system platforms or optionally, via Internet Explorer, on the Internet or an Intranet. The system will provide a Graphical User Interface that minimizes training needs for inexperienced users.

C. The Microsoft SQL Server 2000® system database shall provide efficient system management and extensive reporting capabilities supporting an unrestricted number of client connections. The system shall have the capability to easily interface with other systems and packages as it adopts Industry Standard solutions.

D. Video imaging and Visitor management shall be included as standard. By fully integrating these features, the software shall provide an extremely easy way to customize access control cards by printing an identity badge directly onto the card. The badge design and image capture capabilities combined with the latest technology dye sublimation card printers shall allow the production of an ID badge pass for each card holder or visitor at the time of registration.

E. An unrestricted number of additional clients can be installed to suit your system connectivity requirements using Windows 2000 Server networking capability. This shall provide the means for multiple operators to simultaneously administer the system from convenient locations connected via a local area network (LAN) or across a wide area network (WAN) as required.

F. Relay output modules shall provide contact closures for controlling doors and gates and interfacing to CCTV alarm interfaces and for providing all required logic control functions described under all related sections. Provide relay output modules of sufficient rating, capacity, and quantity to control all required functions.

G. Provide building graphic submaps with control button icons for all required door control functions and monitoring displays. Program and organize submaps for easy and quick access from any user screens or main building map. No more than a couple of mouse clicks will be required to pull up any of the door control screens. Provide a minimum of ten (10) preprogrammed mode screens for emergency operations.

2.3 ACCESS CONTROL SERVER / CCTV PROGRAMMING LAPTOP

A. See Section 28 23 00 for laptop requirements.

2.4 SYSTEM SPECIFICATION

A. Software
   1. Base Software: 1
   2. Additional Clients: Unrestricted
   3. Multi - Company Operation: 64

4. Site Codes: 8
5. Readers per System: Unrestricted
6. Holiday Dates: 32
7. Holiday Types: 4
8. Time Code Intervals: 512
9. Time Codes (2 intervals each): 254
10. Intervals per Time Code: 10
11. Hardwired Chains per Client with Chains: 4
12. Hardwired Chains per Comm. Port Client: 16
13. LAN Chains per LAN Port Client: 256
14. Panels per Chain: 32
15. Global In/Out Antipassback Hardwired chains: per Chain
16. Global In/Out Antipassback LAN chains: System wide

B. Provide the following Software Modules
1. Video Badging and Visitor Management
2. Magnetic Stripe Encoding
3. Smart card Encoding
4. Guard Patrols
5. Muster / Roll call
6. Card Data Import Interface
7. Card Data Export Interface
8. CCTV Switcher and Digital Video Recorder Interface
9. Intercom Control Interface
10. Alarm Panel Interface
11. Dial-Out Alarms Reporting
12. Dial-In Alarms Reporting
13. E-Mail Alarms Reporting

C. System Hardware
1. Readers per multiNODE-2100: 1 to 16
2. Monitor Points per multiNODE-2100: 2 to 96
3. Auxiliary Outputs per multiNODE-2100: 1 to 32

D. MultiNODE-2100 Operations
1. MultiNODE-2100(20K): 20,000 cards/15,000 stored transactions
2. Timed Commands: 256
3. Conditional Commands: 99

2.5 INTELLIGENT SYSTEM CONTROLLER (ISC)

B. An Intelligent System Controller (ISC) shall link the system Software to all other field hardware components (Card Readers and Input Control Modules). The ISC shall provide full distributed processing of access control & alarm monitoring operations. Access levels, hardware configurations, and programmed alarm outputs assigned at the administration Owner provided workstations shall be downloaded to the ISC, which shall store this information and function using its high speed, local 32-bit microprocessor. All access granted/denied decisions must be made at the ISC to provide fast responses to card reader transactions. A fully configured ISC with 32 card readers shall require less than one-half (0.5) seconds to grant access to an authorized cardholder or deny access to an unauthorized cardholder.

C. The system Access Control Field Hardware shall provide a network based ISC. The network ISC shall be a 10 MB Ethernet based panel that has the capability to reside on a local area network (LAN) or wide area network (WAN) without connectivity to a PC serial port. The ISC shall utilize an off the shelf network connectivity device to deliver this functionality. Network based Intelligent System Controllers shall be able to communicate back with the database server through industry standard switches and routers and shall not have to be on the same subnet.

D. The ISC is required to continue to function normally (stand-alone) in the event that it loses communication with the system software. While in this off-line state, the ISC is required to make access granted/denied decisions and maintain a log of the events that have occurred. Events shall be stored in local memory, and then uploaded automatically to the system database after communication has been restored.

E. The ISC must contain the following features:
   1. UL 294, ULC, and CE Certified
   2. Support for Host Communications Speed of 38,400 bps
   3. Support for Direct Connect, Remote Dial Up, or Local Area Network (LAN) Connection
   4. Support for up to 512 KB of On-Board Memory
   5. LAN Support shall utilize RJ45 (10/100baseT) Ethernet Interface or Token Ring 4 MB connectivity
   6. Flash Memory for real time program updates and overall host communications
   7. Support for Two 2 wire downstream ports or one 4 wire downstream ports
   8. Memory storage of up to 12,500 cardholders
   9. Base ISC with standard memory download from the system shall require no more than ten (10) minutes
   10. Downstream ports shall be for connecting card readers and data gathering panels via RS-485 multi-drop wiring configuration
   11. Support for up to 16 devices consisting of Reader Interface Modules, Input Control Modules, and Output Control Modules in any combination desired with a maximum of 16 ICMs per ISC
   12. Support of multiple card technologies
   13. Supervised Communications between ISC and system Software
   14. Multi – drop support for up to eight ISCs per system communications port
   15. Support of up to eight card formats and facility codes

16. RS-485 Full Duplex, UL 1076 Grade AA communication channel to the system head-end
17. Integration to other manufacturer's card readers
18. Uninterruptible Power Supply (UPS) with battery backup
19. 32-bit Microprocessor
20. An ISC downstream serial port shall multi-drop 16 access control field hardware devices using an RS-485 UL 1076 Grade A communication format allowing a distance of 4,000 feet using Belden 9842 cable or equivalent
21. 12 VAC or 12 VDC input power
22. Issue Code Support for both Magnetic and Wiegand Card Formats
23. Individual Shunt Times (ADA Requirement)
24. Up to Nine Digit PIN Codes
25. Downstream serial RS-232 device support
26. Status LEDs for normal component and communication status

2.6 INPUT CONTROL MODULE (ICM)

A. The Input Control Module shall monitor all system alarm inputs.
   1. Grade AA Inputs
      a. The Input Control Module must provide up to 16 UL 1076 Grade AA alarm input zones to monitor and report line fault conditions, alarm conditions, power faults and tampers. When an alarm input is activated, the associated alarm condition shall be reported to the ISC and subsequently to a system alarm monitoring Owner provided workstations.
      b. Status LEDs shall provide information about the sixteen alarm zone inputs, cabinet tamper, and power fault. For each status LED, a slow flash shall imply a "No Alarm" condition, a fast flash shall indicate an "Alarm Condition", and a steady LED shall indicate a "Circuit Fault" (open, short, ground).

B. The Input Control Modules must also be able to operate independently and in conjunction with Output Control Modules (OCM), which will send an output signal to a corresponding output device upon alarm input activation. Once an alarm has been received, the Input Control Module shall activate any or all alarm outputs within the Output Control Module. The Output Control Module shall provide 16 Form C outputs rated at 5A @ 30VDC. Upon an alarm input from the Input Control Module, the Output Control Module shall transmit an activating signal to a corresponding output device.

C. Up to 16 ICMs shall be connected to an available ISC using RS-485 cabling. Diagnostic LEDs shall indicate ISC communication, input zone scanning, and Input Control Module heartbeat.

D. The ICM must contain the following features:
   1. UL 294, ULC, and CE Certified
   2. Alarm contact status scanning at up to 180 times per second for each zone
   3. Eight configuration DIP switches to assign unit addresses and communications speed
   4. A low power CMOS microprocessor
   5. Filtered data for noise rejection to prevent false alarms

6. Up to 16 Grade B, A, or AA Supervised Inputs in any Combination
7. 12 VAC or 12 VDC Input Power
8. 2 Form C Contacts for load switching
9. 2 dedicated inputs for tamper and power status

2.7 OUTPUT CONTROL MODULE (OCM)

A. The Output Control Module shall incorporate 16 Output Relays that are capable of controlling a corresponding output device upon any input activation or on command from the system.

B. Output relays shall be capable of responding to:
   1. Input alarms from a within the same ISC.
   2. Commands from a System Operator.
   3. Time zone control commands for automatic operation.

C. Output relays shall be capable of:
   1. Pulsing for a predetermined duration. Duration shall be programmable for each relay individually.
   2. "Following" any input point an ICM attached to the same ISC (on with alarm, off when clear, or as required).
   3. Responding on command from the System Operator to pulse, command on, command off, or reset to normal state.

D. Each OCM shall provide 16 Form C relays rated at 5A @ 30 VDC. The OCM shall control the relays by digital communication. Upon an input from the ICM or command from the System Operator, the ICM shall transmit an activating signal to a corresponding relay. The OCM shall be UL 294 and CE Certified.

2.8 SINGLE READER INTERFACE MODULE (SRIM)

A. The Single Reader Interface Module shall provide an interface between the ISC and card readers. The Single Reader Interface Module must operate with any card reader that produces a standard Wiegand (Data 1 / Data 0 or Clock and Data) communication output. As with other card reader types listed above, a single ISC shall be able to multi-drop as many as 16 Single Reader Interface Modules.

B. Up to sixteen (16) SRIs shall be connected to each port on the ISC. The SRI shall monitor on a per door basis, door position, exit push button, and two auxiliary alarm inputs. It shall also control the electric strike and provide two auxiliary relay outputs.

C. The SRI shall support up to eight unique card formats.

D. The SRI shall support an integrated card reader/keypad and shall support three access modes upon loss of communication with the ISC; locked, unlocked, and facility code.

E. The SRI shall offer the following features:
   1. UL 294, ULC, and CE Certified
   2. 12VDC Power
   3. Support for up to eight Magnetic and Wiegand Card formats

4. Support for Clock/Data and Data1/Data0 Wiegand Communications
5. 2 Programmable Inputs and 2 Programmable Relay Outputs Per Reader

2.9 FIELD HARDWARE POWER SUPPLIES

A. Power Supplies for field hardware shall be designed specifically for the system equipment installed. These power supplies shall be regulated, isolated versions for the ISC, ICM, Card Readers and other equipment. Each version shall be available in UPS with battery back-up and non-UPS models. All power supplies shall be housed in locked enclosures that also allow mounting space for the ISC, ICM, SRI, DRI or other device/panel required.

2.10 STAR CONFIGURATION SPLITTER

A. The system shall support a star configuration splitter that shall expand a single ISC communications port into eight 2 wire or four 4 wire RS-485 communications ports to be used in a star configuration. All outgoing data shall be broadcast on all eight ports.

2.11 PROXIMITY CARD READER

A. The card reader reads the encoded data from the access card and transmits the data back to the host panel, giving an audible and visual indication of a properly read card.

2.12 PROXIMITY CARDS

A. The proximity card shall be an RF programmable smart card with customer-specified ID numbers.

2.13 PHOTO BADGING STATION

A. The photo badging station shall be provided with all necessary components to print photo ID proximity cards, including but not limited to the following:
   1. PC
   2. Camera
   3. Photo Badging Printer
   4. Card Reader

B. Provide at a location coordinated with the Owner. Connect to the Access Control system through facility network.

2.14 SOURCE QUALITY CONTROL

A. Comply with Section 28 05 00.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Section 28 05 00.

B. Comply with manufacturer's recommendations, procedures and standards for the assembly and operation of the Access Control system. Wire to wire-nut leads, terminal strips, connector plugs, or other termination methods equally acceptable to the Owner.

C. All door hardware field conductors are classified as Class-1 wiring, and their conduits shall only be routed to the designated Class-1 gutter. All other field device conductors under other Sections are classified as Class-2 wiring, unless otherwise noted, and their conduits shall only be routed to the designated Class-2 gutter.

D. Provide sufficient quantity of power supplies of CEC, Class 2 capacity, to power all door monitoring switches, and dry contact interfaces between relay output modules and their associated equipment. Furnish power supplies with over voltage and short circuit protection.

E. Install and adjust components permanently with proper alignment, sufficient ventilation and cooling, and adequate access for maintenance. Layout cabinet with consideration given to equipment placement so that card access controller and modules are not place near or immediately over power supplies. Data equipment shall be located away from interference sources. Heavy and bulky equipment shall be located at the bottom of the cabinet. Terminals shall be located at a height that shall be convenient for maintenance personnel to use.

F. Mount individual components to removable rear panels in access control cabinets or field interface panels using DIN rails, snap track or stand off-mounted PC boards, or properly sized mounting hardware.

G. Provide relay output modules and interposing relays for gate control of sufficient rating, capacity, and quantity to control all required functions. Relay output modules shall provide contact closures for controlling electric door hardware.

H. Provide standby batteries with minimum 24 hour back-up and battery chargers for the card access main controller, the card access interface modules, and the field interface panels. The card access host computer/CPU and workstation terminal shall be powered by the security UPS system.

3.2 TESTING PROCEDURES

A. After installation of the Access Control system's equipment, and prior to point-by-point performance testing, functionally test all card readers, locks, strikes, door monitoring switches and other hardware interconnections, and all interfaces to other systems, including video surveillance alarm functions. Fully coordinate with door hardware suppliers to adjust all magnetic switches, limit switches and all other door hardware components for proper operation.

1. Initial Performance Testing:

   a. Perform a thorough, device-by-device operational test including system integration to all related systems and interfaces. Demonstrate system operations and performance in accordance with Owner's requirements and all previous Owner's review comments. Demonstrate complete functionality of all controls, door alarms, and other system functions.

   b. If test results are not in compliance with requirements, make necessary changes, corrections, repairs or adjustments at no additional cost and arrange for another point-by-point performance test. This process shall continue until the systems are acceptable to the Owner.

2. Performance Testing:

   a. Comply with Section 28 05 00.

3. Continuous Operational/Functional Testing:
   a. Comply with Section 28 05 00.

3.3 TRAINING

A. Provide training in accordance with Section 28 05 00.

END OF SECTION

SECTION 28 15 00

INTERCOM SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Intercom Stations
2. Paging Speakers
3. Master Intercom Stations
4. Intercom Server
5. Power Supplies

B. Related Sections:

1. 28 05 00 Common Work Results for Electronic Safety and Security
2. 28 05 13 Conductors and Cables
3. 28 05 14 Raceways and Boxes
4. 28 05 26 System Signal Grounding
5. 28 05 27 Cabinets, Enclosures and Racks
6. 28 09 00 Electronic Components
7. 28 46 13 PLC Integrated Sequences of Operation
8. 28 46 19 PLC Integrated Control System

1.3 INTEGRATED SEQUENCES OF OPERATION SYSTEM DESCRIPTION

A. Scope of Work Summary:

1. The facility will have a detention grade intercom system integrated with the HMI Control Station to communicate with each of the controlled doors in the secure area and at the individual holding cells. The HMI Control Station operator will have control of intercom selection and monitoring throughout the facility.
2. A zoned Paging system will be provided in detention areas throughout the facility as necessary and controlled via the HMI. Speakers will be placed strategically to provide a uniform sound coverage.
3. See Section 28 46 13 for Integrated Sequences of Operation. Both the drawings and specifications must be used concurrently for a complete understanding of the project.

1.4 SUBMITTALS

A. Comply with Section 28 05 00.

1.5 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

1.6 COORDINATION

A. Coordinate with the Owner for all programmable system functions and features using matrix forms to gather user's inputs. Make all necessary program changes at no additional cost prior to final acceptance.

1.7 EXTRA MATERIALS

A. Deliver the following spare parts to the Owner at a location to be designated (quantities to be determined):
   1. (2) Intercom Call Station
   2. (1) Paging Speaker
   3. (1) Paging Amplifier

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide equipment and components including, but not limited to, the following or approved equal from other approved manufacturers. The Contractor will be responsible for the design and operability of all system components of the final approved system. If any of the below components are no longer in production by the manufacturer, replace with an equivalent or better component. If any of the components cannot be found or are in question, provide and submit for approval a component of equal or better quality.
   1. Paging Amplifier……Bogen C100
   2. Paging Amplifier Rack mt Kit……Bogen RPK50
   3. Paging Speaker……Quam 8C10PAOT/TBLUB
   4. Bi-Directional Surface Mount Round Baffle……...Rauland Borg 3904-8
   5. Outdoor Loud Paging Speaker (with Backbox/Baffle)……....Quam VP-2
   6. Paging Zone Expander……..…….Harding PZE-110-1
   7. Intercom Digital Controller……Harding DCC-S1M4-40440-E100-MDIP
   8. Intercom Digital Expander……..Harding DCE-S100-4040-E1
   9. Terminal Boards……..Harding QCB-120-1
   10. Communication Cables……CBL-STN-10-RR
   11. MTA Connectors……MTA-104-25
   12. Administrative Software……..DXL-SOF-ADM
   13. Master Intercom Station…….…….Harding IMS-640-1
   14. Desktop Push-to-talk Speaker/Mic……...Harding DSM-140
   15. Intercom Station……..…….……Harding ICE-400
   16. Intercom Duress Station……..Harding ICS-420 Series
   17. AM/FM/CD Player…….……...Clarion CZ-302
   18. 8-Port Network Switch…….……..…….Cisco SG 100D-08P

19. Rack Fan……Harding C2T1923F10BK1

2.2 INTERCOM DURESS STATION

A. The Intercom Duress Station shall be custom ordered from the manufacturer to include a red mushroom button switch instead of the standard recessed call button switch. The red mushroom shall activate a duress indication on the HMI with a priority call request (goes to top of intercom call queue) and unique tone.

2.3 SOURCE QUALITY CONTROL

A. Comply with Section 28 05 00, General Requirements Shop Test and Demonstration.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Section 28 05 00, General Requirements.

B. Comply with manufacturer's recommendations, procedures and standards for the installation and operation of the equipment.

C. All microphone and line level audio signals shall be shielded, balanced lines. Matching transformers and pads shall be provided as required to ensure balancing and proper levels. Normal line operating levels shall be 0 dBm.

D. Microphone, line and speaker levels shall be run in separate raceways and shall be separated from one another and from power cabling in racks and on terminal boards.

3.2 ADJUSTMENTS

A. After installation of the Intercommunication and Public Address Systems, and prior to performance testing, functionally test all system devices and other audio components, and all interfaces to other systems, including control panels. In addition, perform the following adjustments and measurements.

B. Make all intercom speaker tap and amplifier gain adjustments prior performance testing as follows:

1. Intercom Speaker Tap Adjustments: Select intercom taps for 75 dBA at 4 feet on-axis with power input equal to tap setting (for example, at 1/2-watt input).
2. System Amplifier Gain Adjustments: Adjust intercom amplifier gain controls in both the monitor and talk direction to provide unity gain (to produce the same level in the control room as the person talking at the intercom station, and vice versa) with speaker volume controls at mid-range. Adjust amplifiers for either unity gain, or for feedback stability, if unity gain cannot be achieved.

C. Once all volume levels have been accepted by the County, permanently mark or identify all adjustment settings on the amplifiers and accessories.

3.3 FIELD QUALITY CONTROL

A. Performance Measurements: Use a one-third-octave spectrum analyzer and pink-noise generator, or other test equipment pre-approved by the County, to measure system performance. Make the following audio performance measurements for the longest and the

shortest intercom runs, and for a minimum of three different intercom stations with the longest and shortest runs:

B. Signal-to-Noise Ratio: Minimum of 40 dB below standard signal levels from 32 Hz to 16 kHz on an “A” weighing scale.

C. Signal-to-Crosstalk Ratio: Minimum of 40 dB below standard signal levels when measured on any other intercom or audio line.

D. Signal-to-Transient Ratio: 30 dB or better, measured as the signal-to-noise during any transient caused by the operations of (a) any piece of equipment associated with that program path, or (b) any other electrical, lighting, ventilation equipment and etc.

E. Intercom Level Uniformity: Less than +/- 2 dB difference in dbA between any two intercom stations.

F. Testing: Comply with Section 28 05 00, General Requirements.

3.4 TRAINING

A. Provide training in accordance with Section 28 05 00.

END OF SECTION

SECTION 28 23 00

VIDEO SURVEILLANCE (CCTV) SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cameras, Lenses and Enclosures
   2. Programming Server
   3. Programmable Keyboard Controller
   4. Network Video Recording System
   5. Camera Power Supply

B. Related Sections:
   1. 28 05 00 Common Work Results for Electronic Safety and Security
   2. 28 05 13 Conductors and Cables
   3. 28 05 14 Raceways and Boxes
   4. 28 05 26 System Signal Grounding
   5. 28 05 27 Cabinets, Enclosures and Racks
   6. 28 09 00 Electronic Components
   7. 28 26 00 Duress Alarm System
   8. 28 46 13 Integrated Sequences of Operation
   9. 28 46 19 PLC Integrated Control System

1.3 REFERENCES

A. ANSI/EIA-170, Electrical Performance Standards - Monochrome Television Studio Facilities A (“RS-170”): Standards for picture quality.

B. ANSI/EIA-330, Electrical Performance Standards for Closed Circuit Television Camera 525/60 Interlaced 2:1 (“RS-330”): Standards for Picture quality.

1.4 SYSTEM DESCRIPTION

A. Scope of Work Summary:
   1. The facility will be provided with high resolution, low light level, color CCTV system to monitor, display, and record critical areas of the building as indicated on the drawings. A new NVR system will be provided. Monitors will be provided at the Central Control and each Housing Unit Control to display cameras via split screen and automatic sequencing. Specific camera call up and alarm event monitoring of cameras will be performed through the HMI Control Station at each control room.

2. All new cameras will be mounted in security enclosures and placed for viewing movement doors and critical areas. Both fixed and pan/tilt/zoom cameras will be used, and each camera will be pre-programmed with video tour and preset positions.
3. See Section 28 46 13 for Integrated Sequences of Operation. Both the drawings and specifications must be used concurrently for a complete understanding of the project.

B. System Components:

1. The system shall consist of, but not limited to, color cameras, camera enclosures, housing mounts, network switch, video encoders, power supplies, and all necessary interfacing components for a fully functional system.

C. Sequence of Operation:

1. Indoor Fixed Cameras: Provide low light, high resolution, color cameras with vari-focal, auto-iris lenses for general video surveillance coverage and continuous digital video recording. Cameras will have wide angle view to provide the intended coverage. The cameras and lenses will be installed in security smoked dome housings so that the direction of camera is concealed. Mounting types shall include ceiling, corner and wall as specified on the drawings.
2. Pan/Tilt/Zoom (PTZ) Cameras: Provide low light, high resolution, color cameras with pan, tilt, and zoom capabilities for general video surveillance coverage and continuous digital video recording. The cameras and lenses will be installed in security dome housings. Provide all necessary sun-shields, heaters, blowers and weatherproof accessories for a complete installation.
3. Alarm/Event Control: Perform camera call up by integrating with other security electronic systems described in the Specifications.

D. Monitoring and Display System

1. Color cameras mounted in security enclosures will be placed for viewing movement doors without line of sight from the control point and will be automatically displayed when the related door is selected.
2. Color cameras mounted in security enclosures will be placed for general surveillance in critical areas. Both fixed and pan/tilt/zoom cameras will be used.
3. Cameras will be displayed on control room monitors ergonomically placed for maximum view capability and operator attention.
4. Camera display functions will be programmable controlled by the programmable keyboard controller in conjunction with the CCTV switch.
5. For each camera, video tour and preset positions will be pre-programmed as required. Coordinate with the facility to obtain requirements.

E. Network Video Recording System

1. All cameras will be digitally recorded upon staff activation and stored for a minimum of 13 months. Recording will be configured at 15 frames per second, 720p, upon motion detection (estimated at 40% activity) and 1 frame per second, low resolution at all other times.
2. A DVD-RW drive with the network video recorder for extracting video from storage archive and transferring onto a removable media will also be provided. The NVR will be sized with 50% spare camera input capacity (not storage capacity). In addition, a RAID 6 configuration for the disc array storage with one (1) hot spare for every six (6) drives

will also be provided.

1.5 SUBMITTALS

A. Comply with Section 28 05 00.

B. Performance Measurements: Record and submit all performance measurements in a complete test report.

1.6 COORDINATION

A. Coordinate with the Owner exact mounting location of all cameras prior to installation.

B. Demonstrate to the Owner camera field of views using variable focal lens at each camera location prior to installation. Select and obtain approval of proper lens size or focal setting at each camera location to provide the required video coverage. If the desired view or coverage is unobtainable due to physical obstructions or limitation of lens, perform minor adjustment of the camera physical location at no additional cost to the Owner.

1.7 EXTRA MATERIALS

A. Deliver the following spare parts to the Owner at a location to be designated (quantities to be determined):

1. (2) Fixed Cameras
2. (1) PTZ Camera

1.8 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

B. CEC Compliance: Comply with applicable requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide video surveillance system equipment and components including, but not limited to, the following or approved equal:

B. Acceptable Products:

1. PTZ Camera…….……Bosch Autodome 7000 HD
2. Fixed Camera……..…….……Bosch Flexidome micro 5000 IP
3. Rack Mountable LCD and KVM….....SmartVM 19" KVM Drawer/ PS2 Switch
4. Video Distribution Amplifier……..……Bosch LTC 5234
5. Joystick/Keyboard……..…….…. ….Bosch KBD-Digital
6. Video Management System…….……Bosch VMS v5.0
7. Recording Storage……..Bosch Divar IP 7000
8. Client Workstation…….....Per Bosch VMS Requirements
9. Management Server……..Per Bosch VMS Requirements
10. VMR Server…..……..Per Bosch VMS Requirements

11. Mobile Video Server……..Per Bosch VMS Requirements
12. 22” LCD Monitor…….……..……..……...Bosch UML Series 22
13. Camera Power Supply……..…….……..Altronix ALTV-2416-CB, Bosch
14. PoE Network Switch……..……...……..Cisco

2.2 MONITORING STATION SOFTWARE

A. The product specified shall be a software program that provides the installation, administration, and operation of video surveillance systems using H.264 video compression technology via local networks. The software scans the network and displays all the available installed video server and decoder devices and network video recorders, including their IP addresses and additional properties, in a window tree display. Video from any of the installed devices may then be displayed by dragging the device symbol into a workspace software monitor window. Video may be displayed in full screen mode or 2x2 and 3x3 multiscreen formats.

B. Alarm Handling Capability

1. The VMS specified shall handle alarms generated from the alarm interfaces of the Bosch video servers that have been integrated into the network with the video management system. In addition, the VMS is capable of combining the alarms generated from the alarm interfaces of the video servers with AND, NAND, OR, or NOR internal gating functions of the software to create new triggers that cause the VMS software to react according to preprogrammed alarm scenarios. Internal and weekly timers may be programmed to determine exactly when alarms can be active.
2. The VMS shall accept input alarm triggers and then place them into an alarm stack to either be acknowledged or the input alarm may automatically trigger a series of system operations (scenarios).
3. Alarm trigger inputs to the VMS may be caused by any of the following conditions at the remote video servers:
    a. Contact input
    b. Motion detection
    c. Video signal loss

C. The VMS specified shall provide, but not be limited to, the following functions:

1. Search the local network for installed video servers (transmitters with connected cameras and receivers with connected monitors) and any installed network video recorders.
2. Treat the network as a digital matrix system by allowing cameras to be connected to monitors using a drag and drop function.
3. Display several simultaneous live picture connections from cameras in the network.
4. Provide a configuration tool that allows the creation of site maps with camera locations and monitor placement and also allows interactive operation including PTZ control.
5. Programming of alarm-triggered events.
6. Programming of automatic video recording to network connected video recorders.
7. Retrieve and playback the archived video from remote hard drives or Compact Flash memory of compatible devices or from network video recorders.

8. Provides a bidirectional audio function to allow communication between remote camera sites and main control location. Full and half duplex audio communication modes are selectable.

2.3 PROGRAMMING WORKSTATION

A. The workstation shall meet or exceed the following minimum requirements:
   1. Operating System – Windows 2000 Server with (5) client access licenses or better
   2. Processor – 3.0 GHz Dual Pentium Xeon Processor
   3. Memory – 2GB, DDR2 SDRAM FBD Memory, 533MHz, ECC
   4. Hard Drive - 250GB SATA 3.0Gb/s,7200 RPM with 8MB DataBurst Cache
   5. Communications – Integrated Gigabit Ethernet
   6. Graphics – 256MB PCIe x16 nVidia Quadro NVS 285, Dual VGA Capable
   7. Optical – 16X DVD+/-RW
   8. 3 PCI Expansion Slots
   9. SQL Server 2000 Standard Edition with (5) client access licenses or better
   10. (4) USB ports
   11. Parallel Printer Port
   12. 20” LCD Monitor
      a. 1600x1200 pixels resolution for sharp and brilliant images of text and graphics
      b. 8 ms response time enables crisp and clear images
      c. Contrast ratio of 600:1 delivers high color accuracy and uniformity
      d. Digital DVI-D and analog inputs

2.4 VIDEO SURGE SUPPRESSERS

A. Minimum surge protection of 100 amps.

B. Response time 5 nanoseconds or less.

C. 75 ohm input/output.

2.5 CAMERA POWER SUPPLY

A. Unit shall be a multiple 24VAC output power supply with sixteen individually protected circuit breakers.

B. Unit shall be equipped with board mounted slide switches allowing each unused output to be shut-off.

C. Unit shall have a minimum of 8 amp continuous current output.

D. Unit shall incorporate a green LED indicator for incoming AC power.

E. Unit shall be housed in a metal enclosure with vents for heat dissipation.

F. Unit shall be UL listed.

2.6 SOURCE QUALITY CONTROL

A. Comply with Section 28 05 00.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Section 28 05 00.

B. Comply with manufacturer's recommendations, procedures and standards for the assembly and operation of the CCTV cameras.

C. Use screw type terminals and crimped lugs for camera power cable terminations.

D. Use BNC connectors, sufficiently sized for each cable type, for all coaxial cable terminations.

E. Install all exterior camera enclosures, conduits, and fittings to meet NEMA-4X and IP66 rating.

F. Coordinate with signage, lighting fixtures, etc. to install all cameras as close to the indicated locations on plans as physically possible. Notify the Owner immediately upon discovering any potential interference that may obstruct the video pictures or reduce the video quality of the devices. Ensure that the minimum distance from any lighting fixture in front of a camera is four (4) feet.

G. Provide video surge protection on all non fiber optic outdoor cameras at the nearest point of entry into the building.

3.2 FIELD QUALITY CONTROL

A. After installation of the video surveillance system, and prior to performance testing, functionally test all cameras, video equipment, and other hardware interconnections, and all interfaces to other systems. In addition, conduct the following adjustments and measurements:

1. Field-of-View Testing: After camera and lens installation, and with CCTV monitoring equipment installed, demonstrate the field-of-view of each camera/lens combination to the Owner. Replace lens type and/or adjust camera positioning as needed to obtain the Owner’s desired field-of-view at no additional cost.

B. Performance Testing

1. Comply with Section 28 05 00, Performance Testing for:
    a. Initial Performance Testing
    b. Performance Testing.
        1) Demonstrate proper alignment, adjustment, and switching, sequencing, auto-positioning and system performance for all camera locations with all required sequences of operation under all operating modes. Demonstrate proper interface with all other security electronic systems.
    c. Continuous Operational/Functional Testing

3.3 TRAINING

A. Provide training in accordance with Section 28 05 00.

B. Provide qualified technicians certified by the product manufacturers to perform the training. Submit evidence of qualifications for Owner's approval prior to training.

END OF SECTION

SECTION 28 26 00

DURESS ALARM SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Duress Alarm Stations.

B. Related Sections:

1. 28 05 00 Common Work Results for Electronic Safety and Security
2. 28 05 13 Conductors and Cables
3. 28 05 14 Raceways and Boxes
4. 28 05 26 System Signal Grounding
5. 28 05 27 Cabinets, Enclosures and Racks
6. 28 09 00 Electronic Components
7. 28 23 00 Video Surveillance (CCTV) System
8. 28 46 13 Integrated Sequences of Operation
9. 28 46 19 PLC Integrated Control System

1.3 SYSTEM DESCRIPTION

A. Scope of Work Summary:

1. Duress buttons will be located at locations where there is threat potential, particularly at screening stations, transaction counters, inmate program/classrooms, interview rooms, exam rooms, control rooms (both Central Control and Housing Units), and other locations as necessary. Either wall or under desk/counter mounted stations will be provided depending on the application and furniture/equipment layout. When activated, a duress alarm will annunciate the location of the alarm at both HMI's at Central Control and the respective Housing Unit (if the duress station is located within the Housing Unit). Central Control or the Housing Unit can then dispatch proper response to the alarm as required.
2. A duress alarm within a control room will automatically activate a lockdown sequence for the control room. When a Housing Unit is under lockdown, the HMI within the control room will not function and all doors will automatically return to secure status. Central Control will be notified and given control of all functions within the Housing Unit. Only Central Control will be able to restore the Housing Unit and return control back to the station. If, however, Central Control enters into a lockdown sequence, all of the Housing Units will be notified, but will not be given control of the areas of control under Central Control. In order to restore Central Control back into normal operations, a reset switch will be provided in a concealed location within the PLC equipment rack in the Security Electronics Room.

3. See Section 28 46 19 for Integrated Sequences of Operation. Both the drawings and specifications must be used concurrently for a complete understanding of the project.

1.4 SUBMITTALS

A. Comply with Section 28 05 00.

1.5 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

1.6 EXTRA MATERIALS

A. Comply with Section 28 05 00.

B. Furnish the following spare parts to the Owner:

1. (1) Duress alarm stations of each kind.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide equipment and components including, but not limited to, the following or approved equal (where applicable) from other approved manufacturers. The Contractor will be responsible for the design and operability of all system components of the final approved system.

1. Duress Station, under-desk……..... Amseco Husk 20
2. Duress Station, wall-mounted…….. IDEC ABW410-R

2.2 SOURCE QUALITY CONTROL

A. Comply with Section 28 05 00.

B. Provide as required for Shop Test and Demonstration.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Section 28 05 00.

3.2 FIELD QUALITY CONTROL

A. Comply with Section 28 05 00.

3.3 TRAINING

A. Provide training in accordance with Section 28 05 00.

END OF SECTION

SECTION 28 31 00

FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers the fire alarm system as shown on the Drawings or as required to support the systems defined in these Specifications. The Work under this Section consists of furnishing materials and equipment, performing labor and services necessary for the installation of the fire alarm system required for the project.

B. Related Work Specified Elsewhere: Refer to all other Division 28 Specification sections and Drawings, and to the Specifications and Drawings under the General Construction Contract to ascertain the extent of Work included.

1.2 SUBMITTALS

A. Fire Alarm Product Data
   1. Submit technical information consisting of marked-up catalog sheets of each specified device inserted in a 3-ring binder in the same order as the devices appear in these Specifications. Mark the appropriate specification reference number in the upper right-hand corner of each catalog sheet. For devices that may not be specifically specified in these Specifications but are required to provide the system functions specified, include those catalog sheets and shop drawings at the end of the submittal binder.
   2. Provide California State Fire Marshal listing numbers for each piece of equipment submitted.
   3. Submit manufacturer’s certification that the submitted equipment will meet or exceed the site-specific system performance requirements.

B. Review of Bid Documents Drawings
   1. Contractor will be responsible for the design of the building fire alarm wiring systems, including voltage drop and battery calculations, based on the specified fire alarm equipment supplied. The fire alarm Contractor will be required to contact the Fire Alarm System manufacturer to obtain the specific design requirements for the specified system equipment.
   2. The County Representative will review the Contractors fire alarm wiring submittal. This review shall be focused on determining that the drawings have been prepared in the specified format, detector and device locations are consistent with the contract documents and for interface with other building systems connected to the fire alarm. The Contractor may begin installation of box, conduit and wiring based on this review.
   3. The Contractor shall provide the fire alarm drawings, including voltage drop and battery calculations, to ensure that they conform with the specific design requirements for the fire alarm system to be installed.
   4. The Contractor shall indicate his approval and acceptance of the fire alarm drawings, by signing and dating the documents. If the design cannot be approved because it does not conform with the specific design requirements for the fire alarm system to be installed, provide detailed notification in accordance with Section 00 72 02 –

Interpretation of the Contract. Notification shall indicate the specific changes that need to be made to the design in order to conform with the specific design requirements for the fire alarm system to be installed.

5. Return two bond copies (and deficiency notification, if required) of the fire alarm, drawings to the County Representative.
6. Notify the County Representative of any differences in the quantity or types of devices and equipment reflected in the Contractor fire alarm drawings and those reflected in the Contractor's contract documents.

C. California State Fire Marshal (CSFM) Submittal:
   1. The County Representative will provide electronic files of the drawings . Incorporate all addenda and bulletins issued to the into the electronic files.
   2. Submit complete California State Fire Marshal (CSFM) submittal based on Contract Drawings (including addenda and bulletins); fire alarm drawings; and the reviewed Fire Alarm Product Data Submittal. Submit the following:
      a. The reviewed set of Fire Alarm Product Data that includes the Engineer of Records stamp.
      b. Complete equipment fabrication descriptions and dimensions of equipment cabinets. For each building, indicate the equipment cabinet size(s) required to accommodate the specific equipment required to perform the specified functions.
      c. FACP point-to-point wiring diagrams, specific for each building. Show all interconnecting wiring of components within the FACP and the termination of all initiating and signaling circuits.
      d. Battery calculations. Battery calculations shall include the specified spare capacity. Final battery sizes, based on calculations, shall be indicated.
      e. Wiring connection diagrams for each device to be installed or connected by the Contractor.
      f. Manufacturer's test procedures for CSFM-approved devices for local and site wide systems.
   3. Incorporate County Representative review comments and submit package to CSFM.
   4. Indicate on CSFM approved drawings all comments provided by the County Representative and CSFM which were not indicated on the original bid package Contract Drawings.
   5. After CSFM approval, transmit two electronic media sets, seven bond copies of shop drawings, each bearing the CSFM stamp of approval, to the County Representative.
   6. System to be installed and inspected utilizing CSFM approved drawings, not original Contract Drawings.

D. Fire Alarm Device Nomenclature Submittal
   1. Submit list of all fire alarm devices by Building name, Building number and device number indicated on approved CSFM drawings to the County Representative. Include system nomenclature restrictions.
   2. Deferred submittal shall utilize NFPA 170 symbols.

1.3 REFERENCES

A. FM - Factory Mutual.

B. NFPA 72-2013 - National Fire Alarm Code.

C. NFPA 101- 2013 - Life Safety Code.

D. UL 38-2013- Manual Signaling Boxes for Fire Alarm Systems.

E. UL 217-2013- Single and Multiple Station Smoke Alarms.

F. UL 268-2013- Smoke Detectors for Fire Alarm Signaling.

G. UL 268A-2013- Smoke Detectors for Duct application.

H. UL 464-2013 - Audible Signal Devices.

I. UL 521-2013- Heat Detectors for Fire Protective Signaling Systems.

J. UL 632-2013- Electrically-Actuated Transmitters.

K. UL 1711-2013- Amplifiers for Fire Protective Signaling Systems.

L. UL 1971-2013- Signaling Devices for the Hearing Impaired.

M. UL 864-2013- Control Units and Accessories for Fire Alarm Systems.

N. ADAAG - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities-2012.

O. California Electrical Code-2013.

P. UL - Underwriters Laboratories, Inc.

1.4 DELINEATION OF RESPONSIBILITY:

A. Products furnished, and installed under this section.
   1. Local Building Fire Alarm System Equipment's which shall include but shall not be limited to:
      a. Signal Initiating Devices (Smoke detectors, heat detectors, duct smoke detectors, manual boxes, etc.)
      b. Alarm Signal Notification Appliances (audible devices, visual devices, etc.)
      c. System Interface Hardware
      d. Input/Output Modules for existing FACP
      e. Fan Control Relays
      f. Special backboxes
      g. Fire Alarm Control Panel batteries
      h. Remote Power Supplies
      i. Standard backboxes for fire alarm devices.
      j. Cable for local building fire alarm system.
      k. Conduit.

B. The Contractor shall provide a complete and functional system.

1.5 QUALITY ASSURANCE

A. Furnish appropriate UL listed fire alarm equipment which bear the “U.L.” label. Partial listing is unacceptable.

B. Furnish system controls UL listed for Power Limited Applications.

C. Furnish an FM approved system.

D. Furnish equipment listed with State of California Fire Marshal.

E. Provide certification of inspection confirming approval of Fire Alarm System by State of California Fire Marshal.

1.6 CERTIFICATIONS

A. Provide certification of inspection confirming approval of Fire Alarm System by State of California Fire Marshal.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. These specifications are based on fire alarm equipment manufactured by Notifier. Equipment manufactured by one of the following Manufacturers is acceptable:
   1. Notifier
   2. Simplex
   3. Siemens Industries, Inc.

B. System Components.

   1. Fire alarm control panel: provide an addressable fire alarm control panel with all equipment required for all initiating circuits, signaling circuits, fan control and monitoring points as indicated on the drawings and specifications.

      a. Refer to building fire alarm reference drawings contained in the building bid package for all fire alarm circuit and input/output requirements.

      b. Provide with approved sealed type batteries with automatic battery charger capable of operating maximum normal load of the system for twenty-four hours and then capable of operating the system for five minutes in the alarm condition. The power supply/battery back-up system shall be sized for 20% spare capacity. All batteries shall be monitored for integrity.

      c. Notifier #NFS2-3030 or approved equal

   2. Remote annunciator: Notifier #LCD-160 or approved equal

   3. Addressable manual fire alarm box: Notifier #NBG-12IX or approved equal

   4. Addressable photoelectric smoke detector: Notifier #FSP-851 or approved equal with System Sensor #B210IP low profile detector base.

   5. Addressable thermal sensor: Notifier #FST-851 or approved equal with system sensor #B210LP low profile detector base.

   6. Duct smoke detector: Notifier #FSP-851R or approved equal with #DNR housing, #DST5 metal duct sampling tube (4'-8' duct widths), #FRM-1 relay module and #RTS151key remote test station with key.

   7. Addressable control module: Notifier #FCM-1 or approved equal

   8. Addressable dual monitor module: Notifier #FDM-1 or approved equal

   9. Addressable monitor module: Notifier # FMM-1 or approved equal

10. Addressable mini monitor module: Notifier # FMM-101 or approved equal

11. Addressable relay module: Notifier # FRM-1 or approved equal

12. Remote power supply: Notifier #FCPS-24S6/FCPS-24S8 or approved equal

13. Multi-candela horn/strobe: System Sensor #P2R or approved equal

14. Multi-candela strobe: System Sensor #SR or approved equal

2.2 EQUIPMENT SUMMARY:

A. See building fire alarm plan drawings included in the Drawings for device types and quantities required for each local building fire alarm system.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. FACP Batteries
1. Furnish batteries for each Fire Alarm Control Panel separate from the other components of the control panel to support additional devices as required.

3.2 QUALITY CONTROL AND TESTING

A. The completed fire alarm system shall be fully tested in accordance with NFPA-72 by the contractor in the presence of the Owner's representative and the State Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the Owner and general contractor.

B. The Contractor will maintain the cleanliness of the smoke and heat sensing fire detectors from the time that the devices are installed to the time that each building system is tested and turned over to the County Representative. The sensitivity listing of all detectors at the time that the system is turned over to the County Representative will not exceed 35% of the total environmental compensation as determined by reviewing the maintenance report at the local building FACP. If any detector exceeds the specified 35% level, then that detector will be removed, cleaned, replaced and re-tested by the other bid package contractor.

C. The Contractor will replace the protective dust covers on the smoke and heat detectors after the building system has been tested and accepted by the County Representative and the California State Fire Marshal.

D. Maintain the cleanliness of the smoke and heat sensing fire detectors until the time that the building system is accepted by the County Representative. The sensitivity listing of all detectors at the time that the system is turned over to the County Representative shall not exceed 35% of the total environmental compensation as determined by reviewing the maintenance report at the local building FACP. If any detector exceeds the specified 35% level, then that detector shall be removed, cleaned, replaced and re-tested.

E. Remove the protective dust covers from the smoke and heat detectors at the building when instructed by the County Representative. If the County Representative provides specific written instructions to leave the protective dust covers on the smoke and heat detectors, then the County Representative assumes the responsibility of removing the dust covers at a later date.

3.3 COMPLETION

A. General: Upon completion of the Work, remove excess debris, materials, equipment, apparatus, tools and the like and leave the premises clean, neat and orderly.

B. Testing: The completed system shall be tested by the Contractor prior to the Final Acceptance test.

END OF SECTION

SECTION 28 41 33

MATV SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications, and Section 27 05 00 apply to this Section.

B. Related Sections:

1. 28 05 00 Common Work Results for Electronic Safety and Security
2. 28 05 13 Conductors and Cables
3. 28 05 14 Raceways and Boxes
4. 28 05 26 System Signal Grounding
5. 28 05 27 Cabinets, Enclosures and Racks
6. 28 09 00 Electronic Components
7. 28 46 13 Integrated Sequences of Operation
8. 28 46 19 PLC Integrated Control System

1.2 SUMMARY

A. Section Includes:

1. Amplifiers
2. Signal Splitters
3. Signal Taps
4. Distribution Cable

1.3 SYSTEM DESCRIPTION

A. Provide a complete and operational MATV system throughout the buildings as described herein and shown on the plans. The system shall meet or exceed the requirements and standards of transmitting EIA channels 1 through 158.

B. The MATV system shall distribute commercially provided and locally originated signals to dayrooms and other areas via a coaxial system with amplifiers, splitters, taps, attenuators, and all components required whether shown or not for a complete and operational system. TV receivers will be provided by the County.

C. Broadcast TV System

1. The county vendor shall provide commercially generated television channels for rebroadcast in the facility.
2. The county vendor shall provide the broadcast signal at the existing facility and transmitted to this project on cable provided by this Division.

D. Refer to the drawings for system riser, tap locations, and system distribution requirements.

E. Provide final system engineering and calculations based on the actual equipment used, system installation and cable lengths.

1.4 REFERENCES

A. Section Specific References

1. ANSI J-STD TIA/EIA-607-A – Commercial Building Grounding and Bonding Requirements for Telecommunication.
2. Title 47 Telecommunications, part 76.
3. Title 47 Telecommunications, part 76.605 (Testing)
4. EIA 542

1.5 DEFINITIONS

A. Agile: The ability to tune to any desired channel.

B. CATV: Community Antenna Television. A communication system that simultaneously distributes several different channels of broadcast programs and other information to each subscribers premises via coax or fiber optics cable.

C. dBmV: Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms.

D. Headend: The control center of the master antenna television system where incoming MATV, SAT-TV, Off-Air, and local origin signals are amplified, processed, and combined into a common cable for transmission to receivers connected to the system.

E. MATV: Master Antenna Television system consists of all the headend equipment, distribution equipment and cabling required for retransmitting and distributing MATV, SAT-TV, Off-Air, MATV, and local origin signals on the customer premises.

F. Off-Air TV: A communication system that simultaneously distributes several different channels of broadcast programs and other information to each subscribers premises via radio frequencies from a local broadcast antenna to a subscribers antenna.

G. SAT-TV: A communication system that simultaneously distributes several different channels of broadcast programs and other information to each subscribers premises via radio frequencies from a geo-synchronous satellite to a subscribers antenna.

1.6 PERFORMANCE REQUIREMENTS

A. The follow requirements shall be met or exceeded.

1. Signal level of each channel at each outlet shall be 10 dBmV (+or-) 7 dBmV.
2. Carrier to noise ratio: 44 dB minimum
3. Isolation (outlet-outlet): 24 dB minimum
4. Cross Modulation: -46 dB
5. Hum Modulation: -55 dB
6. Return Loss: 14 dB
7. Visual to Aural Carrier Ratio: 13 dB to 17 dB below visual
8. Impedance: 75 Ohm

1.7 SUBMITTALS

A. Comply with the requirements of 28 05 00 Submittal's.

B. Test Results:

1. Performance Testing: Submit completed test results for point-by-point testing to the Owner's Representative. Provide an electronic copy.

1.8 QUALITY CONTROL

A. Meet or exceed all referenced codes, standards, specifications, or drawing requirements, whichever is greater.

B. Qualifications

1. The Contractor shall maintain a workforce, as required to perform the work in the contract, for the duration of the project. For those skill areas where formalized training is available, it is mandatory that the selected workforce be formally trained (college, trade school, product's manufacturer) and certified in each type of system or equipment that they will be responsible to, construct, install, and test. Evidence of compliance for each Contractor's or sub-Contractor's employee shall be kept on file and available for OWNER review upon request. It will be the responsibility of the Contractor and at the Contractor's cost, to remedy any deficiencies resulting from faulty or improper installations.
2. It is expected that the Contractor know and meet or exceed the industry standards and guidelines referenced herein for the system installation. These specifications are in addition to the standards.
3. The Contractor shall be certified by the manufacturer for the installation of the equipment provided when such a certification exists.

C. Testing: The Contractor shall furnish, install, test, and certify the operability of the MATV system to meet the referenced standards, specifications and warranty.

1. As a condition of acceptance the Contractor must have supported Test Documentations, and shall demonstrate and provide written or computer generated documentation showing that the system meets the required signal levels.
2. Each tap is to be tested and test results recorded. Advise the Owner of testing 5 days in advance so that contractor testing may be observed.
3. If the contractor does not have the personal qualified to perform testing, the contractor shall provide a qualified firm to conduct testing at no additional cost to the Owner.

1.9 WARRANTY

A. Comply with Div. 1 Warranty requirements.

1.10 EXTRA MATERIALS

A. Comply with Section 28 05 00

B. Furnish (2) two wall outlets of each type and value used

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. The general system design has been base on blonder-tongue products; equivalent products from an approved manufacturer may be used. Final design and any changes to the design are the responsibility of the contractor.

B. Manufacturers submitted for approval shall meet the following criteria:

1. Maintains a factory production line for the items submitted.
2. Maintains a stock of replacement parts for the items submitted.
3. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
4. Has published and distributed descriptive literature and equipment specifications for the items submitted for at least 360 days prior to the Bid.

2.2 MATERIALS

A. All equipment to be supplied under this section shall be new and the current model of the product supplied. Allowance for product obsolescence shall be made at bid time.

B. Equipment specifications set forth herein are the minimum requirements and shall not be construed as limiting the overall quality or performance of the items or system provided.

C. Active components shall consist of solid state components, be rated for continuous duty service and comply with the requirements of FCC Docket 21006.

D. All components of the system shall meet the minimum bandwidth requirements of the system.

2.3 AMPLIFIERS

A. Jerod or Blonder-Tongue

2.4 SPLITTERS

A. Jerod or Blonder-Tongue

2.5 TAPS

A. Jerod or Blonder-Tongue

B. Size tap values for correct dB drop at each location.

2.6 COAXIAL CABLE

A. Series 6 (RG6) for distribution cable

B. Series 11 (RG11) for Trunk cable

2.7 RF CONNECTORS

A. Connectors shall be type F and have a screw type coupling for quick connect or disconnect.

B. Physical connection to the cable shall be a non-reversible crimp type.

C. Working voltage: 500V, Frequency range: 0 to 890 MHz, Impedance: 75 Ohms.

2.8 MATERIALS

A. Materials shall be provided as specified. When material is not specially specified, the selection criteria shall be used.

B. Cable Jackets

1. Unless specially specified otherwise the contractor is to provide cable jackets for the specific application. Cable jacket selection is dependent on codes, standards, and location of the cable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.

B. The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

C. Provide all support framing, raceways, backboards, equipment racks, and cabinets.

D. Mark all cables and termination points with approved method and nomenclature.

E. All connectors to be F type unless otherwise noted. BNC type not permitted.

F. Provide 75 ohm termination resistor for all unused ports or taps designed for the fitting.

G. The MATV system shall be designed and installed so that the combination of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, hum bars, transients, ghosting, etc.

H. Use only connectors recommended by the cable manufacturer and designed for the specific type of cable being used.

I. Use wire management to neatly secure loose cables.

J. After award of contract and within the time period specified in the contract, the Contractor shall deliver the total system in a manner which fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the system without written approval from the Engineer.

K. The Contractor shall install suitable filters, traps and pads for minimizing interference and for balancing the amplifiers and distribution systems(s). All filters, splitters, couplers, tap-offs, matching transformers and TV wall outlets shall be able to pass color TV channels in the frequency bands selected, in the directions specified, with low loss, and high isolation and with minimum delay of the color subcarrier frequency. The Contractor shall install all equipment necessary to meet the requirements of this section and the system performance standards.

L. All passive equipment shall be connected according to the manufacturer's specifications to insure correct termination, isolation, impedance match and signal level balance at each TV outlet.

M. All lines shall be terminated in a suitable manner to facilitate future expansion of the MATV system. There shall be a minimum of one (l) spare output at each distribution point on each floor where shown on the drawings.

3.2 TESTING AND INSPECTION OF COMMUNICATIONS EQUIPMENT

A. Provide tests specified in below, when applicable, and as indicated under individual items of material, equipment, and work specified in other sections.

B. Provide signal generating test equipment to test the bandwidth of the system. dB shall be measured and recorded at low, mid, and high frequencies at a minimum and at each tap.

C. Performance Testing:
   1. Comply with Section 28 05 00, Performance Testing for:
      a. Initial Performance Testing.
      b. Performance Testing.
         1) Provide the Initial Performance Test results and demonstrate the signal level readings at each tap.
      c. Continuous Operational/Functional Testing.
         1) The Performance Test shall have been completed to begin the Continuous Operational Test.
         2) The MATV system shall be operational for the Continuous Operational Test.

D. The MATV system shall meet the performance parameters at each TV outlet as described in Part 1 of this section.

3.3 FIELD QUALITY CONTROL

A. Comply with Section 28 05 00, General Requirements

B. Initial Performance Testing:
   1. Upon completing installation of the MATV system, the Contractor shall align, balance and completely pretest the entire MATV system.
   2. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and signal level meter) that the system is fully operational and meets all system performance requirements of this specification.
   3. The Contractor shall measure and record the visual and aural carrier levels of each channel in use at each of the following points:
      a. Head-End signal level and signal-to-noise for each TV channel specified.
      b. Distribution Amp inputs and outputs.
      c. Each outlet.
      d. After pretest measurements are made, the system shall be left on and operating to "burn in" until the final inspection is completed.

C. Performance Test:

1. Initial Performance Test Certification: After the system has been installed, aligned, balanced, pre-tested and found to meet the requirements of this specification, the Contractor shall submit a letter to the Engineer certifying that the system is ready for the Performance test in the presence of an Owner representative. A copy of the recorded MATV system Initial Performance Test measurements shall be submitted to the Engineer with the certification.
2. Inspection: The Owner representative will observe all areas to insure that all MATV systems are completely and properly installed in place, and are operationally ready for performance testing. Failure of the MATV system to meet the installation requirements of this specification shall be grounds for terminating all testing. The MATV system diagrams and pretest measurements shall be reviewed.
3. The MATV system shall be tested, in the presence of an Owner's representative utilizing the approved test equipment to certify proof-of performance. The system test shall verify that the total system meets all the requirements of this specification.
4. A random sampling of a minimum of 25% of the TV outlets between the first and last leg shall be measured and compared to the pre-test report. If there are incorrect signal levels or the measurements are not consistent with the pre-test report a full system test may be required by the Engineer.
5. The acceptance test shall be performed on a "go/no-go" basis. Only those operator adjustments required to show proof-of-performance shall be allowed. The test shall demonstrate and verify that the installed MATV system does comply with the operational and technical requirements of this specification under operating conditions. The MATV system shall be rated as either acceptable or unacceptable at the conclusion of the rest.

3.4 TRAINING

A. Provide training in accordance with Section 28 05 00 General Requirements.

B. Provide maintenance and service training that includes the basic adjustments and trouble shooting of system components and faults.

END OF SECTION

SECTION 28 46 13

INTEGRATED SEQUENCES OF OPERATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes
   1. Software Development.
   2. Control Electronic System Software
   3. Sequences of Operation

B. Related Sections:
   1. 28 05 13 Conductors and Cables
   2. 28 05 14 Raceways and Boxes
   3. 28 05 26 System Signal Grounding
   4. 28 05 27 Cabinets, Enclosures and Racks
   5. 28 09 00 Electronic Components
   6. 28 15 00 Intercom System
   7. 28 23 00 Video Surveillance (CCTV) System
   8. 28 26 00 Duress Alarm System
   9. 28 41 33 MATV System
   10. 28 46 19 PLC Integrated Control System

1.3 DEFINITIONS

A. Control System Software: A software application program that performs logic and control functions based on programmable criteria.

B. Programming Workstation: Graphic icon display that allows the operator to monitor system activity and alarm conditions on a real-time basis, and presents the operator with a selection of functions. Typically this portion of the screen/graphics is displayed in all operating modes allowing alarms to be monitored while using other system features.

C. Icon: Pictorial graphic display of a symbol or devices such as doors, locks, buttons

D. Operator Interface (OI): Used to generally define computer monitor, mouse, audio, button, or any other devices used for Human-Machine Interfacing.

1.4 SYSTEM DESCRIPTION

A. Provide software development and programming for workstations, control panels, and each system as defined in each respective Section and described in this Section. Sample

sequences of operations have been established to provide a base understanding of the project requirements.

1.5 SUBMITTALS

A. Comply with Section 28 05 00.

B. Theory of Operation: Develop and submit functional narratives supported by full-size, color state diagrams for the various combinations of icons and buttons in each operational state. Submit 14 calendar days prior to Review Meeting.

C. Review Meeting: Attend submittal review meeting to receive Owner comments on the theory of operation and preliminary development submittal.

D. Full Development: Incorporate all Owner review comments and resubmit the theory of operation submittal along with full-size, graphic layouts panel. Submit 14 calendar days prior to Owner Workshop and Demonstration.

E. Control Electronics Software: Develop and submit control electronics software (logic) for each typical function. Submit 14 calendar days prior to Owner Workshop and Demonstration.

F. Owner Workshop and Demonstration: Attend submittal review meeting along with a complete Control Panel training/ demonstration including. After demonstrating the control panel and functions and recording all Owner comments, incorporate as many Owner review comments as possible before re-demonstrating the following day.

G. Record Documents

1. Compile a list giving each PLC program name, its installed version number, the number of copies installed, the serial number of each copy, the publisher's name and address, and the publisher's customer support telephone number.
2. Prepare and submit complete documentation of the final installed runtime versions of the operator interface software, including a diagram of its component modules, subroutines, ladder logic, databases, libraries, drivers, and other parts. Narrative descriptions shall accompany the diagram, giving basic descriptions of each component and describing the interaction between components. Provide complete, annotated program listings of all custom scripts, macros, and subroutines.
3. Provide the Owner with all original installation DVDs or CD-ROMs and all software manuals for every software program installed on the system. Provide one complete copy of the full development environment for the operator interface software installed on the programming laptop (refer to Section 28 23 00).

1.6 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

B. Have the Project Manager support all specified submittal reviews and demonstrations, and all software-related project meetings. Have the Software Engineer support-related project meetings on an as needed basis, or at the Project Inspector's request.

1.7 SEQUENCING AND SCHEDULING

A. Comply with requirements of Section 28 05 00.

B. Submit submittals described in this section in the order they are listed.

1.8 WARRANTY

A. Comply with Section 28 05 00.

B. Warrant all software development and programming to be free of defects for a period of one-year from the date of final acceptance. For warranty purposes, consider a defect to be any programming error or errant software behavior not explicitly agreed upon by the Owner, either intermittent or continuous, and all unincorporated Owner comments.

C. Respond to reported defects with on-site personnel within the response times specified in Section 28 05 00.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Factory Test:

1. Comply with the requirements of Section 28 05 00.
2. Functional Testing:
    a. Thoroughly test every function under all operating sequences and operating modes. Activate system outputs in response operations and test reactions to test inputs.

PART 3 EXECUTION

3.1 CUSTOMIZABILITY OF THE HMI CONTROL STATION

A. The sequence of operations presented in this Specification shall be open to customization by the County. Shapes of icons, size, arrangement, color, and even functionality shall be changeable as required by the County at no additional cost. Contractor shall submit a proposed design, including sample colored screen layouts, of how he/she intends on installing the HMI Control Station controls interface. The included sequence of operations herein shall serve only as a basis of design, and does not exclude further development and customization required by the County.

3.2 HMI CONTROL STATION OPERATIONAL THEORY

A. The HMI Control Station operator interface is designed to increase the efficiency of the staff when tasked with monitoring several areas of a large site. The system is programmed to provide a clear indication of events for the security of the facility. In order to accomplish this, system components are integrated into a PLC designed and programmed to function as the master system component tasked with establishing system activity priorities, sub-system component monitoring and the logging of security-related events.

B. The design is implemented to ensure that the user is always in control of the system functions and has the ability to respond to several levels of controls, alarms and alerts based on actual physical activity on site.

C. User Levels & User Accounts

1. The system supports several levels of user groups each of which may be assigned a different number of functions from monitor-only to full control of all screens and

functions. User names and access levels may be assigned by the system operator while in the ADMINISTRATOR mode of operation.

a. There are 3 user groups by default:

1) OPERATOR –user is able to view all alarms and control standard operations Does not have access to configuration settings/timers, and user creation.

2) SUPER – has all USER functions, in addition to configuration settings/timers, and user creation.

3) ADMIN – has all SUPER functions and has the ability to exit the TS program and access Windows settings.

3.3 DOOR CONTROL SYSTEM

A. Movement Doors

1. Door Control Functions

a. All of the movement doors are controlled (i.e., electronically cycled) on the HMI Control Station Monitor by selecting their corresponding door label and selecting the unlock/open icon. The lock bolt on the door will retract and the door will unlock. The lock bolt on the door will only retract for as long as the unlock timer has been set for from the settings screen, and then it will begin its relock cycle.

2. DPS Indication Icon's

a. Every monitored door opening will have a door icon associated with it. This icon will be different based upon the operator control and door status. When an operator has the ability to operate a particular door, the icon will appear as a closed gray door within the door opening when closed (secure), and will appear opened and red when open (unsecure). If the operator does not have control of the door but is able to monitor its status, the icon will appear as a gray square within the door opening when closed (secure) and will appear as a red square within the wall when opened (unsecured).

B. Cell Doors

1. Cell Door Functions

a. Cell doors are controlled on the HMI Control Station by selecting their corresponding door label and subsequently selecting the "Unlock" button. The lock bolt on the door will retract and the door will unlock. The lock bolt on the door will only retract for as long as the unlock timer has been set for from the settings screen, and then it will begin its relock cycle.

2. Group Release Function

a. The Cell Doors may be opened with a group release function in case of an emergency. When group release is needed, the operator will click the "Group Release" button for the area and verify, via pop up, that this request was intentional. Once activated, the group release will begin the sequence of unlocking 2 cell doors at a time (in accordance with the cell door lists above.) Since the cell locks on this project do not have a ½ cycle hold back feature, the PLC will continue to send the unlock signal to each lock during the group release event any time a secure DPS signal is detected. This will ensure that the lock motors do not continue to run if the door is already unlocked and propped open, but will continue to run the motors for doors that are closed and secure, allowing free egress to take place for those doors

as well. When group release has been canceled, all of the lock bolts associated with that group will extend and the cell door must be physically shut for it to secure.

b. In order to ensure that the 24VDC power supply is not overloaded during this function, the release for any group listed above is staggered using time-staggered releases. That is to say, the release of no more than two locks per dedicated power supply will ever be initialized simultaneously and a short delay is introduced between each release until all of the locks in a group are energized simultaneously (i.e., held open). Cell block A has 2 dedicated power supplies, and will therefore allow the opening of 4 doors at a time. Cell blocks B & C have 1 dedicated power supply which will allow for 2 doors at a time.

C. Interlocks & Interlock Override

1. Interlocks are designed to prevent more than one door in a predefined group to be opened at the same time. When any door in an interlock group is open (or unsecure), then no other door lock in that group may be electronically cycled unless the interlock override function is used (as described below)..

2. The Interlock Override function may be used to override an interlock that is active. In order to electronically cycle a door lock that is currently part of an active interlock (i.e., an interlock group that has one of its doors unsecure), the door label must be selected and the “Interlock Override” button must be clicked. This will generate a pop up screen to verify that this interlock override request was intentional. Once verified, the “Unlock” button will appear and the door will be able to be unlocked in its normal fashion.

D. Door Breach (Invalid Open)

1. A door breach alarm will occur when a door has been opened without the command being sent from the operator. This can occur by someone using a key to open a door instead of calling the operator and allowing the control system to unlock the door. This may also occur when a door has been forced open in some way. When such an alarm comes in it will be sent to the “ACTIVE ALARMS” queue and displayed in **red text.** The associated area will flash **blue** on the sitemap and a “door breach” alarm sound will repeat until the alarm has been acknowledged. When the operator is on the screen showing the door in alarm, you will see a **blue circle** on the door with the alarm. When a breach alarm occurs an associated camera will be called up on the applicable CCTV monitor. The alarm may be acknowledged either by selecting the alarm and clicking the “ACK SELECTED” button or if the alarm is at the top of the queue the “ACK FIRST” button may be clicked. Once this type of alarm has been acknowledged, it will change in the alarm queue to a **green** color indicating that the alarm has been acknowledged but not reset and the alarm will move below any unacknowledged alarms in the queue. Upon resetting the alarm (described in the “Clearing Alarms” section below), the alarm will disappear from the queue. This alarm can only be reset once the door has been secured.

E. Door Prop (Open Too Long)

1. A door prop alarm will occur when a door has been opened for more than the configured time. The default time is set at 60 seconds but may be adjusted in the settings screen. When this type of alarm occurs it will be sent to the “ACTIVE ALARMS” queue and displayed in **red text.** The associated area will flash **magenta** on the sitemap and a “door prop” alarm sound will repeat until the alarm has been acknowledged. When the operator is on the screen showing the door in alarm, you will see a **magenta circle** on the door with the alarm. The alarm may be acknowledged either by selecting the alarm and clicking the “ACK SELECTED” button, or if the alarm is at the top of the queue the

"ACK FIRST" button may be clicked. Once this type of alarm has been acknowledged, it will change in the alarm queue to a **green** color indicating that the alarm has been acknowledged but not reset and the alarm will move below any unacknowledged alarms in the queue. Upon resetting the alarm (described in the "Clearing Alarms" section below), the alarm will disappear from the queue. This alarm can only be reset once the door has been secured.

F. Door Shunt (Ignore Alarm)

1. In the event that an operator wanted to deactivate an alarm for a particular door, (e.g., maintenance is being done on this door), the operator may select the door label and click the "SHUNT" button. This will put a **green circle** around the door and no *new* alarms associated with this door will be displayed on the map or be sent to the Active Alarms queue. Existing alarms will still need to be acknowledged and cleared. To remove this "Shunt", simply repeat the process of selecting the door label and clicking the "SHUNT" button again.

3.4 ANCILLARY FUNCTIONS/ALARMS (HMI CONTROL STATIONS)

A. Panic Alarm

1. When a panic button is clicked, it will latch in place and a signal will be sent to the PLC. When this type of alarm occurs it will be sent to the "ACTIVE ALARMS" queue and displayed in **red text.** The associated area will flash **red** on the sitemap and a "panic" alarm sound will repeat until the alarm has been acknowledged. The operator in control of the area where the alarm has occurred will be navigated directly to the control screen showing the location of the alarm. When the operator is on the screen showing the alarm, you will see a **red circled P** in the location of the alarm. When a panic alarm occurs, a camera associated with the device will be called up on one of the CCTV monitors. The alarm may be acknowledged either by selecting the alarm and clicking the "ACK SELECTED" button, or if the alarm is at the top of the queue, the "ACK FIRST" button may be clicked. Once this type of alarm has been acknowledged, it will change in the alarm queue to a **green** color indicating that the alarm has been acknowledged but not reset and will move below any unacknowledged alarms in the queue. Upon resetting the alarm (described in the "Clearing Alarms" section below), the alarm will disappear from the queue. This alarm can only be reset once the panic button has been released.

B. UPS Alarm

1. The UPS has two (2) alarms associated with it:

   a. UPS Backup On – This alarm will occur when the UPS is no longer getting voltage (e.g., the breaker feeding the UPS has tripped or the power has been cut off). This means the system is being run on backup UPS power only at this time. To avoid nuisance alarms for small power fluctuations of short duration, this alarm will only be generated on the HMI Control Station monitor when the UPS is on longer than 30 seconds.

   b. UPS Trouble – This alarm will occur when there is a problem with the UPS that needs to be checked. The UPS display will give further details.

C. Clearing an Alarm (Alarm Reset)

1. An alarm may sometimes be "reset" when it has been returned to its normal state in the field but has not yet been acknowledged by the operator. If this occurs, the alarm in the queue will change from its **red** color to a cyan color. The associated alarm sound will still repeat until the alarm has been acknowledged by the operator.

2. To clear alarms associated with doors the operator must navigate to the screen showing the door then select the door label. Then click the “ALARM RESET” button in the menu for that door. Once the alarm has been acknowledged and reset it will be cleared from the queue.
3. To clear Panic alarms the device must be key-reset in the field prior to clearing from the HMI Control Station monitor. The operator must then navigate to the screen where the panic alarm is and click the panic alarm icon. Then click the “ALARM RESET” button in the menu for that panic device. Once the panic device has been reset in the field **and** the alarm has been acknowledged it will be removed from the queue.
4. UPS alarms will not have a reset function. Acknowledgement of the alarm is as usual but the condition must be cleared and the reset will be done automatically.

3.5 INTERCOM

A. The 25V intercom system is a half duplex audio system. In a half duplex system, only one person is able to speak at a time. So if a communication path is established from a control station to an intercom station out in the field, the sound is only amplified in one direction at a time.

B. The control station determines which way the sound is amplified. The default mode is ‘Listen’ mode. In Listen mode the sound going into the intercom station in the field is what gets amplified. In ‘Talk’ mode the sound going into the control station microphone is what gets amplified.

C. The HMI Control Station monitor has built in speakers and microphone. The operator primarily can use the built in speaker and microphone for intercom communication. Alternatively, the operator can use the push-to-talk gooseneck microphone.

D. Push-To-Talk
   1. The “Push-To-Talk” icon is on the HMI Control Station monitor and touching this icon puts the intercom system into ‘Talk’ mode as described above. The intercom system will remain in ‘Talk’ mode for as long as the HMI Control Station operator holds down this button. As soon as the operator releases this button, the intercom system returns back to ‘Listen’ mode as described above.
   2. When in ‘Talk’ mode, the HMI Control Station operator can speak and the microphone will pick up the sound of his/her voice and amplify it to the intercom station in the field.

E. Intercom Station Operation
   1. Intercom communication is established from the Master Station at Staff Station to the field intercom station as follows:
      a. A person at an intercom station in the field will click the ‘call-in’ pushbutton to call the Master Station. On the HMI Control Station in Staff Station, the associated area will flash yellow, on the sitemap and an associated call-in tone will repeat until the call-in has been answered. The call-in will be sent to the “Call-In” queue displaying the time and description of the call-in. If the operator navigates to the screen displaying the location of the intercom, he/she will see a flashing yellow intercom icon in the location of the intercom that made the call-in. The intercom may be answered in one of three (3) ways:
         1) Selecting the call-in from the queue and clicking the “Answer Selected” button, or

2) If the call-in is at the top of the queue, the operator may click the “Answer Next” button, or

3) The operator may click the flashing intercom icon.

b. Once selected, the intercom icon will stop flashing and remain lit to indicate that the audio path is open and the intercom system is in ‘Listen’ mode as described above. The operator can now hear whatever sound is coming into the Intercom Station in the field. The operator can then utilize the Push-To-Talk button on the HMI Control Station to put the intercom system into ‘Talk’ mode as described above.

2. When the HMI Control Station operator is finished communicating with the intercom station in the field, he/she will close the audio path by clicking the intercom icon again, or by clicking the “End Call” button. The operator may also click the “Answer Next” button to close the audio path to the current intercom and open the path to the next intercom in the ‘Call-In’ queue. The intercom icon that is de-selected will return to its normal gray color to indicate that the audio path to that station is closed and the intercom system is off.

F. Dayroom Cell All-Call

1. The dayroom operator may choose to select all cell intercoms at the same time. Using the “Push to Talk” button, the operator may speak to all cell intercoms using this feature. This feature will also allow the operator to listen to all cell intercoms simultaneously.

3.6 UTILITY CONTROLS

A. The dayroom HMI Control Station monitor operator has control of local dayroom utilities. By toggling the icons either on or off, the operator is able to control dayroom lights, cell lights, TV power, telephone power, video visitation power, convenience receptacles, and water supply.

3.7 CCTV SYSTEM INTEGRATION

A. Camera Call-ups

1. Camera icons will be located on the HMI Control Stations at the location of each camera and recording status can be seen on the camera icon. If an operator wants to view a single camera as full screen, he/she may select that camera on the HMI Control Station monitor. This will create a full screen display of the camera selected and will hide the other three (3) cameras associated with that monitor.

2. Camera call-ups are also associated with selections of some intercoms and panic alarms. When an intercom has a camera call-up associated with it, upon selection of that intercom, the associated camera will show as full screen on its designated monitor. The selection of an intercom will only create an initial camera call-up (it will not stop the user from navigating elsewhere), if the operator chooses to select a different camera to view, he/she may do so; he/she may also de-select the camera to return to the default view. When a panic alarm comes in, the associated camera will immediately be called-up on its designated monitor.

3. Selecting any alarms in the alarm queue that have an associated camera will also call up the camera programmed for that alarm.

END OF SECTION

SECTION 28 46 19

PLC INTEGRATED CONTROL SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Programmable Logic Controllers (PLC)
   2. Programming Laptop Computer
   3. Power Supplies

B. Related Sections:
   1. 28 05 13 Conductors and Cables
   2. 28 05 14 Raceways and Boxes
   3. 28 05 26 System Signal Grounding
   4. 28 05 27 Cabinets, Enclosures and Racks
   5. 28 09 00 Electronic Components
   6. 28 15 00 Intercom System
   7. 28 23 00 Video Surveillance (CCTV) System
   8. 28 26 00 Duress Alarm System
   9. 28 41 33 MATV System
   10. 28 46 13 Integrated Sequences of Operation

1.3 DESCRIPTION OF WORK

A. The control electronics shall provide control and monitoring functions for systems and interfaces as described on the Drawings and in these Specifications.

B. The controllers shall provide all necessary logic functions, timing functions, memory, software, input/output points and communication capabilities for the operating features required to meet all of the requirements of the Specifications and Drawings.

C. The controller shall be general purpose in nature and not custom designed and built for this isolated application. The controller shall be generally non-location specific in its construction. The controller shall be made location specific and operationally customized by installing EPROM with applicable software, and making the I/O interface boards system specific and installing the proper I/O modules.

D. Logic functions shall include, but not be limited to, AND, OR and INVERT functions with sufficient levels to provide operating features required to perform all of the functions required by the Specifications and Drawings.

E. Timing functions shall include, but not be limited to, on-delay, off-delay, stepping and pulsing. Sufficient variations of programmable timing shall be available to provide all the operating features as required by the Specifications and Drawings.

F. Provide a daisy chain configuration network of PLCs to communicate all signals, between indicated PLC's in areas as shown on drawings.

G. Provide electronic height adjustable desks at each control station.

H. See section 28 46 13 for sequences of operations.

1.4 SUBMITTALS

A. Submit under provisions of Section 28 05 00.

1.5 QUALITY ASSURANCE

A. Comply with Section 28 05 00.

1.6 EXTRA MATERIALS

A. Deliver the following spare parts at a location to be designated:
1. (1) PLC CPUs
2. (1) input module per Unit – minimum 64 point module installed in Chassis.
3. (1) output module per Unit – minimum 64 point module installed in Chassis.
4. (2) network modules (when applicable)
5. (1) PLC power supplies per Unit

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The control electronics shall be the product of a manufacturer engaged in the production of controllers for industrial applications for a minimum of ten (10) years. Only manufacturers with national distribution will be considered.

2.2 CONTROL ELECTRONICS EQUIPMENT

A. The PLC products specified in this section shall be used with 'NO SUBSTITUTIONS'.
1. PLC CPU and Controller…….Omron CS1D Series
2. PLC Input Module…… Omron CS1D Series
3. PLC Output Module……Omron CS1D Series
4. PLC Network Module…….. Omron Controller Link
5. HMI Control Station……..…… 24" Monitor and PC
6. Monitor Mounts…….Workrite Sequoia
7. Electric Adjustable Desk……Workrite Sierra HXL Electric Rectangular Concave Front 70" x 29"
8. HMI Solution…….....Wonderware

2.3 PLC GENERAL DESCRIPTION

A. General Description:

1. Environmental ratings for all components of the PLC system, except programming equipment, shall meet or exceed the following requirements:
    a. Ambient Temperature rating of 0 to 60 C (32 to 140 F) operational and -20 to 70 C (-4 to 158 F) storage.
    b. Humidity rating of 10% to 90% Relative Humidity (non-condensing).
    c. All system modules shall be designed so as to provide for free airflow convection cooling. No internal fans or other means of cooling except heat sinks shall be required.
2. The PLC shall meet the following standards: UL Listed, CSA Certified, and CE.
3. The PLC and I/O modules shall be of modular and rack mounted construction.
4. The system power supplies shall be protected against short circuits.
5. Programmable controller manufacturer must guarantee the availability of replacement/spare parts for a minimum of ten (10) years.
6. All I/O modules and housings must be of a standard type and fully interchangeable with previous PLC series.
7. All controllers and I/O structures of a single manufacturer shall be capable of being mounted on the same size fixing centers to allow for larger capacity controllers to be installed in the future should the facility require an expansion beyond the limits specified in the original contract documents.
8. Controllers must be capable of driving local I/O racks, where local is defined as up to one hundred (100) feet from the control unit, without the need for further intelligent interface modules.
9. When required, the system must be capable of controlling remote I/O up to a distance of 500 meters (1,640 feet) from the controller, using high-speed links with a minimum data rate of one hundred and eighty seven (187) Kbaud. Communications over this link shall be accomplished using twisted-pair wires with an overall shield.

2.4 PLC CENTRAL PROCESSING UNIT

A. The central processing unit (CPU) shall be microprocessor based, encased in a shielded enclosure to provide RFI protection, and shall provide the logic control functions and date transfer based upon the program stored in memory and the status of the inputs and outputs. The controller must be able to support up to 5,120 local I/O.

B. The minimum standard control functions of the CPU shall include:

1. Relay Ladder Logic
2. Latching relays
3. Timer clock pulses (.02s, 0.1s, 0.2s, 1s & 1m) and timers (.01 & 0.1 sec. Increments).
4. Counters (up/down)
5. Data comparison (=, <, >), data range comparison, and data table comparison.
6. Data transfers (single register, blocks of registers, data distribution and collection using pointer).

7. Synchronous shift registers forward and reverse (multiple channel length bit shifts).
8. One-shot output and input controls.
9. Master control relays (interlocks).
10. Bit reads and moves.
11. I/O forcing and setting
12. BCD to Binary or Hexadecimal conversion.
13. Binary or Hexadecimal to BCD conversion.
14. I/O Refresh on command, immediate I/O inputs, and scheduled interrupt on command.
15. On-line program editing.

C. The following minimum modes of operation of the CPU must be selectable via a key operated switch or programming software commands:
   1. PROGRAM – Processor is not scanning program in memory and all outputs are held OFF.
   2. MONITOR – Processor is executing program and changes in user memory and data memory are allowed.
   3. RUN – Processor is executing program in memory and outputs are controlling to the program. No editing of program or data registers is allowed.

D. The above settings shall require either a key, a programming console with a key, or programming software loaded on a computer to change the operating mode of the CPU.

E. The processor shall incorporate extensive self-diagnostic, which will not half the processor. In addition, separate visual indicators will annunciate at the following conditions:
   1. POWER – Logic power is applied to the CPU and I/O rack from the power supply.
   2. RUN – Processor is executing the program in memory outputs are being controlled according to the program.
   3. OUTPUT INHIBIT – Processor is executing program in memory according to input status, but, outputs are being held in the OFF-state.
   4. ALARM – A non-fatal error (such as a low memory battery condition) has occurred in the PLC hardware or program software. The PLC is still running and the outputs are being controlled according to the program.
   5. ERROR – A fatal error (such as a memory parity error) has occurred, the CPU is not scanning the program, and the outputs are held in the OFF-state.
   6. COMM – Indicating the CPU is communicating with the device connected to the peripheral port or RS-232C port.

F. In addition to visual self-diagnostic indicators (LED's) the processor shall have a specifically designated block of a least 100 words of internal diagnostic words and bits. These shall provide more detailed system status and fault diagnostic information accessible by programming equipment or intelligent peripherals.

G. The processor must contain an error log area. This area must be able to log what error occurred and when the error happened, giving exact time and date. This area must be able to store a minimum of 1000 records.

H. At a minimum, the internal diagnostic registers shall the following information:

1. Type of digital (input or output) or intelligent (analog, ASCII, etc.) I/O unit inserted in a particular slot (I/O table listing). This data should be accessible via programming console or programming software.
2. If an I/O module is improperly mounted (wrong slot) or not in a slot (I/O verify or I/O bus error).
3. Error codes for intelligent I/O module errors.
4. PLC operation mode.
5. Present and maximum scan time.
6. Local Area Network operation status and error status.
7. Local Area Network data Send and Receive verification and error status.
8. Serial Host Computer interface operation and error status.
9. Remote I/O rack operation and error status.
10. Memory Error Area.
11. Startup time. The start time should be updated every time the power is turned ON.
12. Power Interruption Time.

I. A single RS232 or RS422 compatible or Fiber Optic

J. Differential communication port shall be used for software based ladder logic programming and communications to other compatible devices. The PLC system must support up to three of these ports simultaneously.

K. The data rate of the serial communications port shall be switch selectable. The following shall be the minimum available data rates: 300, 1200, 2400, 4800, 9600 and 19,200 baud.

2.5 INPUT/OUTPUT MODULES

A. Each input or output module shall be a self-contained unit housed within an enclosure so that no part of its circuit board is exposed to contact by handling.

B. Input and output units shall be UL listed, CSA certified and CE.

C. Pressure type screw terminals will accept one No. 12 or two No. 14 stranded or solid wires.

D. Convenience marker strips shall be provided adjacent to the I/O field wiring terminals for user labeling of all I/O points.

E. It shall be possible to replace any I/O module without or disturbing user field wiring.

F. Input and output modules shall be available in 8, 16, 32, 64, and 96 points per unit. The 32, 64, and 96-point units shall not be multiplexed I/O and shall have a thumbscrew secured, high density connector capable of accepting individual soldered or crimped connector pins or ribbon cable via IDC type connector configuration.

G. All high-density DC input or output units shall be solid state in nature. The output units shall be transistor type for long life and high DC reliability. Reed relays are not acceptable.

2.6 NETWORK OPTIONS

A. Networking options must include Ethernet, Ethernet IP, Profibus DP, DeviceNet and Omron’s SYSMAC bus remote I/O and ControllerLink network. Ethernet communications

must support TCP, UDP, and FTP protocols. The PLC should have the ability to generate e-mail messages to be sent via WAN or LAN, to report errors, provide scheduled maintenance and status reports. In addition, FTP (file transfer protocol) can be used to transfer data files between a host computer and or FLASH memory card and the PLC's memory.

2.7 HMI CONTROL STATION

A. Each HMI Control Station shall function as the primary means of overall system control and monitoring. The computer equipment shall be arranged to present an efficient and organized appearance.

B. The computer equipment shall be arranged to present an efficient and organized appearance. The following components shall be located with the workstation:

1. PC based computer.
2. 24" LCD Monitor.

C. Provide computer equipment that meets the following minimum specification requirements

1. Intel Pentium 4 microprocessor operating at 3.4 GHz. 2 MB L3 Cache.
2. 4 GB, 533 MHz, DDR2 SDRAM memory.
3. Two (2) 40 GB SATA with RAID.
4. One (1) 48X24X48 IDE CD-RW drive with 8 MB memory, 700 MB media capacity and fifty (50) CD's.
5. Local bus 32-bit IDE controller capable of supporting two (2) hard disk drives.
6. ISA expansion bus with three spare expansion slots.
7. 48X CD-RW and 16X DVD+RW/+R and fifty (50) CD's.
8. Single SVGA video output card 1820 X 1200 pixels at 76Hz, 256 color) with 128 MB DDR SDRAM Memory.
9. Harman/Kardon HK-206 speakers, 3 watts each, 3 in. full range driver, 90 Hz-20Hz frequency response.
10. Tower type chassis including high capacity power supply with surge suppressor.
11. 101 key keyboard.
12. Microsoft mouse.

D. Audio tone generator to activate on reception of an alarm. Audio tone shall be capable of being enabled or disabled on operator command.

E. A 24" LCD panel (monitor) may be an "off-the-shelf" consumer grade panel, but must be secured using custom mounting for adjustable (horizontal, vertical, tilt, with lockable position) movement and minimize shake/torque while in normal operation.

F. A keyboard and mouse is the only means of operator access to the system. To communicate with the direct digital control system, the operator shall input via the keyboard or mouse a command along with a proper alphanumeric identification of the system. Keyboard shall have standard ASCII coded logic outputs, providing full International English language displays and printouts. Auxiliary function keys shall be provided for various functions. These keys shall allow common operations to be performed by punching a single key instead of having to type out the command on the keyboard.

G. A digital display clock shall display on the monitor at all times. Provision for manually resetting it shall be provided. It shall be a 24 hour real-time clock and seven-day calendar to provide data for logging.

H. A network control key or software passwords shall allow automatic functions of the system to continue, but prevent unauthorized tampering with any computer pushbuttons or controls while the computer is unattended. This shall not disable the scanning or alarming functions.

2.8 HUMAN MACHINE INTERFACE (HMI) SOLUTION:

A. Software Architecture General Design Features:

1. The HMI package shall:
2. Be 32-bit software capable of running on operating systems currently supported by Microsoft, including Windows XP, Windows Vista, Windows Server, Windows 2000 (Advanced) Server, Windows 2003 Server, Windows 2008 Server R2.
3. Support and take advantage of multiple processors on the same machine (symmetric multiprocessor design). For example, adding another chip to the computer should distribute the load of the HMI software across both chips, thereby increasing performance, etc.
4. Support and take advantage of multiple threads within the CPU. This multi-threading, among other benefits, aids in multi-tasking for CPU optimization, dependencies, and the like.
5. Have a scalable architecture such that the user can start with a small application and later grow the application database to any size by upgrading the license.
6. Embrace and integrate Microsoft Standards including:
   a. Microsoft Access
   b. Microsoft SQL Server
   c. Microsoft Data Engine (MSDE)
   d. Open Database Connectivity (ODBC)
   e. ADO, OLE-DB for Database Interface
   f. Object Linking and Embedding (OLE)
   g. ActiveX Technologies
   h. OLE for Process Control (OPC)
7. Have the ability to write scripts within the package using a non-proprietary language (e.g.: VBScript).
8. Must support modifications in the driver worksheet to allocate addresses in the PLC (to maintain flexibility on the PLC supplier).

B. Networking:

1. The HMI package shall:
   a. Implement Client / Server Distributed Networking.
   b. Support industry standard network protocols such as Ethernet (TCP/IP and UDP/IP) and Ethernet IP as well as all Omron legacy networks (Controller Link, SYSNET, etc.), without any OPC interface.
   c. Operate on a network with multiple protocol stacks.

d. Plug and Play with standard routers, switches, network Intranets and the Internet.

2. Support, where applicable, a Web based Browser Plug-in so that Alarming, Graphics, Trends can be viewed from any Internet Explorer station in addition to alarming through any Microsoft based operating system. Also, it will permit interaction (e.g., changing set point, switching screens, etc.) from these dedicated Internet Explorer stations.
3. Be configurable as an independent distributed database regardless of the number of nodes in the system.
4. Support at least 256 workstations (nodes) simultaneously.
5. Expansion of the system shall be possible with the addition of non-proprietary PC based off the shelf hardware.
6. Connect to a large number of I/O Device Interfaces via OPC Servers across the network.
7. Allow different versions of the development environment to reside simultaneously on the same computer, under different directories.
8. Have the ability to exchange data with external SQL Relational Databases, via 3rd party ADO providers, without the addition of any add-on packages.
9. Have the ability to save alarm history and event history to any SQL Relational Database, via 3rd party ADO providers, without the addition of any add-on packages.

C. Graphic Display Software Module:

1. The graphical display module shall have the ability to:
   a. Allow configuration of highly detailed screens with animation.
   b. Use an object-oriented design.
   c. Permit using the mouse for object creation, editing, and placing on the screen.
   d. Show object properties for customization with either menu choices, right-clicking, pop-up menus, or double-click shortcuts.
   e. Offer floating, dockable tool bars with drawing and animation tools for building the display.
   f. Provide a grid that can be displayed on screen to assist in aligning objects precisely.
   g. Permit re-sizing of the grid in both the X and Y direction (independently) in one-pixel increments.
   h. Allow "Snap to Grid" functionality to be turned on/off during configuration.
   i. Not require compilation of the displays before use; a simple "save" is all that is needed for use.
   j. Offer Password Protection of displays created.
   k. Provide language switching "on the fly"; with the ability for user-created displays to change languages, as well as the menus and tools employed by the graphics package itself.
   l. Display the graphic interface in 2 monitors connected to the same computer (CPU). The graphic interface available on each monitor must provide independent screen navigation.
   m. Run more than one instance of the graphic interface on the same computer (Thin Client solution) without any additional configuration on the Server station.
   n. Create tags as structures/classes of at least on member.

o. Create array tags and configure another tag as its index when configuring objects on the screen.

D. Alarms and Events:

1. The alarm system shall provide complete alarm and event management with a user-definable message structure.
2. The alarm system shall provide 16 message sub-classes and 16 message types.
3. The alarm system shall provide the ability to condense system alarming by the provision of group messages/alarms.
4. The alarm system shall be programmed to alarm any change of state that the system detects, including:
   a. The failure of communications channels used by the system.
   b. The failure of system's hardware which results in an automatic fail-over of the system's functions from the active to standby server.
5. The alarm system shall be capable of annunciating alarms, including, but not limited to:
   a. Activation of an audible alarm or light.
   b. Alarm display updated with the current alarm.
   c. Alarm banner updated on configured process displays.
6. The alarm system shall display alarm messages in a manner to facilitate easy interpretation of current alarms, including, but not limited to:
   a. Different text color and background color for those points that are in alarm, those that have been acknowledged, and those that are no longer in alarm.
   b. Flashing of the current alarm message(s) in the alarm list.
7. The alarm system shall provide capability to acknowledge alarm message when data point enters and/or exits alarm state. The system shall permit alarm acknowledgement, including, but not limited to:
   a. On an individual point.
   b. On a filtered group of points.
   c. On all alarms.
8. The alarm system shall provide filtering to control the alarms display. The filtering shall include, but not be limited to:
   a. Date.
   b. Time.
   c. Alarm class.
   d. Alarm type.
   e. Alarm priority.
   f. Status (in alarm, out of alarm, or acknowledged).
   g. Any defined alarm message field.
9. Alarm colors vary by equipment served. Alarms colors shall visually annunciate to meet site requirements.

E. Security:

1. The software shall provide a security component for restricting access to different areas of the system.
2. It shall be possible to configure different sets of individual users (range at least 1 to 1000 users) as well as categorizing those users (e.g., engineers, operators, supervisors, etc.) into groups (range at least 1 to 100 groups).
3. It shall be possible to assign a person to more than one group (e.g., Engineer and a Supervisor).
4. For each individual user, and for each group, it shall be possible to define:
    a. Name.
    b. Password, including such parameters as minimum length required, time allowed before it must be changed, and uniqueness over time).
    c. Data Points which can and cannot be written to.
    d. Which screens they have access to.
5. It shall be possible to configure an Auto-Logout period, whereby the user is automatically logged out of the system after a specified amount of time has elapsed.
6. Restrictions on software module interaction shall be configured on a per-user and per-group basis. Items to lock out include:
    a. Exiting the applications.
    b. Printing.
    c. Entering Configuration Mode.
    d. Switching Languages.
    e. Starting/Stopping of Alarm and/or Data Logging.
    f. Acknowledgement of Alarms.
    g. Alarm Filtering.
    h. Changing Zoom Factors in Graphics and Trends.
    i. Modifying and Executing Trend Reports.
    j. Adding, Editing and/or Deleting Trend Pens.
    k. Running a Script.
    l. Accessing the Windows Desktop.
7. If a user fails to successfully log in after a configurable number of times, it shall be possible to lock that account out until either an administrator clears it, or after a preset amount of time has elapsed.
8. A utility shall be provided to show which users are logged into the system (both on the local machine, and on networked machines).

F. Internet Connectivity:
1. A stand-alone Web Server software module shall be provided so the HMI software can be accessed over the Internet.
2. The Web Server module shall run under Windows NT, embedded NT, and Windows 2000.
3. A user shall only require Internet Explorer to be installed on their machine (Thin Client) to access the system, with any “Plug-ins” automatically installed for them by the Server

when they first access a graphic, trend, or alarm screen.

4. A mechanism shall be provided to deliver the software and data updates through firewalls.
5. The Web Server module shall manage the number of concurrent users of the Internet connection. Software licensing agreements shall be provided to allow for six (6) concurrent users.
6. It shall be possible to have “floating” web licenses, whereby if one user logs off, that license is freed up so that another user can log in.
7. The same security system employed by the HMI software shall also manage users connecting via the web.
8. The graphics files shall be represented over the web in the same manner as shown on a “standard” HMI workstation (i.e., close-approximations via HTML are NOT acceptable: the graphics should look and interact the same as a regular station).
9. Anywhere a file path name can be used within the graphics software, a URL shall also be able to be specified.
10. Alarms on a web station shall look and interact the same as a standard workstation.
11. Trend View windows on a web station shall look and interact the same as a standard workstation.
12. A “standard” workstation user shall also be able to connect to a networked system of other “standard” workstations via the Internet.

G. OPC Data:

1. If OPC databases are used, must be able to import OPC tags
2. The OPC Browser shall list all registered OPC Data Servers when making a connection to I/O data, and OPC Alarm and Event Servers when configuring alarms, and OPC Historical Data Access servers when configuring trending applications.
3. It shall be possible to browse OPC Servers installed on the local machine as well as those installed on any node visible on the network.
4. Ability to keep OPC tags on scan to optimize communications to commonly used data items.
5. On-line OPC Data Configuration changes (e.g., adding a new tag on-line) shall be supported by the HMI package.
6. OPC Data Ranges shall be read in and used to configure limits on graphic dynamics, trend limits, data entry field ranges, and so on.
7. OPC Quality Flags shall be used in graphic dynamics (degrees of communication quality shall be indicated by change in color used for objects), data logging, and alarm presentation.
8. A component for bridging/mapping OPC Data from one server to another shall be provided (e.g., map a PLC data point to a Modbus register).

H. Historical Data:

1. The system shall provide a complete historical subsystem providing the user the capability to capture and analyze historical data.
2. There shall be no limit (other than storage capacity) on the number of archives that can be created. The system shall also allow selection of any point in the system to be

added/configured for archiving.

3. The historical subsystem shall use standard Windows tree/list view presentation techniques to facilitate the display and editing of archive timers, archive types, graphical data displays and tabular data displays.
4. The historical subsystem shall promote the visualization of historical data in both tabular and graphical form. This includes the capability to view historical data via a web-enabled interface as specified herein.

I. Reports:

1. The system shall provide an integral reporting subsystem used to report both current and archived data.
2. The reporting subsystem shall provide the capability define reports for both visualization and printed format.
3. The reporting subsystem shall provide the capability to define both the dynamic and static properties reports, including, but not limited to:
   a. Inclusion of archived data, alarm data or event data.
   b. Customization of the format, layout, and graphical images, included on a report.
4. Configuration of automatic report generation, including frequency, destination of the report, and a prioritized list of alternate system resources should problems be encountered during automatic production.
5. The system shall be supplied with pre-configured reports, including, but not limited to:
   a. Graphic display documentation.
   b. Historical archiving.
   c. Alarm archiving.
   d. Control logic/scripting configuration.
   e. User and group security configuration
6. The reporting subsystem shall not impose limits on the number of reports that can be configured.

J. Database:

1. The system shall utilize a real-time relational database for storage of all process related data.
2. The database shall be based on an accepted industry standard database technology.
3. Tag names should be able to support up to 255 characters
4. The database subsystem shall provide the capability of “browsing” an application database, independent of the application.
5. The database system shall support both internal (computational) and external tags (real world). Use of internal tags shall be unlimited.
6. The database system shall provide the ability for each tag (dependant on type) to have high and low limits, start and substitute values.
7. The database system shall provide for event driven execution for data processing. Systems that require external data sources (PLCs) be polled for complete database update shall not be accepted.

K. Client/Server:

1. The software shall employ native client-server architecture. The architecture shall promote the use of multiple server and multiple client (i.e., workstation) configurations.
2. Any server computer shall be able to be dedicated to specific process functionality (i.e., Alarm Service, Historical Data Collection, etc.)
3. All clients shall have the capability to locally store and utilize process displays, as well as local control actions. Should a requested display and/or control action not exist locally at the client level; the client will access the data for the server. This operation will be transparent to the user.
4. All clients shall have complete visibility to all servers, and all servers shall have visibility at the peer level.
5. The software shall promote portability of applications between computers without any redevelopment or modification.
6. It shall be possible for the user to monitor and control the process from client or server. This includes, but is not limited to:
   a. View the same or different displays simultaneously.
   b. Make process adjustments and acknowledge alarms.
   c. View alarms, events, trends, and reports.
7. The development and runtime environments shall be decoupled allowing the user to configure run-time only clients without any development capabilities. Modification of a client from run-time only, to runtime/development, shall be achieved as a simple license upgrade. Reinstallation or new installation of software will be permitted to achieve this functionality.
8. The system shall support implementation of thin-client technology.
9. The HMI system shall support thin-client platforms from PDAs to Industrialized PCs.

L. Redundancy:

1. To maximize data availability and integrity, the system shall provide the ability for configuration of system redundancy.
2. Configuration of system redundancy shall in no way limit or restrict the use of the client/server configuration and/or architecture.
3. Clients shall automatically “failover” to the backup or redundant server. This operation shall not require any application reprogramming or reconfiguration.
4. System redundancy shall be configurable on a “server by server” basis up to a profile of six (6) redundant servers
5. Once a failed server becomes available, the active server shall checkpoint data missing data to the previously failed server. This operation shall occur in the background, and shall not effect the operation of the on-line server.

2.9 BACNET ROUTERS

A. Provide all BACnet routers as necessary to meet the requirements of these specifications.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Section 28 05 00.

B. Comply with manufacturer's recommendations, procedures and standards for the assembly and operation of the Control Electronics.

C. Common functions such as sallyport interlocks shall be wired to a single system. This type of function shall not be networked.

3.2 TRAINING

A. Comply with Section 28 05 00, TRAINING.

3.3 FIELD QUALITY CONTROL

A. Testing: Comply with Section 28 05 00.

END OF SECTION

DIVISIONS 29-30
NOT USED

DIVISION 31
EARTHWORK

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Site clearing and grubbing.

B. Related Sections

1. Section 31 20 00 – Earth Moving.
2. Section 31 25 00 – Erosion and Sediment Controls.

1.2 ENVIRONMENTAL REQUIREMENTS

A. Burning is not permitted.

B. Clearing or grubbing

1. Do not perform during weather conditions which may produce runoff from the site.
2. Resumption of clearing and grubbing will be determined by the County Representative.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Submit plan for debris removal and disposal.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Perform site preparation Work in accordance with the Contract Documents.

B. Verify field measurements are as shown on the Contract Documents.

C. Determine with County Representative existing utilities and other elements that are to remain.

D. Protect elements surrounding the site from damage.

E. Review Storm Water Pollution Prevention Plan (SWPPP) and implement permit recommendations prior to beginning work.

3.2 SITE CLEARING

A. Clear site of trees, shrubs, and other vegetation, except for those indicated to remain. Clearing and grubbing shall consist of:

1. Clearing the area within the limit of work of all objectionable plant material, to include roots, snags, brush, grass, weeds, and similar undesirable vegetation and other debris found at the site not specified as improvements to be included as part of this project. All such

material shall be removed from the site and disposed of in an acceptable manner.

2. In addition to the clearing of vegetation growth, the area shall be grubbed to a depth of 3 inches below finished grade, of debris and rocks over 4 inches in size. Said material shall be removed from the site and disposed of in an acceptable manner.

B. Remove existing above-grade and below-grade improvements as shown on the Contract Documents or found on site and require removal in order to facilitate new construction. For items found on-site that are not identified in the Contract Documents, Contractor shall coordinate with the County Representative for removal.

3.3 DEBRIS DISPOSAL

A. Remove all cleared and grubbed material from the prepared sites areas.

B. Dispose of excess soil material offsite at the designated excess fill disposal area. The fill disposal area shall be where indicated in the Construction Documents.

C. Dispose of trash, demolished material, and debris at approved landfill sites.

D. Burning is not permitted.

END OF SECTION

SECTION 31 13 11

TREE PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the installation of Tree Protection measures as shown on the Drawings and as specified in this Section.

1. The work includes pruning and replacements of trees and vegetation indicated to be protected on the Drawings that are affected by temporary or permanent construction.

B. Related work includes but is not limited to:

1. Demolition
2. Earthwork and Grading
3. Soil Preparation
4. Landscape Planting

1.3 DEFINITIONS

A. Vegetation: Shrubs, groundcovers, grass, and other plants.

B. Root Zone: The root zone diameter of a tree is determined to be that area located out a distance 15 times the trunk diameter in all directions or the drip line, whichever is greater, unless otherwise noted on the Drawings.

C. Protection Zone: Area surrounding individual trees, vegetation areas, and groups of trees and vegetation to be temporarily protected during construction with fencing, as shown on the Drawings. May be referred to as Tree Protection Zone, TPZ or Plant Protection Zone on the Drawings.

1. Temporary protection shall extend till the edge of the Root Zone, unless otherwise noted and shall be fenced.
2. At no time shall the fencing be located closer than 3-feet away from the approved foundation, retaining wall, or grade cut, whichever provides the greater distance from the tree trunk.

D. Topsoil: The top layer of existing soil in planting areas, containing minerals and organic materials including humus, and completely free of weeds, roots, rocks/clods over one cubic inch and other objectionable material. Depth of topsoil shall be taken to be 2-4 inches deep or as determined by the Engineer at the time of construction after clearing and grubbing.

1. At turf areas topsoil starts below the grass root zone.
2. At planting areas other than turf, topsoil starts below the mulch layer.

1.4 QUALITY ASSURANCE

A. Arborist Qualifications: Engage an ISA certified arborist to direct plant-protection measures in the vicinity of trees and vegetation indicated to remain and to prepare inspection reports. Submit qualification data indicating proof of certification / license of the Arborist for approval by Engineer.

1. Cost of the arborist's services shall be borne by the Contractor.

C. Tree Pruning Schedule: Submit written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

D. Reviews: Prior to proceeding with any tree removal or pruning, the Contractor shall notify the Engineer 24 hours in advance for a review by the Engineer.

E. Post-construction Certification: Submit from arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

1. Submit from arborist, recommendations for care and protection of trees affected by construction during and after completing the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fencing: New or re-used chain-link, plywood, wood, or plastic, as approved by the Engineer, minimum 5' high. Fence material shall be mounted on 2" diameter galvanized iron poles, maximum spacing 10' between poles.

B. Warning Sign: Laminated card, rigid plastic or metal sheet, minimum 8.5"x11", with attachment holes, legibly printed with non-fading letters.

1. Sign shall clearly state "WARNING – TREE & PLANT PROTECTION ZONE"

PART 3 EXECUTION

3.1 PRE-CONSTRUCTION

A. Erosion and Sedimentation Control: Verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross Protection Zones.

B. Existing Conditions: Review trees and vegetation indicated to remain on site, and document preconstruction conditions that might be misconstrued as damage caused by construction activities.

C. Documentation: Prepare written report if necessary, endorsed by arborist, listing conditions detrimental to the protection of trees and vegetation.

D. Preconstruction Meeting: Review methods and procedures related to temporary plant protection including, but not limited to:

1. Construction schedule. Verify availability of materials, personnel, and equipment neededto make progress and avoid delays.
2. Enforcing requirements for protection zones.
3. Arborist's responsibilities.
4. Field quality control.

E. Install all protection fencing for tree and Protection Zones prior to any site preparation, demolition, or grading work.

F. Identification: Trees to be preserved shall be marked with a spot of paint. The marking is required to notify County Inspectors that the subject tree or tree(s) are to be fenced at all times during construction.

G. Verification: Verify in writing that all preconstruction conditions noted herein have been met and are in place. Submit verification to the Engineer for approval prior to any site preparation, demolition, or grading work.

3.2 PROTECTION ZONES

A. Protection Zones shall be maintained in a natural condition and not compacted. The following practices are prohibited within tree and Protection Zones:

1. Storage of construction materials, debris, or excavated materials.
2. Dumping of chemicals or garbage.
3. Parking vehicles or equipment.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.
8. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Prohibit heat sources, flames, ignition sources, and smoking within or near Protection Zones and mulch.

C. Signage: Install warning signs in visibly prominent locations in a manner approved by the Engineer or Project Arborist - in enough quantity so as to be visible from all visible sides.

D. Fencing:

1. Fencing shall be located at the edge of the Protection Zone, unless otherwise noted on the Drawings or as approved by the Engineer or Project Arborist.
2. Fencing shall be rigidly supported and maintained during all construction periods until Final Inspection.

3. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the Protection Zone.
4. Temporary access is permitted subject to preapproval in writing by Project Arborist if a root buffer effective against soil compaction is constructed as directed by Project Arborist. Maintain root buffer so long as access is permitted.
5. Removal of fencing shall be approved by Project Arborist or Engineer.

3.3 EXCAVATION

A. All cut, fill and/or foundations shall be located a minimum of three (3) times the diameter of the tree away from the outside edge of the trunk of all trees scheduled for preservation. However, the minimum distance permitted shall be 6-feet away from the outside edge of the trunk for all trees of a trunk diameter less the 2-feet. The diameter of a tree shall be measured at 4-feet and 6-inches above the surrounding grade (diameter at breast height, (DBH). Where Drawings conflict with this, immediately contact the Engineer for direction.

B. Utility and Drainlines: Shall be located outside the root zone of all trees scheduled for preservation. In cases where alternative routes are not available, utility conduit, pipe, wire and drain lines shall be tunneled under major roots. Major roots are determined to be those that exceed two (2) inches in diameter. In no case shall utility lines be permitted within six (6) feet of the trunk. Immediately contact the Engineer if the Drawings conflict with this.

C. All approved construction work within the root zone of trees scheduled for preservation shall observe the following minimum tree protection:

1. Hand trench at point or line of grade cuts closest to the trunk to expose major roots 2-inches in diameter or larger. In cases where rock or unusually dense soil prevents hand trenching, mechanical equipment may be approved by the Engineer, provided that work inside the drip-line is closely supervised by the Arborist to prevent tearing or other damage to major roots.

D. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3-inches back from new construction and as required for root pruning.

E. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.4 PRUNING

A. All tree pruning and tree damage repair shall only be performed by a qualified tree care specialist, or certified tree worker. Verify all pruning with Project Arborist or Engineer prior to start of pruning work.

B. Trees shall be pruned to reduce hazards and develop a strong, safe framework of branches. Trees may also be pruned for ‘crown cleaning’ as defined by the International Society of Arboriculture Pruning Guidelines. Any pruning beyond these activities must be authorized by the Project Arborist in writing.

3.5 REPAIR & REPLACEMENT

A. General: Repair or replace trees and vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Engineer.

1. Perform repairs within 24 hours.
2. Replace trees and vegetation that cannot be repaired and restored to full-growth pattern, as determined by Project Arborist.
3. Replacement planting shall conform to Specification Section Landscape Planting, and soil amendments shall conform to Specification Section Soil Preparation.

B Soil Aeration: Where directed by Project Arborist or Engineer, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.6 REGRADING

A. Lowering and raising grades: Where new finish grade is indicated below or above existing grade around trees, maintain existing grades within the Protection Zone, and slope grade beyond the Protection Zone, unless otherwise noted on the Drawings.

B. Lowering grade within Protection Zone: slope grade away from trees as recommended by Project Arborist unless otherwise noted on the Drawings.

C. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single un-compacted layer and hand grade to required finish elevations.

3.8 CLEAN-UP

A. Remove waste materials and unsuitable and excess material from the Owner's property and dispose of legally.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Site grading.
2. Excavation, filling, and compaction.
3. Rock slope protection.
4. Rock crushing.
5. Scarifying.

B. Related Documents and Sections

1. Geotechnical Investigation Design Phase for Monterey County Adult Jail Housing Addition, prepared by Butano Geotechnical Engineering, Inc., October 2013
2. Storm Water Pollution Prevention Plan (SWPPP) for Monterey County Jail Addition, prepared by Kimley-Horn
3. Structural Testing, Inspection and Observation Program for Monterey County Jail, prepared by Lionakis, February 2, 2016
4. Section 01 40 00 – Quality Requirements
5. Section 02 30 00 – Subsurface Investigation
6. Section 31 11 00 – Clearing and Grubbing
7. Section 31 23 33 – Trenching and Backfill
8. Section 31 25 00 – Erosion and Sedimentation Controls
9. Section 31 32 15 – Lime Stabilization Soil

1.2 REFERENCES

A. ASTM References:

1. ASTM D422-63 (2007) – Test Method for Particle-Size Analysis of Soils.
2. ASTM D1556-06 – Test Method for Density and Unit Weight of Soil in Place by the Sand-cone Method.
3. ASTM D1557-07 – Test Methods for Laboratory Compaction Characteristics of SOild Using Modified Effort (56,000 ft-lb/ft^3 (2,700 kN-m/m^3)).
4. ASTM D2216-12 – Test method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
5. ASTM D2488-09 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
6. ASTM D6938-10 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
7. ASTM D2974-13 – Test Methods for Moisture, Ash, and Organic Matter of Peat and Other

Organic Soils.

8. ASTM D4829-11 – Standard Test Method for Expansion Index of Soils.

B. Caltrans Testing Methods:

1. #206 – Specific Gravity and Absorption of Coarse Aggregate.
2. #229 – Durability Index.
3. #301 – Test for Resistance "R" Value.
4. #373 – Unconfined Compressive Strength of Lime Treated Soils and Aggregate.

C. Caltrans Standard Specifications, May 2010.

1.3 DEFINITIONS

A. Engineered fill – Area within vertical planes located five feet outside the perimeter of each building; or one foot outside the outermost edge of the surface of roadways, parking areas, sidewalks, concrete traffic slabs, or their shoulders unless specifically indicated otherwise on the drawings.

B. Nonstructural Areas – Graded areas for landscaping, including concrete walkways less than four feet wide, berms, and all other areas not defined as a engineered fill or as storm water detention basin.

C. Influence Area – Area within planes sloped downward and outward at an angle of 45 degrees from the horizontal from (a) the outermost edge of engineered fill; or (b) the bottom, outer edge of building perimeter foundations; or (c) the outermost edge at the surface of roadways or shoulder; or (d) one foot outside the exterior edge at the spring line of pipes and culverts.

D. Unclassified Excavation – Nature of materials to be encountered is not identified or described.

E. Free from organic material – no visible wood or roots larger than two inches in diameter and all representative samples one cubic foot or larger shall contain no more than five percent by weight organic material when tested in accordance with ASTM D2974.

1.4 DESCRIPTION

A. Provide materials, services and equipment required for rough and finish grading of the site; construction of berms and embankments; preparing building, structure and road earthen foundation pads to include excavating and recompacting or replacing existing soils to requirements shown on the Contract Documents; densification and stabilization of site soils; rock crushing; and dewatering.

1. Verify shrinkage characteristics of imported soils and existing soils to be reused.
2. The County will not be responsible for additional costs associated with variations in shrinkage factors and related earthwork quantities.
3. The County makes no representation regarding the balance of cut and fill earthwork on the site. The Contractor is responsible for the calculation of cut and fill required and available, for the cost of obtaining fill required, and for the cost of disposal of surplus.

B. Excavations, filling, and fill and backfill material shall have the approval of the County's Representative. Work shall be performed only under the general observation and, where required, the detailed inspection and testing by the County Representative and the Geotechnical Engineer.

1.5 SUBMITTALS

A. Submit, under provisions of Division 01, product data and certificates of compliance for all products and materials proposed to be used under this section.

B. Independent Testing and Laboratory Reports: Submit results of specified tests performed by the Contractor.

C. Storm Water Pollution Prevention Plan (SWPPP) including the firm responsible for preparing the SWPP and the Contractor's representative.

D. Survey Data for Completed Grading: Submit supporting survey data indicating that completed grading conforms to Contract requirements. Submit drawings showing "as-built" elevations marked on the grading plans; include coordinates of each shot.

E. Construction staging plan detailing means, materials, and staging of the work.

F. Samples, product data, and certification for imported materials.

G. Fill Samples: Submit, in air-tight containers, 50 lb sample of each type of imported fill to the County's testing laboratory.

H. Dewatering Plan: Submit dewatering plan for deep excavations.

I. Excess Soils Disposal Plan. Submit drawings showing a proposed grading plan for the disposal of material at the on-site soils disposal area. Plans shall include dimensions, elevations, slopes, drainage patterns, erosion control methods and materials, and drainage facilities.

J. Submit "Shoring and Bracing Drawings" prior to beginning any trench or structure excavation 5 feet deep or over in accordance with Section 6705, California Labor Code. If such plan varies from the shoring system standards established in the construction Safety Orders of the State of California, such alternative system plans shall be prepared, stamped and signed by a civil or structural engineer licensed in the State of California at the Contractor's expense.

K. Submit a construction drainage plan showing the collection and disposal of surface and subsurface water that may be encountered in the course of construction.

1.6 QUALITY ASSURANCE

A. The County will employ and pay for the services of an independent testing laboratory to perform specified testing per CCR Title 24, and any other testing specifically indicated in the Contract Documents to verify compliance with the Contract Documents

B. Relative compaction, moisture, and permeability tests will be made at locations determined by the County Representative. When tests indicate that the specified requirements have not been achieved, that portion of the Work shall be reworked until the required density, moisture, and permeability has been attained. Re-testing to show compliance shall be at the Contractor's expense.

C. Daily testing of material and the work of the Contractor will be made during construction.

D. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with ASTM D 1557. Where cohesionless, free draining soil material is required to be densified to a

percentage of relative density the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 6938, or by such other means acceptable to the Engineer.

1.7 STORAGE AND HANDLING

A. Cover and protect earth materials stockpiled for use from erosion and contamination.

1.8 ENVIRONMENTAL CONDITIONS

A. Weather: Protect bearing surfaces under foundations. Should bearing surfaces become softened, excavate to solid bearing and fill with concrete, mix and strength as approved by the County Representative, to elevations indicated.

B. No fill material shall be placed, spread, or rolled if weather conditions increase the moisture content above permissible limits. When work is interrupted by rain, the earthwork operations shall stop and not be resumed until directed by the County Representative.

PART 2 PRODUCTS

2.1 MATERIALS

A. Engineered fill

1. Fill material for structural pad areas or engineered fill material may be native material obtained from onsite excavations, free from organic and inorganic debris. Particle size shall not exceed 2½ inches in any dimension.
2. Imported soil shall be primarily granular with no material greater than a particle size of 2½ inches in diameter and no more than 20 percent of material passing the #200 sieve. The fines fraction of the fill should not consist of expansive material.
3. Representative samples of material to be used for engineered fill and earth shall be tested to determine the maximum density, optimum moisture content, and classification of the soil.
4. During earthwork operations, soil types other than those identified and/or analyzed in the Geotechnical Report may be encountered. The County's Representative will determine the use or disposal of these soils.

B. Berms, embankments, or Stormwater Detention Basin Material

1. Shall be native on-site fine grained, silty, sandy clay material, free of organic or other deleterious matter and shall not contain lumps or stones larger than 3 inches in maximum dimension. The materials shall include a minimum of 30 percent passing 200-mesh sieve and have a plasticity index of greater than 20 and less than 30. Material may be obtained and used from on-site excavation with the approval of the Geotechnical Engineer.

C. Engineered Fill Material for Influence Areas

1. Shall be the same as engineered fill.

D. Drain Rock

1. Shall conform to Section 68 of the Caltrans Standard Specifications, Class 2 permeable. Material may be obtained and used from on-site excavation with the approval of the Geotechnical Engineer.

E. Sand

1. Material with 100 percent passing a 3/8 inch sieve, at least 90 percent passing a No. 4 sieve, and a sand equivalent value of not less than 30.

F. Filter Fabric

1. Filter fabric shall be a pervious sheet of polyester, polyethylene, nylon, or polypropylene filaments, non-woven, and formed into a uniform pattern. The fabric shall have the following minimum properties when measured in accordance with the referenced standard:
   a. Grab tensile strength, ASTM D1682 — 140 lbs
   b. Trapezoidal tear, ASTM D2263 — 70 lbs
   c. Mullen Burst, ASTM D751 — 200 psi
   d. Permeativity — 50 gpm/sf
2. The filter fabric shall be finished so that the filaments will retain their relative positive with respect to each other. The edges of fabric shall be finished to prevent the outer material from pulling away from the fabric.

G. Rock (Riprap) Slope Protection (RSP)

1. Rock riprap shall be angular and well graded rocks in accordance with Section 72 of the Caltrans Standard Specifications, Facing Class. Rock encountered during site grading operations may be utilized for Rock Slope Protection as approved by the County Representative.
2. Grouted riprap shall be in accordance with section 72-5 of the Caltrans Standard Specifications.
3. Rock slope protection fabric, if used, shall be in accordance with Section 88 of the Caltrans Standard Specifications.

H. Aggregate Base

1. Aggregate base shall be crushed rock aggregate base material meeting the requirements of Section 26, “Aggregate Bases”, for ¾ inch maximum grading of the Caltrans Standard Specifications.

I. Topsoil

1. Topsoil material may be selected excavated, crushed material, graded, free of roots, rocks larger than 2 inches, subsoil, debris, and large weeds. Excavated soil from on-site grading operations may be used for topsoil with the approval of the County Representative.

J. Steel Plate

1. When steel plate bridging is provided in-lieu of backfill and temporary asphalt, it shall conform to Section 602.1 of the Caltrans Encroachment Permit Manual, with the following minimum thicknesses:

Trench Width	Minimum Plate Thickness
10”	1/2”
1’-11”	3/4”
2’-7”	7/8”
3’-5”	1-1/4”

5'-3" [ ]

2. For spans greater than 5 feet 3 inches, a structural design shall be prepared by a civil engineer registered with the State of California.

PART 3 EXECUTION

3.1 PREPARATION

A. Should indicated conditions conflict with actual conditions and contours, notify the County Representative and await directions before proceeding. Commencement of work indicates acceptance of existing conditions.

B. Contractor shall protect adjacent property and existing improvements and structures as necessary to prevent undermining, caving of cuts, and miscellaneous damage. Protect structures, utilities, sidewalk, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

C. Excavate for structures to the lines and grades shown or as required to accomplish the construction. Perform all excavation regardless of the type, nature, or condition of the material encountered. The method of excavation used is optional; however, no heavy equipment shall be operated within 5 feet of existing structures or newly completed construction, except as approved. Excavation that cannot be accomplished without endangering the present or new structures shall be performed with hand tools. The bottom of all excavations shall be proof rolled to observe the presence of any potentially soft, yielding subgrade conditions. Notify the County Representative prior to commencement of proof rolling.

D. Excavations and trenches shall be properly sheeted, shored, braced and/or sloped to support adjacent earth banks, structures, construction materials, and equipment and to provide safe working conditions. No trench, pit, or other excavation shall remain open longer than is necessary to expeditiously carry out the work.

3.2 SITE PREPARATION

A. Perform clearing and grubbing in accordance with Section 31 11 00.

B. Material with concentrations of organics greater than 5 percent, as determined by ASTM D2974, shall be removed or placed in non-structural areas. Strippings shall not be used within embankment, structural, or pavement fills and shall be spread in the designated excess fill disposal area shown on the Drawings.

3.3 REMOVAL OF WATER

A. At all times, provide and maintain means and devices to remove and dispose of water entering excavations until backfill is complete.

B. Determine means and methods and perform dewatering as needed to establish a stable structure base. Additional dewatering and/or other measures may be necessary to prevent flotation or disturbance of underground structures.

C. Dewatering facilities shall be installed and functioning prior to excavation below groundwater levels in order to avoid heave of the excavation bottom and/or wall instability. Sufficient time shall be planned between dewatering and excavation to allow for drawdown of groundwater surfaces to below the lowest adjacent excavation. Dewatering may consist of closely spaced

well points, sheet piling, parallel subdrains, cutoff trenches, and/or other means and methods proved suitable by the Contractor.

D. Water disposal shall meet applicable Federal, state, and local requirements.

3.4 EXCAVATION

A. Excavation method shall be approved by the County Representative prior to commencement of the Work. Explosives may not be used unless specifically authorized.

B. Excavate and remove earth material per specified requirements within the areas scheduled for subgrade construction.

C. Extend excavations a minimum lateral distance of 8 feet beyond the building perimeters or a distance equal to the depth of the excavation, whichever is greater. Unless shown or specified, excavate a minimum of 3 feet below the bottom of the building footing or slab, whichever is deeper.

D. Pavement areas shall be excavated to a minimum depth of 1.5 feet below finish ground surface.

E. Excavate to solid bearing based on depths or elevations indicated on the Contract Documents. Do not carry excavations deeper than the elevation shown or established by the County Representative. Excavations carried below the grade lines shall be replaced with approved compacted engineered fill material at the Contractor's expense. Over-excavations under footings shall be filled with engineered fill. Cuts below grade shall be corrected by similarly cutting adjoining areas and creating a smooth transition. The Contractor shall bear all costs for correcting over-excavated areas.

F. If solid bearing is not achieved at indicated elevations because of naturally occurring conditions, over-excavate per County direction. Costs for over-excavation shall be paid by contract change order at the unit cost provided in Contractor's bid.

G. In excavating for footings and slabs on grade, do not disturb the bottom of excavation. Trim bottoms to required lines and grades and provide a solid base to receive concrete. Bottom of excavated areas shall be free of loose materials, debris, and water before concrete is placed.

3.5 PLACING ENGINEERED FILL

A. Following required clearing, grubbing and excavation, exposed soil surfaces to receive engineered fill shall be scarified to a depth of 12 inches, moisture conditioned to at least 2 percent above the optimum moisture content, and recompacted to a minimum of 90 percent dry density based on ASTM D1557. Moisture conditioning and compaction shall be performed within 48 hours of fill placement. If fill operations do not occur within 48 hours, periodic sprinkling of the surface will be required to maintain moisture conditioning

B. Filling and backfilling shall consist of placing and compacting engineered fill material in excavations to the finish grades indicated in the Contract documents. Do no backfilling until each specific location is approved by the County Representative. Perform subgrade stabilization by removing unsuitable material and backfilling with approved material as directed by the County Representative.

C. Fill composed of native or import soil shall be brought to grade in level lifts which do not exceed a thickness which allows for uniform compaction throughout the lift(i.e. 3 to 6 inches for hand tampered, 6 to 8 inches for convential sheeps foot drum roller, or 18 inches for open

hub/ring wheel compactors). Spread each layer evenly and thoroughly mix each layer during the spreading to insure uniformity of material and moisture in each layer. After each layer has been placed, mixed, and spread evenly, it shall be compacted to a minimum of 90 percent, but not more than 95 percent, dry density based on ASTM D1557.

Engineered fill placed within 4 feet of the finished grade in building areas shall be moisture conditioned to at least 4 percent above the optimum moisture content. All other engineered fill shall be moisture conditioned to at least 2 percent above the optimum moisture content.

In lieu of compaction, engineered fill material placed with 1.5 feet of finished subgrade elevation within building, pavement or exterior concrete (wider than 2 feet) areas may be wheel rolled during placement to a firm consistently, in preparation for lime treatment.

D. If material is too dry, add water to raise fill to the required moisture content. If material is too wet, disc as required to dry to the required optimum moisture content. “Puddling” or “soaking” will not be permitted.

E. Cut/Fill slopes shall be graded to the slopes shown on the Drawings. Track-walking is not an acceptable method of slope compaction. Slopes shall be overbuilt and cut back to finished grade.

F. Work that has been suspended by weather, scheduling or for any other reason, shall be protected against the effects of such weather or other conditions. Grading which has been considered acceptable, but which has been subsequently damaged shall be re-worked to meet the requirements of the Contract Documents.

G. Slopes shall be re-dressed as required to mitigate any erosion that may occur prior to establishment of the erosion control mitigation measures. Exterior slopes shall be roughened by track walking or with a serrated slope bar.

H. Where engineered fill is placed on a grade steeper than 6V:1H (17 percent), essentially level benches shall be cut into the sloping grade as fill is brought up. The vertical height of a single bench shall not exceed 3 feet.

3.6 COMPACTION

A. Compact areas not accessible to heavy equipment with pneumatic hand tampers.

B. Compact areas within 5 feet of footings, foundations, and walls with hand-held vibratory and/or impact type compaction equipment.

C. Comply with all recommendations of the County Representative and the requirements of the CBC Chapter 33, Section 1-3301.

D. Contractor shall allow for and accommodate the County Representative to perform compaction testing.

3.7 SAWCUTTING

A. Existing asphalt concrete or portland cement concrete to be removed shall be sawcut along a neat, straight line. Removal of existing asphalt concrete or Portland Cement concrete shall be performed in such a manner as to prevent chipping or spalling of the existing asphalt concrete or Portland Cement concrete that is to remain in place.

3.8 GRADE TOLERANCES

A. The subgrade below base and subbase of the various pavement structural section types indicated in the Contract Documents shall not vary by more than 0.10 foot above or below the grade determined from the Contract Documents. The subgrade below asphalt shall not vary by more than 0.05 foot above or below the grade determined from the Contract Documents.

B. The elevation of building pads shall not vary by more than 0.05 foot above or below the grade determined from the Contract Documents.

C. The average plane of excavation and embankment slopes equal to or steeper than six horizontal to one vertical (6H:1V) shall conform to the slopes indicated in the Contract Documents. No point on the completed slopes shall vary from the designated slopes by more than 0.5 foot measured at right angles to the slope.

D. The average plane of excavation and embankment slopes flatter than six horizontal to one vertical (6H:1V) shall conform to the slopes indicated in the Contract Documents. No point on the completed slopes shall vary from the designated slopes by more than 0.1 foot measured at right angles to the slope.

E. The average flow line grade of ditches and swales shall conform to the grades determined from the Contract Documents, shall be free draining, and shall not vary from the designated grade by more than 0.10 foot above or below.

F. Finished grades in all other areas shall not vary from the grades indicated in the Contract Documents by more than 0.1 foot above or below. Rough interim grades established prior to finish site grading operations shall not vary from the grades indicated in the Contract Documents by more than 0.2 foot above or below.

3.9 DISPOSAL OF EXCESS EXCAVATION

A. Dispose of excess excavated materials to the on-site locations designated for excess fill disposal indicated in the Contract Documents or as directed by the County Representative. Leave the disposal areas in a neat, uniformly graded, free draining condition or as indicated on the plans. Provide erosion control measures as required to prevent silt runoff.

3.10 SETTLEMENT

A. Any settlement in backfill, fill, or in structures built over the backfill or fill, which may occur within the guarantee period will be considered to be caused by improper compaction methods and shall be corrected at the Contractor’s expense. Any structures damaged by settlement shall be restored to their original condition by the Contractor at no cost to the County.

3.11 FILTER FABRIC

A. Surfaces to receive filter fabric shall be prepared to a relatively smooth condition and be free of obstructions. The fabric shall be placed loosely, not in a stretched condition. The drain rock shall be placed so the fabric is not punctured and shall completely cover the fabric. The fabric shall overlap a minimum of 12 inches on sloping surfaces and the upper panel shall overlap the lower.

3.12 ROCK (RIP RAP) SLOPE PROTECTION

A. Rock riprap shall be so placed as to provide a minimum of voids. The larger rocks shall be placed in the toe course and on the outside surface of the slope protection surface. Local

surface irregularities shall not vary from the design grades by more than 1 foot measured at right angles to the slope.

B. All rock slope protection shall be installed per Method "A" in accordance with section 72-2.03 of the Caltrans Standard Specifications.

C. Grouted riprap shall be installed in accordance with section 72-5.04 of the Caltrans Standard Specifications for placement of concrete.

D. Rock slope protection fabric shall be installed in accordance with section 72-2.025 of the Caltrans Standard Specifications.

3.13 FIELD QUALITY CONTROL

A. The County will retain the services of an independent testing agency to perform field quality control tests.

B. In general, frequency of testing shall be as follows. Additional testing may be performed as determined by the County Representative.

Test Method	Cubic Yards Placed
1. Laboratory Testing	
a. Grain Size Analysis - ASTM D422	20,000[a,c]
b. Moisture-Density Relationships (Compaction) - ASTM D1557	20,000[a]
c. Expansion Index - ASTM D4829	35,000[a]
d. Moisture Content - ASTM D2216	25,000[a,d]
2. Field Testing	
a. Nuclear Gauge Density Testing - ASTM 6938	2,000[b]
b. Sand Cone Density Testing - ASTM D1556	25,000[e]

[a] Testing will be performed more frequently if soils vary, i.e., at least one test per soil type.

[b] One or more test per day will be performed when the rate of fill placement is between 1 and 2,000 cubic yards per day. One test per lift per each 1,500 square feet in structural pad areas will be performed.

[c] Testing will not be required for native site soil, where visual obsesrvation can confirm the maximum particle dimension is less than 2½ inches.

[d] Test to be performed in connection to sand cone density test.

[e] Test to be performed at location of nuclear gauge density test. First test shall be performed on first day of grading to confirm nuclear gauge calibration.

C. If tests indicate Work does not meet specified requirements, the County Representative will notify Contractor who shall proceed to correct the deficient work and request a retest. Costs for retesting shall be paid for by the Contractor.

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Trenching and Backfill.

B. Related Documents and Sections

1. Geotechnical Investigation Design Phase for Monterey County Adult Jail Housing Addition, prepared by Butano Geotechnical Engineering, Inc., October 2013
2. Structural Testing, Inspection and Observation Program for Monterey County Jail, prepared by Lionakis, February 2, 2016
3. Section 01 40 00 – Quality Requirements
4. Section 02 30 00 – Subsurface Investigation
5. Section 31 20 00 – Earth Moving
6. Section 31 25 00 – Erosion Control and Sedimentation Controls

1.2 REFERENCES

A. ASTM References:

1. ASTM C33-13 – Concrete Aggregate.
2. ASTM C94-14b – Ready-Mixed Concrete.
3. ASTM C136-06 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM D1557-07 – Test Methods for Laboratory Compaction Characteristics of SOild Using Modified Effort (56,000 ft-lb/ft^3 (2,700 kN-m/m^3)).
5. ASTM D2487-11 – Classification of Soils for Engineering Purposes (Unified Soil Classification System)
6. ASTM D422-63 (2007) – Test Method for Particle-Size Analysis of Soils.
7. ASTM D4318-10 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
8. ASTM D6938-10 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. Caltrans Testing Methods:

1. #205 – Determining Percentages of Crushed Particles.
2. #217 – sand Equivalent.
3. #229 – Durability Index.

C. Caltrans Standard Specifications, May 2010.

1.3 DEFINITIONS

A. Pipe Base: The trench area between the bottom of the trench and the bottom of the pipe. Extend full width and length of trench.

B. Pipe Zone: Area of trench between the top of the pipe base and six inches above the pipe, unless otherwise indicated. Extend full width and length of trench.

C. Backfill Zone: Area above Pipe Zone to finish grade.

D. Relative Compaction: Field-measured dry weight expressed as a percent of maximum dry density of same soil determined in accordance with ASTM D1557.

E. Unclassified Excavation: Nature of materials to be encountered is not identified or described.

1.4 DESCRIPTION

A. Provide materials, services, and equipment required for trenching, backfilling, and compacting.

B. Trenching, backfilling, and compacting shall have the approval of County Representative. Work shall be done only under the general observation and, where required, the detailed inspection of the County Representative. Do not backfill until each specific location is approved. Water lines shall be pressure tested and approved by the CSFM before pipe zone and backfill zone materials are installed.

1.5 SUBMITTALS

A. Submit, under provisions of Division 01, product data and certificates of compliance for all materials proposed to be used under this Section

B. Independent Testing and Laboratory Reports: Submit results of specified tests performed by the Contractor.

C. Submit methods and procedures for excavation, backfilling, compaction, and moisture addition or drying of all materials.

D. Dewatering Plan: Submit dewatering plan for trench construction below anticipated groundwater levels.

E. Submit “Shoring and Bracing Drawings” prior to beginning any trench or structure excavation 5 feet deep or over, in accordance with Section 6705, California Labor Code. If such plan varies from the shoring system standards established in the construction Safety Orders of the State of California, such alternative system plans shall be prepared, stamped and signed by a civil or structural engineer licensed in the State of California at the Contractor’s expense.

F. Submit a construction drainage plan showing the collection and disposal of surface and subsurface water that may be encountered in the course of construction.

1.6 QUALITY ASSURANCE

A. The County will employ and pay for services of an independent testing laboratory to perform specified testing per CCR Title 24, and any other testing specifically indicated in the Contract Documents to verify compliance with the Contract Documents.

PART 2 PRODUCTS

2.1 PIPE BASE AND PIPE ZONE

A. Use sand conforming to ASTM C33 for conduit of any material less than 3-inch diameter and PVC pipe of any size.

B. Use crushed, partially crushed, or naturally occurring granular material, free from organic and inorganic debris, liquid limit less than 50, and plasticity index less than 20, that meets the following requirements for underground piping three inch or larger diameter, unless otherwise indicated:

San Equivalent	35% minimum
Passing 3/4-inch square sieve	100%
Passing 3/8-inch square sieve	50% - 75%
Passing No. 8 square sieve	5% - 15%
Passing No. 200 square sieve	0% - 3%

2.2 BACKFILL MATERIAL

A. Native material: Free from organic and inorganic debris and containing materials no larger than 3-inches maximum size.

B. Sand Slurry Mixture: One sack cement mix with sand aggregate; maximum slump of four inches.

2.3 STABILIZATION MATERIAL

A. Shall consist of uniformly graded, 2-inch minus coarse aggregate with percent by weight conforming to 100 percent passing the 3-inch sieve and 0 to 10 percent passing the No. 200 sieve.

2.4 STRUCTURAL FILL UNDER AND AROUND VAULTS, MANHOLES, AND STRUCTURES

A. Shall be 3/4 inch class 2 aggregate base or equivalent. Aggregate Base shall be crushed rock aggregate base material meeting the requirements of Section 26 of the Caltrans Standard Specifications.

2.5 STEEL PLATE

A. When steel plate bridging is provided in-lieu of backfill and temporary asphalt, it shall conform to Section 602.1 of the Caltrans Encroachment Permit Manual, with the following minimum thicknesses:

Trench Width	Minimum Plate Thickness
10”	1/2”
1’-11”	3/4”
2’-7”	7/8”
3’-5”	1-1/4”
5’-3”	[ ]

1. For spans greater than 5 feet 3 inches, a structural design shall be prepared by a civil engineer registered with the State of California.

2.6 CONCRETE FOR TRENCH BACKFILL

1. Conform to ASTM C94, Alternate 3. Proportion to obtain a 28 day compressive strength of 2,500 pounds per square inch. Use a minimum of five sacks of cement per cubic yard of concrete.

PART 3 EXECUTION

3.1 GENERAL

A. Verify that native excavated material to be reused as backfill meets specified requirements and is acceptable to County Representative.

B. Verify lines and grades of proposed trench/utilities.

C. Water lines that are part of the fire protection system shall be tested per California State Fire Marshal (CSFM) requirements prior to placement of pipe zone and backfill materials.

3.2 REMOVAL OF WATER

A. At all times, provide and maintain means and devices to remove and dispose of water entering trench during preparations for and during pipe laying, and until backfill of the pipe is complete.

B. Determine means and methods and perform dewatering as needed to establish a stable structure base. Additional dewatering and/or other measures may be necessary to prevent flotation or disturbance of underground structures.

C. Dewatering facilities shall be installed and functioning prior to excavation below groundwater levels in order to avoid heave of the excavation bottom and/or wall instability. Sufficient time shall be planned between dewatering and excavation to allow for drawdown of groundwater surfaces to below the lowest adjacent excavation. Dewatering may consist of closely spaced well points, sheet piling, parallel subdrains, cutoff trenches, and/or other means and methods proved suitable by the Contractor.

D. Water disposal shall meet applicable Federal, state, and local requirements.

3.3 TRENCH EXCAVATION

A. Trench excavation is unclassified. Excavate depth and width as shown or as directed. Allow for cover and pipe base under pipe. Remove loose matter.

B. Comply with CAL-OSHA requirements regarding trench bracing and shoring.

C. If Contractor elects to slope top of trench in lieu of trench bracing, the trench width shall be maintained at least 2 feet above top of pipe before sloping begins. Sloping, unless otherwise approved by the County Representative, shall not be steeper than 1(H):1(V).

D. The Contractor shall furnish and install all shoring, sheeting and bracing required to support adjacent earth banks and structures for the protection and safety of all personnel working in the trench. All shoring, sheeting and bracing shall conform to the requirements of the State or local agencies having jurisdiction over such matters. Remove shoring, sheeting and bracing in a manner that will protect the workman and prevent caving of banks and damage to the pipe, excavation, backfill or adjacent property.

E. Contractor shall construct the trench to the line and grades as shown on the Contract Documents. Proper allowance shall be made for pipe thickness, bedding material and stabilization material.

F. Any part of the trench excavated below grade shall be backfilled with stabilization or pipe base/zone material as approved by the County Representative and compacted to a density equal to the undisturbed trench bottom at Contractor’s expense.

G. All pipe with grades less than 1 percent shall be installed to grade and alignment established by an electronic, self-leveling, collimated laser beam which shall have good visibility and meet

all Federal, State, and Engineer requirements as to safety, operation and field use. The laser beam shall have an off-grade warning system which shall operate until the instrument is corrected to grade. The beam shall have a minimum accuracy of + 0.001 percent of grade, + 0.01 percent of alignment, and a minimum visible range of 600 feet. The Contractor shall periodically check the accuracy of the laser setting. Corrections in grade shall be made at the Contractor's expense as directed by the County Representative.

H. The Contractor may use batter boards with a string line with horizontal level and vertical grade rod for grades over one percent, or may use other methods approved by the County representative.

I. No dead flat or reverse grades will be accepted.

J. Where pipelines are to be installed in embankments, embankment shall be placed and compacted to a minimum of 2 feet above the top of the pipe before trench excavation will be allowed.

K. On all roadways, except with specific approval of the County Representative [and the jurisdictional authority if the roadway is off-site], no more than 150 feet of open trench shall be excavated in advance of laying the pipe. No excavated trench shall remain open at the end of each day's work without trench plates. All operations shall be carried out in an orderly fashion. Backfilling, compacting, base and cleanup shall be accomplished as sections of the pipe are installed.

L. Where it is necessary to cross or parallel drainage ditches and swales or channels, the backfill on the bottom and banks of such shall be carefully placed and compacted to 95 percent relative compaction with impervious material so as to avoid settlement or erosion. The shape of the banks and bottom shall be restored and left in good condition.

3.4 PIPE BASE

A. Provide pipe base for supporting pipe for full width of trench. Unless shown otherwise, minimum depth of pipe base below pipe shall be four inches and not less than three inches under pipe bell.

B. Hand-grade ahead of pipe laying. Provide a firm, unyielding base.

C. If trench is excavated below required depth for pipe base, fill the excess depth with stabilization or pipe base/zone material to proper subgrade. Place pipe material for full width of trench in layers not exceeding six inches deep and compact until material does not yield or move.

D. Authorized overexcavation and backfill for subgrade stabilization will be paid for by contract change order when the exposed subgrade is unstable and subgrade stabilization is required, as determined by the County Representative. Stabilization required as a result of the Contractor's operations or inadequate dewatering shall be performed by the Contractor at no additional cost to the County.

3.5 PIPE ZONE

A. Do not proceed with placing pipe zone material until pipe base stability has been approved by the County Representative. Perform pipe base stabilization including dewatering and drying of the subgrade, removal of yielding soils as directed by the County Representative and replacement with additional pipe base material, gravel or crushed rock (3-inch minus).

B. Use pipe zone material within the pipe zone except where concrete encased. Place material simultaneously on both sides of pipe in a manner approved by the County Representative. Lifts shall not exceed six inches.

C. “Walk-in” each lift of backfill. Slice with a shovel or tamp with J-bars or similar devices so that all voids around pipe are filled.

D. Give particular attention to zone from bottom of pipe to pipe springline. Ensure firm support to prevent lateral movement or pipe deflection during final backfilling.

3.6 BACKFILL ZONE

A. Place moisture-conditioned backfill material in lifts not exceeding six inches for hand operated mechanical compactors and not exceeding eight inches for heavy equipment compactors.

B. Compact backfill to at least 90 percent relative compaction to within 2 feet of subgrade.

C. Compact the upper 24 inches of backfill to a minimum of 95 percent relative compaction when the trench is beneath pavement areas or where trench is beneath structures. Compact to 90 percent relative compaction in all other locations.

D. Jetting will not be permitted.

3.7 SETTLEMENT OF PAVED AND UNPAVED AREAS

A. The Contractor shall repair all damage caused by settlement deemed to have occurred if the following conditions exist:

1. In paved areas, the depression of 3/8-inch below the average of the sides of the uncut portion shall be deemed a settlement.
2. Along shoulder areas and unpaved portions of the roadways, a depression of 3/4-inch below the average of the sides of the uncut portion shall be deemed a settlement.
3. Across all unpaved areas, or areas untravelled by automotive equipment, a depression of 1-1/2-inches below the average of the sides of the uncut portion shall be deemed a settlement. In this regard, any settlement that causes drainage problems or concentration causing water to run along the depression shall be subject to correction immediately during the entire guaranty period.

3.8 PAVING REMOVAL

A. Asphalt concrete or concrete on roads shall be saw cut before excavation. Cutting with a spade or jackhammer or grader-mounted wheel will not be allowed. Armor coats on roads shall be cut with a suitable tool before excavation. Breaking of asphalt, concrete or armor coats with excavation equipment will not be permitted.

B. All edges of asphalt concrete or armor coats shall be cut vertically, with a neat, square edge.

C. In all cases, existing asphalt paving, concrete, or armor coating shall be saw cut after construction and just prior to final paving to a point 6 inches or wider than each side of the trench line. Saw cuts shall parallel or be perpendicular to center line of the trench.

D. Excess paving shall be disposed of per the County Representative’s direction and shall not be used as backfill material.

3.9 FIELD QUALITY CONTROL

A. Field testing will be performed under provisions of Division 1.

B. The County Representative will conduct nuclear gauge moisture and density testing in accordance with ASTM 6938 procedures on each lift of trench materials placed every 100 feet of trench or every 100 cubic yards, whichever occurs sooner

3.10 COMPLETION REQUIREMENTS

A. Dispose of suitable excess excavated material in fill area. Dispose of unsuitable excavated material in disposal area. Leave disposal area in a neat, free-draining condition.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Erosion and sediment control measures.

B. Related Documents and Sections

1. Storm Water Pollution Prevention Plan (SWPPP) for Monterey County Jail Addition, prepared by Kimley-Horn
2. Geotechnical Investigation Design Phase for Monterey County Adult Jail Housing Addition, prepared by Butano Geotechnical Engineering, Inc., October 2013
3. Section 00 31 19 – Existing Condition Information
4. Section 00 31 26 – Existing Hazardous Material Information
5. Section 00 31 32 – Geotechnical Data
6. Section 00 31 43 – Permit Application
7. Section 31 20 00 – Earth Moving

1.2 REFERENCES

1. ASTM A116 – Metallic-Coated Steel Woven Wire Fence Fabric.
2. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
3. ASTM A702 – Steel Fence Posts and Assemblies, Hot Wrought.
4. ASTM D4632 – Test Method for Grab Breaking Load and Elongation of Geotextiles.
5. ASTM D5034 – Test Methods for Breaking Strength and Elongation of Textile Fabrics.
6. CTM 206 – Test for Specific Gravity and Absorption of Coarse Aggregate.
7. CTM 229 – Durability Index.

1.3 DESCRIPTION

A. Provide materials, services, and equipment required for controlling pollutants in storm water runoff associated with construction activity.

B. Perform Storm Water Pollution Prevention Plan (SWPPP) requirements in accordance with the project SWPPP and Section 01 35 43.

C. Water Quality – Measures must be provided to prevent siltation of streams, rivers, lakes and bays etc.; avert instream degradation due to turbidity and pollutant load; and prevent toxic materials from leaving the construction site.

D. Existing System – Existing System - Methods must be provided to prevent construction sediment from entering existing drainage facilities or other watercourses.

E. Adjacent Properties – Methods shall be employed to prevent any damage to adjacent public and private properties.

F. Areas requiring protection shall include all areas disturbed by demolition, site preparation, or earthwork. Other areas including access roads, staging areas, and other areas potentially disturbed by the Contractor's activities shall be protected.

G. Maintain fences, fiber rolls, straw mulch, dikes, check dams, sediment basins, detention basins, and other erosion control features provided under this Bid Package.

1.4 SUBMITTALS

A. Submit, under provisions of Division 01 33 00, product data and certificates of compliance for all materials proposed to be used under this section.

B. Submit revision form for any modification to the SWPPP.

1.5 SCHEDULE

A. Construct erosion control measures early in the project, but no later than the start of excavation or hard demolition.

B. Stake grading areas after receiving the Notice to Proceed and before any grading operations have taken place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Silt Fence filter Fabric:

1. A pervious sheet of synthetic polymer composed of at least 85 percent by weight ethylene, propylene, amide, ester or vinylidene yarn, woven or non-woven, and containing stabilizers and/or inhibitors to resist deterioration by heat, water, and ultraviolet light.
2. Fabric shall conform to the following criteria:
   a. Equivalent Opening Size (U.S. Standard Sieve): 70 to 100 range.
   b. Tensile Strength: ASTM D1682, Method G; Minimum 200 pounds.

B. Silt Fence Posts:

1. Redwood, cedar, or Douglas fir, cut from sound timber, free from unsound knots, or other defects which render them unfit structurally.
2. Metal posts; ASTM A702, Class B steel with anchor plate. Metal posts shall be minimum length of 5 feet.

C. Wire Fence Fabric for Silt Fences:

1. ASTM A116, Class 1; 39 inches wide, consisting of nine horizontal wires with vertical stays spaced 6 inches apart; top and bottom wires 10 gauge, remaining wires 12-1/2 gauge.

D. Fiber Rolls:

1. Prefabricated rolls of straw, flax or similar material.
2. Rolled tubes of erosion control blanket/mat:
   a. Roll length of erosion control blanket/mat into a tube of minimum 8 inch diameter.
   b. Bind roll at each end and every 4 feet along length of roll with jute-type twine.

E. Aggregate for Stabilized Construction Entrance: Asphalt concrete grindings shall not be used.

1. 2 to 4 inches in size, washed, well-graded gravel or crushed rock conforming to the following quality requirements:

Test	California Test Method	Requirement
Apparent Specific Gravity	206	2.5 min
Absorption	206	4.2% max.
Durability Index	229	52 min.

F. Straw bales shall be machine baled clean rice straw free of seed from noxious weeds using standard baling wire or string.

PART 3 EXECUTION

3.1 LIMITS OF WORK

A. Confine soil disturbance, grading and machinery access to the construction areas shown on the Contract Documents

B. No payments will be made for additional Work or damages caused by the Contractor's performance of the Work, either inside or outside the County property.

3.2 SILT FENCES

A. On slopes, construct the fence to follow the contours as closely as possible. In small swales, curve the fence upstream at the sides to direct the flow toward the middle of the fence.

B. Cut filter fabric from a continuous roll to avoid the use of joints. When joints are necessary, splice fabric only at a support post, with minimum 6-inch overlap, both ends securely fastened to the post.

C. Space posts a maximum of ten feet apart; place securely into the ground, with a minimum buried depth of 12 inches for steel, three feet for wood.

D. Excavate a trench approximately six inches wide and six inches deep along the line of posts and upslope from the barrier.

E. Staple or wire filter fabric to the fence, and extend into the trench as shown on the Contract Documents. Extend fabric approximately 36 inches above the original ground surface.

F. Backfill the trench and compact soil over the toe of the filter fabric.

G. Remove the silt fence at the completion of construction per direction from the County Representative.

3.3 FIBER ROLLS

A. Locate fiber rolls on level contours spaced as follows:

1. Slope inclination of 4:1 (H:V) or flatter: Fiber Rolls should be placed at a maximum interval of 20 feet. Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 feet.
2. Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 feet.
3. Fiber Rolls at the toe of slopes greater than 5:1 (H:V) should be a minimum of 20-inch diameter or installations achieving the same protection (i.e. stacked smaller diameter fiber

rolls, etc.).

B. Turn the ends of the fiber roll up-slope to prevent runoff from going around the roll.

C. Stake fiber rolls into a 2 to 4 inch deep trench with a width equal to the diameter of the fiber roll.

D. Drive stakes at the end of each fiber roll and spaced 4 feet maximum on center.

E. Use wood stakes with a nominal classification of 0.75 inches by 0.75 inches and minimum length of 24 inches.

F. If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.

3.4 STRAW BALE DIKE

A. Bales shall be placed in a row with ends tightly abutting. Place loose straw between adjacent bales to close voids. Each bale shall be anchored with two #4 rebar conforming to ASTM A615, Grade 40.

3.5 STABILIZED CONSTRUCTION ENTRANCE PAD

A. Provide one stabilized construction entrance pad located on the primary construction road servicing the site. Maintain the entrance pad in a condition that will prevent tracking mud or flowing of sediment onto public right-of-ways.

B. Stabilized construction entrance shall be minimum 50 feet long and 30 feet wide. Provide adequate turning radii at the entrance for construction vehicles. Aggregate depth shall be a minimum of 12 inches, or as directed by the County representative and Geotechnical Engineer, designed for the heaviest vehicles and equipment used.

C. Provide periodic top dressing with additional rock as conditions demand; repair and clean out trapped sediment. Remove any sediment spilled, dropped, washed or tracked onto public rights-of-way, through street sweeping or vacuuming.

D. Clean vehicle and equipment wheels to remove any retained sediment prior to entrance onto public rights-of-way. When washing is used to prevent tracking, wash on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin. Prevent sediment from entering any storm drain, ditch, or watercourse through use of sand bags, gravel, boards, or other methods as approved by the County Representative.

E. Each stabilized construction entrance shall include a tire wash rack. The wash rack shall be a corrugated steel panel. Each panel must be pressed or shop welded and have a slot or hook for connecting the panels together.

3.6 WIND EROSION / AIR POLLUTION CONTROL

A. Prevent wind erosion and air pollution by wetting down or applying other approved dust control measures to the work site. Control the generation of dust which could violate State and Local air pollution control standards, damage on-site/off-site facilities, and/or impact crops growing on adjacent properties.

B. Apply water or other dust control measures to common areas that will be used by all Bid Package Contractors. Coordinate dust control Work performed under this contract with the dust control work of other Bid Package Contractors.

3.7 WATER POLLUTION CONTROL

A. Comply with laws, rules, and regulations of the State of California, U.S. Army Corps of Engineers, and the Environmental Protection Agency prohibiting the pollution of lakes, oceans, bays, wetlands, streams, or river waters from the placing or dumping of refuse, construction materials, soils, or debris. In the event of a conflict, the most stringent requirement shall govern.

3.8 EQUIPMENT MAINTENANCE

A. Perform equipment repairs and maintenance including lubrication and fueling at sites approved by the County Representative.

3.9 EMERGENCY TREATMENT

A. In the event of precipitation during construction which produces contaminated runoff from the project site, immediately provide additional erosion control measures such as check dams, temporary sediment basins, or other controls as necessary to prevent site runoff. Coordinate additional erosion control activities and measures with the County Representative.

3.10 MAINTENANCE

A. Inspect all silt fences, dikes, and other erosion control features immediately after each precipitation event that produces runoff at the erosion control installation and at least daily during prolonged events. Make required repairs to restore the erosion control function immediately.

B. Inspect local roads to the site and roads adjacent to the construction entrance(s), daily. Sweep as required by the Qualified SWPPP Practitioner’s recommendation to remove visible sediment and prior to forecasted rain events.

C. Maintain erosion control features throughout project construction. Unless shown or specified to be removed, leave all erosion control features in good condition.

D. Remove sediment deposits that exceed one-third the height of the barriers.

E. Dispose of sediment deposits on-site at a location shown on the Contract Documents and acceptable to the County Representative. .Leave the disposal area in a neat free draining condition.

END OF SECTION

SECTION 31 32 15

LIME STABILIZATION SOIL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Lime stabilization of expansive soil used as subgrade in building, pavement, and exterior concrete (wider than 2 feet).

B. Related Documents and Sections

1. Geotechnical Investigation Design Phase for Monterey County Adult Jail Housing Addition, prepared by Butano Geotechnical Engineering, Inc., October 2013
2. Structural Testing, Inspection and Observation Program for Monterey County Jail, prepared by Lionakis, February 2, 2016
3. Section 01 40 00 – Quality Requirements
4. Section 02 30 00 – Subsurface Investigation
5. Section 31 20 00 – Earth Moving
6. Section 31 23 33 – Trenching and Backfill

1.2 REFERENCES

A. ASTM References:

1. ASTM C25-11 – Test Method for Chemical Analysis of limestone Quicklime and Hydrated Lime.
2. ASTM C110-11 – Test Method for Physical Testing of Quicklime, Hydrated Line and Limestone.
3. ASTM C110-11 – Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM C977-00 – Standard Specification for Quicklime and Hydrated Lime for Soil Saturation.
5. ASTM D1557-12 – Test Methods for Laboratory Compaction Characteristics of SOild Using Modified Effort (56,000 ft-lb/ft^3 (2,700 kN-m/m^3)).
6. ASTM D2216-10 – Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
7. ASTM D4829-11 – Test Method for Expansion Index of Soils.
8. ASTM D6938-10 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. Caltrans Testing Methods:

1. #373 – Unconfined Compressive Strength of Lime Treated Soils and Aggregate.

C. Caltrans Standard Specifications, May 2010.

1.3 DEFINITIONS

A. Lime – Anhydrous calcium oxide (CaO) in the form of high calcium quicklime.

B. Spreader – Motorized vane fed spreader which can control application rate to measure lb./sq. ft. ± 5%.

C. Mixer – Cross-shafted mixer with a mixing depth of 1.5 feet and capable of controlled introduction of water.

D. Drop Pan – Rectangular metal box with minimum area of 3 sq. ft. to measure lime application rate.

E. Mellowing Period – Time between initial and final mixing to promote initial chemical reaction between lime, water, and soil.

1.4 DESCRIPTION

A. Provide materials, services, and equipment required for lime treatment of soil.

1.5 SUBMITTALS

A. Submit, under provisions of Division 01, product data and certificates of compliance for all materials proposed under this section.

B. Independent Testing and Laboratory Reports: Provide chemical and physical analysis of lime from manufacturer or supplier.

1.6 QUALITY ASSURANCE

A. The County will employ and pay for the services of an independent testing laboratory to perform specified testing per CCR Title 24, and any other testing specifically indicated in the Contract Documents to verify compliance with the Contract Documents

B. Lime application rate, mixing uniformity, mixing depth, moisture and relative compaction test will be made at locations determined by the County Representative. When test indicate the specified requirements have not been achieved, that portion of the work shall be reworked until the specified requirements have been attained.

C. Daily testing of material and the work of the Contractor will be made during construction.

D. Relative compaction will be determined based on dry density using the maximum dry density at optimum moisture content determined by ASTM D1557. Compacted field in-place density and moisture test will be performed in accordance with ASTM D6938. Nuclear gauge moisture content determination will be periodically corrected to ASTM D2216.

E. The uniformity of the mix and mixing depth shall be confirmed by visual observation and sprayed phenolphthalein alcohol indicator solution.

1.7 STORAGE AND HANDLING

A. Lime shall be stored and transported in a manner which prohibits pre-mixing hydration.

B. Lime shall be handled (transported, transferred, spread and mixed) in a manner which minimizes airborne discharge and is safe for construction and quality assurance personnel.

1.8 ENVIRONMENTAL CONDITIONS

A. Weather: the lime shall not be spread in windy conditions that will result in dust outside the work area. No material shall be spread or mixed if rain is sufficient to render the lime soil

mixture content high enough to hamper required compaction (compacted saturation level greater than 90%).

B. Any excess lime-soil mixture shall be deposited on-site at a location where the elevated pH is not detrimental or removed to an authorized waste disposal site.

PART 2 PRODUCTS

2.1 LIME

A. Lime must comply with ASTM C977 and the following criteria:

Lime Quality		
Property	ASTM	Requirement
Minimum Available Calcium Oxide	C25 or C1271 and 1301	90%
Maximum Loss on Ignition	C25	7% (total) 5% (CO_2) 2% (free moisture)
Minimum Slaking Rate	C110	30ºC rise in 8 minutes

B. A 0.50 pound sample of lime dry-sieved in mechanical sieve shaker for 10 minutes ± 30 seconds shall comply with the following grading:

Lime Grading	
Sieve Size	Percentage Passing
3/8 inch	98-100

2.2 WATER

A. If available, potable water shall be used for mixing soil and lime. Water, other than potable water, shall:

1. Contain no more than 500 parts per million chlorides as Cl and no more than 500 parts per million sulfates as SO_4.
2. Not contain an amount of impurities that will cause water reduction in the strength of the stabilized soil.

2.3 CURING SEAL

A. Curing seal shall comply with Section 94 of the Caltrans Standard Specification for asphaltic emulsions Grade SS1, SS1h, CSS1 or CSS1h.

PART 3 EXECUTION

3.1 GENERAL

A. Deliver lime in full loads unless it is the last load for the work shift.

B. Apply lime when ground temperature is above 35ºF.

C. From the application of lime to 3 days after the finish grading, only equipment and vehicles associated with the lime stabilization work shall be allowed on the treated soil.

D. Treatment of subgrade soil shall be to a depth of 1.5 feet below the specified subgrade elevation and shall extend to a minimum lateral distance of 5 feet beyond building perimeters and 1 foot beyond the outer edge of pavement or pavement curbing and exterior concrete (wider than 2 feet).

3.2 SOIL PREPARATION

A. The soils to be treated shall be essentially free of irreducible particles greater than 4 inches in maximum dimension, contain less than about 10% irreducible particles greater than 3 inches in maximum dimension, and determined by Contractor to be satisfactory to not damage mixer.

B. Before adding lime, the grade of the treated area shall be within ±0.1 foot of the specified finish subgrade elevation.

3.3 APPLYING LIME

A. Lime shall be applied in dry form.

B. Lime shall be uniformly spread over the work area. The design spread rate is 6.6 pounds/square foot, which is based on a dry soil weight of 110 pcf and a mix design of 4% lime.

C. Spreader speed shall be controlled to maintain an application rate of 6.2 to 7.0 pounds/squared foot.

D. The spread area should not exceed the area which can be uniformly moisture conditioned and initially mixed during the work shift.

3.4 MIXING

A. The lime and soil to be stabilized shall be uniformly mixed at least twice to a depth of 1.5 feet.

B. The soil/lime mixture shall be moisture conditioned during initial mixing to at least 4% above the optimum moisture content determined by ASTM D1557.

C. During each work shift a composite sample from 5 random locations shall be taken after initial mixing. The moisture content of the composite sample test under ASTM D2216 shall be at least 4% above optimum.

D. Mixing shall occur in a series of parallel lanes of convenient width and length. Mixing of adjoining lanes shall overlap the previous lane by at least 1 foot to provide continuity. Mixing adjoining treat areas constructed during a previous work shift shall overlay the previously compacted treated soil at least 1 foot to provide a bond and subgrade continuity.

E. Mix until the mixture is visibly uniform with no streaks or pockets of lime. Mixed material shall have a color reaction with sprayed phenolphthalein alcohol indicator for the full 1.5 foot depth

of treatment.

F. After the initial mixing, allow a mellowing period of at least 14 hours before mixing. Additional water and mixing can be performed during the mellowing period, if dictated by duration or weather conditions proceeding final mixing.

G. Final mixing and moisture conditioning to at least 4% above optimum shall be performed immediately prior to beginning compaction.

3.5 COMPACTION

A. Begin compaction within 3 days of initial mixing.

B. Compaction using an open hub/ring wheel compactor (e.g. Rex 760) capable for compacting the 18 inch treated layer, followed by a non-vibrating steel drum or pneumatic tired rollers.

C. Use other compaction methods in areas inaccessible to the heavy equipment (e.g. around manholes or drain inlets).

D. The relative compaction of lime stabilized soil shall be at least 90% of the ASTM D1557 maximum dry density from 0.5 to 1.5 feet and at least 95% in the upper 0.5 feet.

3.6 FINISH GRADING

A. Maintain the moisture of the surfaces of the lime treated soil through the entire finish grading operation.

B. The finish surface of the lime stabilized soil shall be ±0.05 foot of the specified subgrade elevation.

C. If the lime stabilized soil surface is above the allowable tolerance, trim, remove and dispose of excess material.

D. If the lime stabilized soil surface is below the allowable tolerance, any trimmed material may be used to fill low areas if trim grading and compaction occurs within 24 hours of the initial compaction. Low areas can also be filled with a properly prepared soil-lime mixture. With either approach, the surface or the area to be filled shall be scarified to a depth of 2 inches. Alternatively, low areas can be filled with the material covering the lime stabilized subgrade (i.e. Portland or asphalt concrete).

E. Finish rolling of the final trimmed or filled surface shall be with at least one complete coverage with a non-vibrating smooth steel drum or pneumatic tired roller.

3.7 CURING

A. Curing shall consist of an initial water cure followed by either:

1. Curing seal
2. Moist material blanket

B. Curing shall begin the same day as finish grading.

C. Water curing shall keep the surface of the lime stabilized soil at, or above, the optimum moisture. Water curing shall be used of the duration of the day of finish grading and may be used for up to 3 days, after which a curing seal shall be applied or a moist material blanket shall be placed.

D. Curing seal shall be applied to the finished surface of the lime stabilized soil to the perimeter of the buildings or outer edge of pavement or exterior concrete in conformance with Section 94-1.03 of the Caltrans Standard Specifications. Apply the curing seal:

1. At a rate of 0.1 to 0.2 gallon per square yard.
2. When the ambient temperature is above 40ºF and rising.

E. The moist material blanket is a temporary layer of sufficient thickness to prevent drying of the lime stabilized soil. Maintain the moist material blanket above the optimum moisture content until the final surface treatment (i.e. concrete slab or pavement) is placed.

3.8 FIELD QUALITY CONTROL

A. The County will retain the services of an independent testing agency to perform field quality control tests.

B. In general, frequency of testing shall be as follows. Additional testing may be performed as determined by the County Representative.

The following tests and test minimums shall be used:

Property	Test Procedure	Minimum Frequency
1. Maximum Density	ASTM D1557[a]	5,000 CY
2. In-Place Density	ASTM D6938[b]	5,000 SF
3. In-Place Moisture	ASTM D6938[b]	5,000 SF
4. Moisture Bias	ASTM D2216	Weekly[c]
5. Composite Moisture	ASTM D2216	Daily
6. Lime Application	Pan Test	40,000 SF[d]
7. Thickness Verification	Phenolphthalein	20,000 SF[e]
8. Mixture Uniformity	Visual and Phenolphthalein	20,000 SF[e]

[a] Samples to mellow at least 14 hours.
[b] At least one-third of the daily test at 0.5 to 1.5 feet.
[c] Test at the beginning of the week with sample from ASTM D6938 test location.
[d] At least one per day.
[e] At least one per day, thickness and uniformity at same location.

END OF SECTION

SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Section Includes: Requirements for designing, furnishing and installing, maintaining, and removing excavation support and protection.

B. Related Documents and Sections

1. Section 01 50 00 – Temporary Facilities and Controls.
2. Section 03 30 00 – Cast-in-Place Concrete.
3. Section 31 20 00 – Earth Moving.
4. Section 31 23 33 – Trenching and Backfill.

1.2 REFERENCES

A. American Institute of Steel Construction, Inc. (AISC): Manual of Steel Construction Allowable Stress Design.

B. American Society of Civil Engineers: Guidelines of Engineering Practice for Braced and Tied-Back Excavations.

C. California Code of Regulations (CCR): Title 8 – Construction Safety Orders.

D. California Labor Code Sections 6705 to 6707 (CLC).

E. Department of the Navy Naval Facilities Engineering Command (NAVFAC):

1. NAVFAC Design Manual 7.2 – Foundations and Earth Structures.
2. NAVFAC Design Manual 7.3 – Soil Dynamics Deep Stabilization and Special Geotechnical Construction.

F. California Building Standards Code.

G. State of California Department of Transportation (Caltrans): Caltrans California Trenching and Shoring Manual.

H. United States Steel Corporation (USS): USS Steel Sheet Piling Design Manual.

1.3 DEFINITIONS

A. General Engineering Design Practice: General engineering design practice in area of the Project, performed in accordance with recent engineering literature on subject of shoring and stability of excavations.

B. Shoring: A temporary structural system designed to support vertical faces, or nearly vertical faces, of soil or rock for purposes of excavation. Shoring includes cantilevered sheet piling, internally braced sheet piling, slurry walls, soldier piles and lagging, and other similar shoring systems. Sloping of the soil is not shoring.

1.4 SYSTEM DESCRIPTION

A. Where General Engineering Design Practice is specified, provide drawings and signed calculations and have design performed by civil or structural engineer registered in California.

1. Provide design calculations that clearly disclose assumptions made, criteria followed, and stress values used for the materials being used.
2. Furnish references acceptable to County Representative substantiating appropriateness of design assumptions, criteria, and stress values.

B. Design Requirements:

1. General:
   a. Design means for safe and stable excavations in accordance with general engineering design practice.
      1) The preceding requirement does not apply to trench excavation support conforming to standards set forth in CCR Title 8 – Construction Safety Orders.
   b. Design Steel members in accordance with the California Building Code and the AISC Manual of Steel Design.
   c. Design shoring involving materials other than steel in accordance with California Building Code.
   d. Perform Design in accordance with soil characteristics and design recommendations contained in a written report prepared by a geotechnical engineer hired by Contractor and registered in California.
      1) Make copy of geotechnical report available at project site for the County Representative's review.
      2) Retain and pay for geotechnical engineer's services.
      3) Obtain report based on soil samples, field and laboratory tests, and borings performed for the report.
   e. When electing to design with material stresses for temporary construction higher than allowable stresses prescribed in the Manual of Steel Construction and the California Building Code, increase in such stresses must not exceed 10 percent of value of prescribed stresses.
   f. Minimum Safety Factor: 1.5.
   g. Increase the calculated minimum depth of penetration of shoring below the bottom of the excavation not less than 30 percent if the full value of passive pressure is used in design.
   h. The maximum height of cantilever shoring above the bottom of excavation must not exceed 15 feet. Use braced shoring when the height of shoring above the bottom of excavation exceeds 15 feet.
   i. Location of the Point of Fixity for Shoring: Not less than half the calculated minimum embedment depth below the bottom of the excavation.
   j. Generally acceptable references for the design of shoring and excavations are as follows:
      1) CALTRANS California Trenching and Shoring Manual.
      2) NAVFAC Design Manual 7.2 – Foundations and Earth Design.

3) NAVFAC Design Manual 7.3 – Soil Dynamics Deep Stabilization and Special Geotechnical Construction.

4) USS Steel Sheet Piling Design Manual.

5) Guidelines of Engineering Practice for Braced and Tied-Back Excavations published by American Society of Civil Engineers.

C. Performance Requirements:

1. General:

a. Support faces of excavations and protect structures and improvements in vicinity of excavations from damage and loss of function due to settlement or movement of soils, alterations in ground water level caused by such excavations, and related operations.

b. Herein Specified Provisions:

1) Complement, but do not substitute or diminish, obligations of Contractor for the furnishing of a safe place of work pursuant to provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for protection of the work, structures, and other improvements.

2) Represent minimum requirement for:

a) Number and types of means needed to maintain soil stability.

b) Strength of such required means.

c) Methods and frequency of maintenance and observation of means used for maintaining soil stability.

2. Provide safe and stable excavations by means of sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain the stability of soils and rock.

3. Provide support for trench excavations for protection of workers from hazard of caving ground.

4. Provide Shoring:

a. Where, as result of excavation work and analysis performed pursuant to general engineering design practice, as defined in this Section:

1) Excavated face or surrounding soil mass may be subject to slides, caving, or other types of failures.

2) 2Stability and integrity of structures and other improvements may be compromised by settlement or movement of soils, or changes in soil load on structures and other improvements.

b. For trenches 5 feet and deeper.

c. For trenches less than 5 feet in depth, when there is a potential for cave-in.

d. Where indicated on the Drawings.

5. For safe and stable excavations, use appropriate design and procedures for construction and maintenance to minimize settlement of supported ground and to prevent damage to structures and other improvements, including:

a. Using stiff support systems.

b. Following appropriate construction sequence.

c. Preventing soil loss through or under support system.

1) Provide support system that is tight enough to prevent loss of soil and extend deep enough to prevent heave or flow of soils from supported soil mass into the excavation.

d. Providing surface runoff routing and discharge away from excavations.

e. Where sheet piling is used, use interlocking type sheets. Provide continuous sheet piles driven in interlock. If the bottom of the excavation is located below the water table, use “thumb and finger” type interlock.

f. Do not apply shoring loads to existing structures and other improvements.

g. Do not change existing soil loading on existing structures and other improvements.

h. Provide welded steel packing between soil retaining members such as sheet piles and wales and similar members when the gap exceeds ½ inch before the wales are loaded.

1.5 SUBMITTALS

A. Provide submittals required in this section a minimum of 30 days prior to the scheduled date to begin excavation work.

B. Shop Drawings and Calculations:

1. Submit detailed drawings showing means for safe and stable excavations in accordance with requirements in California Labor Code for trench excavations 5 feet or more in depth and for trenches less than 5 feet in depth when there is potential for cave-in.

a. Where such drawings vary from excavation support standards set forth in California Code of Regulations Title 8 – Construction Safety Orders, submit design calculations pursuant to general engineering design practice.

b. Provide means for safe and stable excavations that are not less effective than required in CCR Title 8 – Construction Safety Orders.

2. For excavations other than trenches, submit, in advance of excavation work, design calculations as performed pursuant to general engineering design practice, as specified in this Section, and detail drawing showing means for safe and stable excavations. In design calculations and detail drawing, cover, as a minimum:

a. Excavations adjacent to structures and other improvements, and

b. Excavations 5 feet or more in depth, or less than 5 feet in depth when there is potential for cave-in, at other locations.

3. Submit Following:

a. Calculations for the different load, support, and other conditions that occur during the sequence of installation of shoring, construction of facilities protected by the shoring, and sequence of removal of shoring.

b. Sketches showing the condition at various stages of installation and removal of shoring.

1) Show structures, pipelines, and other improvements located near the shoring, and the shoring on a plan.

2) When utilities penetrate the shoring, submit an elevation of all sides of the shoring showing the locations of penetrations. Submit details on ground support and sealing around utility penetrations.

C. Written geotechnical report on soil characteristics and design recommendations, as specified in this Section.

D. Control Points and Schedule of Measurements:

1. Submit location and details of control points and method and schedule of measurements in accordance with requirements of this section.
2. Promptly upon constructing control points and making measurements at such control points, as specified in this Section, submit copy of field notes with such measurements. The field notes must show the current measurement and the change in measurement from the first measurement taken.

E. Detailed Sequence of Installation and Removal of Shoring:

1. Consider effects of ground settlement in the sequence of installation and removal of shoring.
2. Provide sketches showing the conditions at various stages in the sequence of installation and removal of shoring.

F. Submit submittals for stability of excavations as a complete package and include all items required in this section. Incomplete submittals will not be reviewed and will be returned for resubmittal as a complete package.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 INSTALLATION AND REMOVAL

A. Install means for providing safe and stable excavations as indicated in the submittals.

B. Do not begin construction of any shoring or excavation operations until:

1. Submittals have been approved by County Representative.
2. Control points as specified in this Section and as indicated on the Drawings on existing structures and other improvements have been established and surveyed to document initial elevations and locations.
3. Materials necessary for installation are on site.

C. Except for concrete encased soldier piles, slurry walls, and similar shoring systems, remove shoring by completion of the work. Select shoring system and method of removal, which will minimize soil that sticks to shoring from creating large voids and causing settlement. To prevent settlement caused by pulling shoring, fill voids with sand, pea gravel, or pressure injected grout. The methods used must prevent settlement. Pressure preservative treated wood lagging may be left in place when acceptable to the County Representative.

3.2 MAINTENANCE

A. Where loss of soil occurs, plug gap in shoring and replace lost soil with fill materials acceptable to the County Representative.

B. Where measurements and observations indicate possibility of failure or excessive movement of excavation support, determined in accordance with general engineering design practice, take appropriate action immediately.

3.3 CONTROL POINTS

A. Establish control points on shoring and on structures and other improvements in vicinity of

excavation for measurement of horizontal and vertical movement.

1. Set Control Points on Shoring Support System:
   a. Set points at distances not exceeding 25 feet at each support level.
   b. Levels of tie-backs, wales, bottom of excavation, and other types of supports.
2. Set control points in corners of existing structures and on curbs, manholes, and other improvements indicated on the Drawings.

B. Provide plumb bobs with horizontal targets indicating original position of plumb bobs in relation to shoring at control points located on shoring.

C. Perform horizontal and vertical survey and measurement of control points at least once every week.

END OF SECTION

DIVISION 32
EXTERIOR IMPROVEMENTS

SECTION 320190

LANDSCAPE MAINTENANCE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for Landscape Maintenance as specified in this Section during the landscape maintenance period, referred to herein as the Maintenance Period. The work includes establishing the plantings, providing pest and disease control, mowing, and maintaining the irrigation system and related construction elements during the Maintenance Period.

B. Related Work:

1. Landscape Irrigation
2. Landscape Planting

1.3 MAINTENANCE PERIOD

A. Time Limits: Maintenance Period shall commence from the date of approval of substantial completion and extend for 60 calendar days, or until final completion approval, whichever is later.

1.4 REVIEWS

A. Substantial Completion Review: Contractor shall specifically request this review at least (5) five days in advance of the proposed start of the Maintenance Period. The Architect will review for a final checklist of minor items to be completed. Once the items are completed by the Contractor and approved by the Architect, the Maintenance Period shall commence. Items to be checked during this review include but are not limited to:

1. All planted areas including turf and naturalized areas if applicable.
2. Valve box inspection and overall operation of the irrigation system.

B. Punch-list Check: The Architect shall conduct this review within two weeks of the end of the Maintenance Period, at the request of the Owner, when punch-list items identified at Substantial Completion have been corrected and are ready for inspection. The Final Review shall be rescheduled at the discretion of the Engineer, if additional time beyond the scheduled date of final completion is needed to correct Punch-list items.

C. Final Review: Contractor shall specifically request this review at least (5) five days in advance of the end of the Maintenance Period. Failure to request this notice shall automatically extend the date of completion. The Maintenance Period will continue until final completion is approved by the Engineer. Items to be checked during this review include but are not limited to:

1. All planted areas including turf and naturalized areas if applicable, including all punch-list items identified at Substantial Completion Review and Punch-list Check.

2. All irrigation punch-list items identified at Substantial Completion Review, and Punch-list Check.

1.5 MAINTENANCE PERIOD SUBMITTALS

A. Fertilizer: Submit written certificate showing rates, materials, and date of fertilizer application, to the Owner within five (5) days of each application.

B. Pesticides / herbicides: If pesticides / herbicides are used, submit written certificate showing rates, materials, and date to the Owner within five (5) days of each application.

1.6 MAINTENANCE BINDER ADDITIONAL DOCUMENTS

A. Submit prior to the Final Review, the following additional documents for the Maintenance Binder.

1. Counter-signed documents shall include the following items, countersigned by the Owner:
   a. Fertilizer applications, including initial application.
   b. Pesticide and herbicide applications, including initial application.
   c. In-service meeting discussion / decisions.
2. Copies of the following documents:
   a. Amended soils test report.

B. Controller Schedule: 8.5x11 size type-written and laminated irrigation schedule for established (mature) landscape at end of Maintenance Period for reference purposes inside the controller. Schedule shall note run-times and frequency for each station.

1. Attach irrigation schedule to laminated valve stationing plan – see Specification Section Landscape Irrigation.

C. The Final Review shall not take place until the additional submittals and documents have been reviewed and approved by the Engineer.

1.7 AMENDED SOILS TEST

A. Test Samples: After completion of soil preparation operations and first watering, Contractor shall take one quart samples of the amended soil, from 0”-6" deep from three separate locations in the planting areas. Samples shall be mixed from the three locations to provide a composite sample, representative of amended soil in the planting areas. Amended soil samples shall be forwarded to the Testing Lab by the Contractor for testing to determine any revisions to fertilizer applications, and additional amendments if any, during landscape maintenance.

1. Testing Lab shall be as specified in Specification Section Soil Preparation, and shall be the same lab that provided the existing soils test report.
2. Submit the amended soils test report to the Engineer for review as soon as it is available.
3. Revisions to fertilizer applications and the addition of amendments, if required by the amended soils test report, shall be at no additional cost to the Owner.

PART 2 MATERIALS

2.1 FERTILIZER

A. For maintenance fertilization shall be as specified in Specification Section Landscape Planting.

2.2 WATER

A. During the course of construction and maintenance, water for landscape shall be paid for by the Owner. Submit watering schedule with dates, times and frequency at start of the Maintenance Period.

2.3 CHEMICALS

A. Insecticides, fungicides, pre and post-emergent herbicides as recommended by licensed Pest Control Operator and approved by the Owner.

PART 3 EXECUTION

3.1 GENERAL

A. Contractor's Responsibility: Work installed under this Contract damaged by vandalism, vehicular damage and/or theft during the installation of the work and up to the Substantial Completion approval, shall be repaired or replaced by the Contractor without costs to the Owner.

B. Owner's Responsibility: Throughout the Maintenance Period, these damages and similar factors such as excessive litter, abuse and defacement shall be the Owner's responsibility to repair or replace and shall not be a part of this Contract. No planting shall be guaranteed beyond the Maintenance Period, except as to conformance to specified species and variety, and as specified in Specification Section Landscape Planting.

3.2 BASIC REQUIREMENTS

A. Irrigation and Erosion: All planting areas shall be kept at optimum moisture for plant growth. Planting not adequately served by the automatic irrigation system shall be hand watered. Settlement of soil and plants and soil erosion shall be repaired and areas replanted. Dying or deficient plants shall be replaced as they become apparent.

B. Cultivating and Clean-Up: Planting areas shall be kept neat and free from debris at all times and shall be cultivated at not more than ten (10) day intervals.

C. Weed control: All planting areas shall be kept weed-free at all times during the Maintenance Period. All pest and disease control shall be the Contractor's responsibility.

D. Insect, Pest, and Disease Control: Insects, pests, rodents and diseases shall be controlled by the use of insecticides and fungicides, as applied by a licensed pest control operator with the prior approval of the Owner.

E. Fertilizer: Application for all planting areas shall be as specified in Specification Section Landscape Planting.

G. Pruning: Prune new trees and shrubs with the direction of the Engineer. Do not remove lower branches from multi-trunk or low branching trees unless directed.

H. Replacement Materials: Immediately replace any dead or damaged plant materials. Turf areas not fully established and healthy shall be repaired or replaced as directed by the Engineer. Replacements shall be made to the specifications as required to match adjacent plantings at no cost to the Owner.

I. Irrigation: Schedule and monitor controller stations as necessary to minimize water consumption while still providing adequate water for the plant material.

1. Adjust and clean all heads, emitters, valves, filters, regulators and other equipment as necessary to maintain the system.

3.3 CONDITION OF PLANTING AT END OF MAINTENANCE PERIOD

A. All mulched planting areas shall be free of all weeds (broadleaf and grass weeds). Plantings that do not conform to specifications shall be replaced and brought to a satisfactory condition before final acceptance of the work.

B. Remove all nursery tree stakes and associated tying materials prior to Final Review.

C. Rake out watering basins from all plants under a permanent irrigation system and re-spread the mulch prior to Final Review, keeping mulch away from the plant stem.

3.4 IN-SERVICE MEETING

A. Contractor shall request, prior to Final Review, an in-service meeting with the Owner's maintenance staff to identify any landscape maintenance issues and verify mowing schedules, and irrigation station sequence / run-times (controller schedule).

1. The Contractor shall document any discussions / decisions at the in-service meeting and provide this to the Owner. Include a copy in the Maintenance Binder.
2. The Final Review shall not take place until the in-service meeting is completed, and final approval is contingent on the in-service meeting taking place to the satisfaction of the Owner.

3.5 HARDWARE

A. Contractor shall provide the Owner at the in-service meeting (2) sets of each of the following:

1. Quick Couplers – (2) quick coupler key / hose swivels
2. Irrigation Controller – (2) enclosure keys
3. Special tools required for the maintenance of specific components
4. Other enclosures / back flow preventers – (2) enclosure lock keys

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Aggregate Base (AB).
2. Aggregate Subbase

B. Related Sections

1. Section 31 20 00 - Earth Moving.

1.2 REFERENCES

A. CTM 216 - Relative Compaction of Untreated and Treated Soils and Aggregates.

B. CTM 217 - Sand Equivalent.

C. CTM 229 - Durability Index.

D. CTM 301 - Resistance “R” Value of Treated and Untreated Bases, Subbases and Basement Soils (Stabilometer).

E. Caltrans Standard Specifications, dated 2010

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Submit independent Testing Laboratory Reports that indicate material compliance with specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base: Free from organic matter and other deleterious substances, capable of being compacted to form a firm and stable base conforming to the following grading and quality requirements:

Aggregate Grading Requirements

Sieve Sizes	Percentage Passing by Weight
1 inch	100
3/4 inch	90 to 100
No. 4	35 to 60
No. 30	10 to 30
No. 200	2 to 9

Quality Requirements

Tests	Requirement

Resistance (R-value) (CTM 301)	78 min.
Sand Equivalent (CTM 217)	22 min.
Durability Index (CTM 229)	35 min.

B. Aggregate Subbase shall be Class 2 and shall conform to the provisions of Section 25, "Aggregate Subbases," of the Caltrans Standard Specifications.

PART 3 EXECUTION

3.1 GENERAL

A. Verify that subgrade is to the correct line, grade, and required compaction immediately prior to placing base material. Subgrade shall conform to specified compaction requirements and elevation tolerances and shall be free of loose or extraneous materials.

B. Obtain approval from the County Representative prior to placing aggregate base.

C. Schedule work during favorable weather conditions.

3.2 PLACING AGGREGATE BASE

A. Aggregate Base shall be delivered as uniform mixture and spread free from pockets of coarse or fine material.

B. When Aggregate Base is placed, moisture content shall be sufficient to obtain the required compaction. Supplement with sprayed water as required to achieve compaction. Moisture shall be uniformly distributed throughout the material.

C. Maximum compacted thickness of any one layer shall not exceed 6 inches. Begin compaction of each layer as soon after spreading as practicable. Continue compaction to a minimum 95 percent relative compaction per CTM 216.

D. Each layer shall be placed and compacted to the specified density before a succeeding layer is placed.

E. The finished surface shall be trimmed and shaped to produce a smooth, uniform surface. The entire work area shall be left in a neat condition and ready for placement of paving, as shown on the Contract Documents.

3.3 FIELD QUALITY CONTROL

A. The County will conduct compaction testing on each lift for every 300 feet of roadbed length in accordance with CTM 216.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt concrete (AC) paving and overlay work.
2. Paving maintenance for existing AC paving during construction.

B. Related Sections:

1. Section 31 20 00 - Earth Moving.
2. Section 32 11 23 - Aggregate Base Course.

1.2 REFERENCES

A. ASTM C29 - Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate.

B. ASTM C88 - Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C. ASTM C131 - Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

D. ASTM C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.

E. ASTM F778 - Test Methods for Gas Flow Resistance Testing of Filtration Media.

F. ASTM D461 - Test Methods for Felt.

G. ASTM D1075 - Standard Test Method for Effect of Water on Compressive Strength of Compacted Bituminous Mixtures.

H. ASTM D1188 - Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

I. ASTM D2041 - Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.

J. ASTM D2172 - Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

K. ASTM D24745 - Standard Specifications for Felt

L. ASTM D2726 - Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.

M. ASTM D2950 - Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.

N. ASTM D3776 - Test Methods for Mass Per Unit Area (Weight) of Fabric.

O. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

P. ASTM D4632 - Test Method for Grab Breaking Load and Elongation of Geotextiles.

Q. AASHTO T30-10-UL - Test Method for Mechanical Analysis of Extracted Aggregate.

R. Marshall Method of Mix Design, Chapter III, Asphalt Institutes Manual Series No. 2 (MS-2).

S. Pacific Coast Conference on Asphalt Specifications.

T. Asphalt Institute Specification SP-1.

U. California Department of Transportation (Caltrans) Standard Specifications.

1.3 SUBMITTALS

A. Submit in accordance with Sections 01 33 00.

B. Prior to producing any mixture for use in paving, submit mix design and source of mix. Indicate the following in mix design:

1. Gradation of each aggregate constituent to be used in mixture.
2. Proportion of each constituent to be used to produce combined gradation of aggregate within limits specified.
3. ASTM bulk specific gravity of each aggregate constituent.
4. Measured maximum specific gravity of mix at optimum asphalt content determined in accordance with ASTM D2041.
5. Properties of mix for at least four different asphalt contents other than optimum, two of which will be below optimum and two of which will be above optimum.
6. Percent of asphalt lost due to absorption by aggregate.
7. Temperature of water when discharged from mixer.
8. Bitumen percentage based on the total weight of mix.
9. Other information pertinent to design of mix.

C. Submit Testing Laboratory Reports for all tests used to develop each job mix formula to the County Representative. Mix formula shall be developed for the Contractor by an independent testing laboratory retained by the Contractor.

D. Submit Certificate of Compliance from testing laboratory for aggregates.

E. Submit Certificate of Compliance for each carload (or equivalent) of bitumen shipped to the mixing plant for use on the project.

1.4 DESCRIPTION

A. Provide materials, services, and equipment required for asphalt paving and overlay work.

B. Asphalt concrete paving materials and methods of construction shall have the approval of the County Representative. The Work shall be done only under the general observation and, where required, under the detailed inspection of the County Representative.

C. Asphalt concrete shall be mixed in a central mixing plant and placed on a prepared course in accordance with these Specifications. Conform to lines, grades, thicknesses, and typical cross sections shown on the Drawings.

D. Each course shall be constructed to the depth, typical section, or elevation required by the Contract Documents, and shall be rolled, finished, and reviewed before the placement of the next course. Unless otherwise indicated, uppermost 1-inch of asphalt shall not be placed until scheduled per milestones in Section 00 73 00 - Supplementary Condition or when authorized by the County Representative.

1.5 QUALITY ASSURANCE

A. County will employ and pay for the services of an independent testing laboratory to perform specified testing per CCR Title 24, and any other testing specifically indicated in the Contract Documents to verify compliance with the Contract Documents

B. Contractor shall retain a testing laboratory certified by the State of California, Office of the State Architect, to perform tests required by this section and other sections of these Specifications.

1.6 STORAGE AND HANDLING

A. Store materials in a bermed area away from drainage courses.

1. Cover materials when not in use.
2. Place drip pans or absorbent materials under paving equipment when not in use.

B. Refer to Section 01 35 43 for additional storage requirements.

1.7 ENVIRONMENTAL CONDITIONS

A. Do not place asphalt concrete when atmospheric temperature is lower than 50 degrees F, when substrate is wet and/or when precipitation is imminent.

PART 2 PRODUCTS

2.1 GENERAL

A. Asphalt concrete, prepared in a central plant, shall be a mixture of aggregate, filler if required, and bituminous material.

B. Aggregate fractions shall be sized, uniformly graded, and combined in such proportions that resulting mixture meets grading requirements of job-mix formula.

2.2 PRODUCTS

A. Aggregate

1. As specified in Section 39 of the Caltrans Standard Specifications for hot plant mix bituminous pavement.

B. Prime Coat

1. Liquid asphalt, Grade SC-250 conforming to Section 93 of the Caltrans Standard Specifications.
2. Emulsified asphalt, conforming to Section 94 of the Caltrans Standard Specifications.

C. Tack Coat

1. Emulsified steamed-refined paving asphalt, Type SS-1, conforming to Section 94 of the Caltrans Standard Specifications.

D. Asphalt Concrete Mixture

1. Asphalt Concrete: Type A, AR 4000, 3/4-inch maximum, medium grading, as specified in Section 39 of the Caltrans Standard Specifications.

E. Asphalt Cement

1. Asphalt cement to be used in the asphalt concrete mixture shall be Grade AR-4000 as specified in Section 92 of the Caltrans Standard Specifications.

PART 3 EXECUTION

3.1 MINING AND PLACEMENT

A. As specified in Section 39 of the Caltrans Standard Specifications, and as indicated on the approved Submittals.

3.2 TRANSPORTATION AND SPREADING

A. Schedule so that spreading and rolling of all mixture prepared for one day's run can be completed during daylight, unless otherwise approved by the County Representative and adequate artificial lighting is provided. Hauling over freshly placed material is not permitted until material has been compacted and cooled to atmospheric temperature.

B. Immediately before placing, underlying course shall be cleared off all loose of deleterious material with power blowers, power brooms, or hand brooms.

C. Mix shall be placed at a temperature of not less than 225 degrees F. (107 degrees C.). Moisture content of mix shall not exceed 1 percent.

D. Upon arrival, spread mixture by approved paving machine. Strike off in uniform layer such that, when the Work is completed, it shall have required thickness and shall conform to the grade and contour indicated. Speed of paver shall be controlled to eliminate pulling and tearing of the bituminous material.

E. In areas where irregularities or unavoidable obstacles make use of mechanical spreading and finishing equipment impractical, mixture may be spread, raked, and luted by hand tools.

F. Refer to Section 01 35 43 for spill prevention and control.

3.3 COMPACTION

A. Rolling shall continue until all roller marks are eliminated and a density of at least 92 percent of the measured maximum density determined in accordance with ASTM D2041 has been obtained.

B. Sufficient rollers shall be furnished to handle output of mixing plant. Speed of rollers shall be sufficiently slow to avoid displacement of hot mixture. Any displacement occurring as a result of reversing roller direction, or from any other cause, shall be corrected at once by rakes and fresh mixture.

C. Roller wheels shall be kept properly moistened to prevent adhesion of the mixture, but excessive water will not be permitted. In areas not accessible to the roller, asphalt mixture shall be compacted with hot hand tampers.

D. Any mixture which becomes loose and broken or in any way defective, shall be removed and replaced with fresh hot mixture and immediately compacted to conform to surrounding area. Skin patching shall not be allowed.

3.4 JOINTS

A. Joints shall be made in such a manner as to ensure a continuous bond between old and new sections. Joints shall present same texture, density, and smoothness as other sections of the course.

B. All joint contact surfaces shall be cut vertically and uniform for full course depth, then given a tack coat of liquid bituminous material or emulsified asphalt before placing any fresh mixture against joint in order to provide a watertight seam.

C. Roller shall not pass over the unprotected end of freshly laid mixture except when necessary to form transverse joint. When necessary to form transverse joint, it shall be made by means of placing a bulkhead or by tapering the course, in which case the edge shall be cut back on a straight line to its full depth.

3.5 TOLERANCES

A. Production Mix:

1. Average of all mix tests shall fall within requirements specified for job mix formula.
2. Individual field quality assurance tests may fall outside job-mix formula per the following, provided job mix average does not fall outside master grading band:

Material	Tolerance (plus or minus)
Aggregate passing No. 4 sieve or larger	7 percent
Aggregate passing No. 8, 16, 30, and 40 sieves	4 percent
Aggregate passing No. 100 and 200 sieves	2 percent
Bitumen	0.40 percent
Temperature of mix	20 degrees F. (7 degrees C.)

3.6 FINISH SURFACE:

A. Tests for conformity with indicated crown and grade shall be made by the Contractor immediately after initial compression. Variations shall be corrected by removal or addition of materials and by rolling.

B. Finished surface shall not vary more than 1/4 inch for the surface course when tested with a ten foot straightedge applied parallel with, or at right angles to surface and shall meet CBC maximum slope requirements in accessible parking stall, access aisle and accessible routes without fail regardless of being within above tolerance.

C. After completion of final rolling, smoothness of top course shall again be tested; humps or depressions exceeding specified tolerances shall be corrected by removing defective work and replacing with new material.

D. Finished surfaces shall not vary from gradeline, elevations, and cross sections shown by more than 1/2-inch (0.04-foot). Contractor shall correct pavement areas varying in excess of this amount by removing and replacing defective work. Skin patching not permitted.

3.7 FIELD QUALITY CONTROL

A. Contractor shall retain the services of an independent Testing Laboratory approved by the County Representative to perform field testing specified in this section.

B. Each day when asphalt concrete is placed at the project site, the County Representative will perform the following tests at least twice daily on production mix:

1. Bitumen content in accordance with ASTM D2172.
2. Aggregate gradation in accordance with AASHTO T30.
3. Index of retained strength in accordance with ASTM D1075.
4. Index of retained strength shall not be less than 75.
5. Marshall specimens in accordance with Marshall Method procedures.

C. During each day when asphalt concrete is being placed, the County Representative will perform at least four in-place field compacted density tests for each 1,000 tons of asphalt concrete placed (or per day's total placement when less than 1,000 total tons per day is placed). In-place density tests will be performed on 2-1/2-inch or larger diameter cores of placed material in accordance with ASTM D2726 or D1188, as applicable, or with a nuclear device in accordance with ASTM D2950. If the nuclear device is used, the County will select an area between 2,500 square feet and 10,000 square feet and perform at least 4 core density tests and 10 nuclear density tests within the area. Compliance with these specifications requires that the average density of the four core samples equals or exceeds the average density of the 10 nuclear device measurements. Location of sampling sites for density measurements shall be random in accordance with Appendix C of the Asphalt Institute Specification Series No. 1 (SS-1), Fifth Edition.

D. Upon completion of asphalt concrete placement for each project milestone, the County Representative will select up to 25 random locations to be cored by the Contractor for pavement thickness verification. The Contractor shall provide tools, equipment, and labor to obtain two-inch and larger diameter cores and to patch cored holes to match adjacent pavement. If cored thicknesses are less than indicated design thicknesses, the County Representative may reject all or part of paving and the Contractor shall take corrective measures as directed to provide acceptable paving.

E. If any of the quality control tests performed by the County indicates the Work does not meet specified requirements, the Contractor shall be advised and, upon approval of the County Representative, proceed to remove and replace the defective work. All work will be retested by the County at Contractor's expense.

3.8 CLEANING

A. Remove broken asphalt concrete from the site.

3.9 MAINTENANCE

A. Except where damaged by trenching by other Contractors, this Work includes maintenance of all asphalt concrete surfaces installed by the Contractor throughout the project. Maintain surfaces in driveable condition throughout project duration and repair areas of settlement and cracked surfaces prior to placement of the final lift of asphalt concrete.

3.10 FINAL LIFT

A. In general, final lift of pavement shall not be constructed until heavy construction traffic has ceased. Perform final lift paving operations following approval by the County Representative to proceed. Apply tack coat to existing asphalt concrete surface prior to placing final lift.

END OF SECTION

SECTION 32 13 13

CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete paving over prepared subbase.

B. Related Sections:

1. Section 03 11 00 - Concrete Forming
2. Section 03 20 00 - Concrete Reinforcing
3. Section 03 30 00 - Cast-In-Place Concrete
4. Section 31 20 00 - Earth Moving.
5. Section 32 11 23 - Aggregate Base Course.

1.2 REFERENCES

A. ACI 117 - Specification for Tolerances for concrete Construction

B. ACI 301 - Specifications for Structural Concrete

C. ACI 304R – Guide for Measuring, mixing, transporting and Placing Concrete

D. ACI 347 - Guide to Formwork Concrete

E. ASTM C94 – Ready-Mixed Concrete

F. CRSI – Manual of Standard Practices

G. CRSI – Placing Reinforcing Bars

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, and ground granulated blast-furnace slag, subject to compliance with requirements.

1.4 SUBMITTALS

A. Submit in accordance with Sections 01 33 00.

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

1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, etc.: Indicate compatibility with other material used.

C. Design Mixtures: Submit proposed mix designs and test date for each class of concrete and for each method of placement.

1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905A.3.

2. Mix designs shall be prepared and signed by a structural or civil engineer registered in the State of California.
3. Identify for each mix design submitted the method by which proportions have been selected.
    a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength f'c calculations.
    b. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength f'c results. Provide gross weight and yield per cubic yard of trial mixes.
    c. Indicate quantity of each ingredient per cubic yard of concrete.
    d. Indicate type and quantity of admixtures proposed or required.
    e. Indicate water to cement ratio by weight.
    f. Measured slump.
    g. Measured air content.
    h. Provide shrinkage test results.
    i. Provide minimum 10-15% fly ash, ground granulated blast-furnace slag, and/or silica fume content as Portland cement replacement in all concrete.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
2. Comply with ACI 315, part B and CRSI requirements.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete if different than layout indicated on plans.

1. Location of joints are subject to approval of the Architect.

F. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

G. Pavement-Marking Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

H. Qualification Data: For qualified ready-mix concrete manufacturer (batch plant) and installer of detectable warnings.

I. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.

J. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Aggregates and sand.

3. Steel reinforcement and reinforcement accessories.
4. Admixtures.
5. Curing compounds.
6. Bonding agent and epoxy adhesives.
7. Joint fillers.
8. Sealer

K. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

L. Detectable Warning Device Warranty: Submit copies of manufacture's five year warranty for each of these products.

1.5 DESCRIPTION

A. Provide materials, services, and equipment required for concrete paving and overlay work.

B. Concrete paving materials and methods of construction shall have the approval of the County Representative. The Work shall be done only under the general observation and, where required, under the detailed inspection of the County Representative.

1.6 QUALITY ASSURANCE

A. County will employ and pay for the services of an independent testing laboratory to perform specified testing per CCR Title 24, and any other testing specifically indicated in the Contract Documents to verify compliance with the Contract Documents.

B. Contractor to provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers.

C. Contractor shall retain a testing laboratory certified by the State of California, Office of the State Architect, to perform tests required by this section and other sections of these Specifications.

1.7 STORAGE AND HANDLING

A. Deliver, handle and store materials in accordance with the manufacturer’s instructions.

B. Refer to Section 01 35 43 for additional storage requirements.

PART 2 PRODUCTS

2.1 PRODUCTS

A. Concrete Materials

1. Design mix: ASTM C94, 3,500 psi, 28 day minimum compressive strength.
2. Slump Limits: 3 to 4 inches.
3. Air Content: 5 to 8 percent.
4. Finish: Broom finish, perpendicular to direction of travel.

5. Finish: Exposed aggregate.

B. Wire Mesh Reinforcement: Welded plain steel wire fabric, ASTM A185

C. Reinforcing Bars: Deformed steel bars, ASTM A615, Grade 60.

D. Fabricated Bar Mats: Steel bar or rod mats, ASTM A184, using ASTM A615, Grade 60 steel bars.

E. Joint Dowel Bars: Plain steel bars, ASTM A615, Grade 60.

F. Curing Compound: specified by Section 201-4 of the SSPWC.

2.2 EXPANSION AND CONTROL JOINTS

A. Curbs and gutters: Asphalt impregnated fiber filler material, 1/2 inch thick.

B. Control joints for concrete walks and exterior pavement: As shown on the Drawings.

1. Control joints shall be a formed joint.
2. Tops of joints shall be installed flush with the concrete surface.
3. Depth of joint shall be a minimum of 1/4 the thickness of slab.
4. Use control joints on all curbs, curbs and gutters, and cross gutters at maximum intervals of 15 feet on center. Sawed joints may be used in lieu of the above.
5. Provide “Zip Strip” as distributed by S.C.A Construction Supply, Santa Fe Springs, California or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Construction all site concrete of 3,500 psi concrete unless otherwise indicated or specified. Provide reinforcing bars or mesh where indicated. Form accurately to profiles shown, using wood or metal firms as approved. Place and handle concrete in manner that will avoid segregation of ingredients.

B. Comply with ACI 330r-08 for measuring, mixing, transporting, and placing concrete.

C. Proof roll subbase and check for unstable areas. Report unsatisfactory conditions to the County Representative. Beginning paving work mean acceptance of subbase.

D. Comply with concrete mix, testing placement, joints, tolerances, curing, repairs and protection.

E. Concrete Walks: Provide 1/2” expansion joints as specified for curbs and gutters where walks abut rigid structures.

F. Control Joints: Provide for concrete walkways and exterior concrete pavement as indicated. Install tops of the joints flush with the concrete surface and depth of joint a minimum of 1/4 the thickness of slab.

G. Dispose of over-mixed concrete off-site in a legal manner.

H. Protect concrete paving until weight of a person will not leave any impression. Remove and replace concrete paving, which shows impressions or other defects. Skim coating defects is not acceptable.

3.2 FINISH SURFACE:

A. Walkways and Pavement

1. Light broom finish perpendicular to longitudinal direction of the walk. Score walks in direction and pattern indicated on the Drawings.

B. Gutters

1. Light broom finish with 3 inch wide steel trowel at flowlines.

C. Curbs

1. Steel trowel finish, followed by fine hair brush finish.

D. Finished surfaces shall not vary from gradeline, elevations, and cross sections shown by more than 1/4-inch in 10-feet. Contractor shall correct areas varying in excess of this amount by removing and replacing defective work.

3.3 CURING

A. Concrete work shall be properly cured and protected against injury and defacement of any nature during construction operations. If weather is hot or surface has dried out, spray surface with fine mist of water, starting no later than 2 hours after final troweling. Surface of finish shall be kept continuously wet at least 10 days. Wetting is considered emergency work and shall be performed on weekends and holidays if necessary.

B. In lieu of water curing, within 24 hours after finishing, the concrete may be cured with an approved clear liquid curing compound, applied in accordance with the manufacturer's recommendations.

3.4 CLEANING

A. Remove broken concrete from the site.

3.5 FLOOD TEST

A. All concrete gutters and concrete pavement shall be given a flood test. All concrete work where water ponds and does not run off shall be removed to the nearest score or joint line and replaced to provide proper drainage.

END OF SECTION

SECTION 321413

PRECAST CONCRETE UNIT PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the installation of Concrete Pavers as shown on the Drawings and as specified in this Section.

B. Related work includes but is not limited to:

1. Earthwork and Grading
2. Site Concrete

1.3 STANDARDS

A. Applicable ASTM International Standards (latest revisions) as they apply to this work and related test methods, including:

1. C33 / C33M Specification for Concrete Aggregates
2. C91 Specification for Masonry Cement
3. C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
4. C140 Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
5. C144 Specification for Aggregate for Masonry Mortar
6. C150 / C150M Specification for Portland Cement
7. C260 Specification for Air-Entraining Admixtures for Concrete
8. C404 Specification for Aggregates for Masonry Grout
9. C476 Specification for Grout for Masonry
10. C494/C494M Specification for Chemical Admixtures for Concrete
11. C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
12. C979 Specification for Pigments for Integrally Colored Concrete
13. D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
14. D2940 Specification for Graded Aggregate Material for Bases

B. Interlocking Concrete Pavement Institute (ICPI) Tech Spec No.5 – Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement, available at www.icpi.org .

C. Applicable ANSI Standards (latest revisions) as they apply to this work and related test methods, including:

1. ANSI A118.4 Latex Portland Cement Mortar

D. Mortar-set Paving:

1. CTMA Handbook for Concrete Tiles, latest edition, by the Concrete Tile Manufacturer's Association, and available at www.concretetile.org.

2. TCA Handbook for Ceramic Glass and Stone Tile Installation, latest edition, by the Tile Council of North America.

1.4 SUBMITTALS

A. Documentation: Submit the following within fourteen (14) days after Notice to Proceed.

1. Product literature and warranty for each type of precast concrete paver. Warranty shall cover precast concrete paving units against defects in material and workmanship for a period of 5 years.
2. Product data: Sealer, if applicable.

B. Samples: Submit the following within fourteen (14) days after Notice to Proceed. Samples shall be the basis of all rejection or approval of the material.

1. One full-size sample of each type of precast concrete paving unit representative of quality and tolerances.
2. Color-chip samples of each type of precast concrete paving unit representative of color ranges and textures available from the manufacturer.

1.5 QUALITY ASSURANCE

A. Warranty: shall cover precast concrete paving units against defects in material and workmanship for a period of 5 years.

B. Source Limitations:

1. Obtain each type of paver and joint material from a single source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. Physical properties:

1. Precast concrete pavers shall have a minimum compressive strength of 5,000 psi at 28 days.
2. Average Water Absorption (ASTM C 140): 5% with no unit greater than 7%.

1.6 MOCK-UPS

A. Site Reviews: Stake and lay out a minimum 3-ft x 3-ft mock-up of paver installation for review and approval by the Engineer. Mock-up shall include all paver types and colors / finishes specified and be a representative example of each paver pattern specified.

1. Approved mock-up(s) shall remain on site intact until final approval has been given by the Engineer.
2. The approved mock-up(s) shall be the basis for approval or rejection of paver installations.

3. Any paver installation installed that does not conform to the approved mock-up(s) shall be removed and reinstalled by the Contractor, as directed by the Engineer, at the Contractor's expense.

1.7 DELIVERY, STORAGE & HANDLING

A. Delivery & Handling: Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact in each paver bundle. Unload pavers in such manner that no damage occurs to the product or existing construction.

B. Storage & Protection Store materials such that they are kept free from mud, dirt, and other foreign materials.

PART 2 PRODUCTS

2.1 PAVER ASSEMBLIES

A. Paver assemblies shall consist of the following materials / products, on stabilized subgrade, as specified elsewhere in this Specification Section and shown on the Drawings:

B. Pedestrian Paving (permeable) on stone bed:

1. Permeable aggregate base
2. Crushed Stone Setting Bed - ASTM No.8
3. Pedestrian Grade Concrete Paver

2.2 PAVER MATERIALS

A. Materials used to manufacture pavers shall conform to the following:

1. Portland Cement: ASTM C150, Type-III, high early strength.
2. Aggregate: ASTM C33. Washed, graded sand and rock; no expanded shale or light weight aggregates.
3. Color: ASTM C979. Integral color admixture by Davis Colors, or equal, as required to achieve color as selected.

B. Finishes: Walking surfaces of precast concrete paving units shall be slip-resistant.

2.3 CONCRETE PAVERS

A. General: Paver color and finish shall be per the Drawings.

1. Supply the Owner will additional pavers for future repairs. Fifty (50) pavers in each color specified on the Plans.

B. Concrete Pavers:

1. Pavestone - Verona Series/ size and color as shown on Drawings; www.paverstone.com.
2. Hanover – Architectural Paver Series / size and color as shown on Drawings; www.hanoverpavers.com.
3. Stepstone Inc – California Architecteral Paver Series / size and color as shown on Drawings; www.stepstoneinc.com.

2.4 BASE MATERIALS

A. Permeable Aggregate Base: Class 2 Permeable, three fourths inch (3/4") maximum, gradation in accordance with Standard Specifications 68-1.025: ***F***

Sieve Size	Percent Passing
1" (25.0 mm)	100%
3/4" (19.0 mm)	90-100%
3/8" (9.5 mm)	40-100%
#4 (4.75 mm)	25-40%
#8 (2.36 mm)	18-33%
#30 (600 um)	5-15%
#50 (300 um)	0-7%
#200 (75 um)	0-3%

R-value 78 Min.
Sand Equivalent (Cal 217) 75 Min.
Durability Index (Cal 229) 40 Min.

Class 2 Permeable Material shall be an imported material consisting of durable crushed rock or gravel and sand that is free from slaking and decomposition under the action of alternate wetting and drying.

2.5 SETTING BED MATERIALS

A. Bedding Material: for Porous Pavers shall conform to the sieve analysis / gradation below. Clean crushed stone free of deleterious substances.

ASTM No.8 Stone	
Sieve Size	Percent Passing
1/2" (12.5mm)	100%
3/8" (9.5mm)	85-100%
#4 (4.75mm)	10-30%
#8 (2.36mm)	0-10%
#16 (1.18mm)	0-5%

B. Polymeric Joint Sand: for Narrow Modular Pavers installed on a concrete base shall be Polymeric Sand by Alliance Gator, Quebec, Canada (866)212-1611 or approved equal.
   1. Color shall be Beige / Slate Grey / Ivory

C. Mortar: Shall comply with ASTM C144 and be a mixture of Portland Cement and sand in a ratio of 1:5.

2.6 OTHER MATERIALS

A. Stain & Efflorescence Removers: As specified in ICPI Tech Spec No.5.

B. Sealer: Non-staining, water based penetrating material, VOC / EPA / OSHA compliant, suitable for exterior use. Approved products:
   1. 511 H20 Plus Water Base Penetrating Sealer, by Miracle Sealants Company, Arcadia, CA (800)350-1901, miraclesealants.com
   2. Water Block, by GST International, Sparks NV, (888)898-8181, www.gst-intl.com

3. Factory apply product per manufacturer's recommendations.

C. Paver spacers: shall be plastic Mortarless Spacer by Paver Help, San Jose, CA (408)266-4176, or approved equal. Spacer size as recommended by manufacturer.

D. Urethane expansion joint sealant: Shall comply with ASTM C920, grade M.

PART 3 EXECUTION

3.1 JOB CONDITIONS

A. Sub-grade: See Specification Section Earthwork and Grading for sub-grade preparation and compaction requirements. Verify that sub-grade preparation, compacted density and elevations conform to the Specifications.

B. Concrete Base: Verify that concrete base has been installed correctly and to required grades and slope.

C. Coordination: Fit paving work into other work. Scribe and cope as required for accurate fit.

3.2 INSTALLATION – GENERAL

A. Installation: Pavers shall be clean and free of foreign materials before installation.

B. Lay paving as shown on the Drawings with setting bed and joints as shown. Follow paver manufacturer's guidelines for typical joint widths for pavers, unless otherwise noted on the Drawings.

C. Pavers shall start from a corner or straight edge and proceed forward. Paving work shall be plumb, level, and true to line and grade; shall be installed to properly coincide and align with adjacent work and elevations String lines should be used to hold pattern lines true.

D. All paving shall be laid to provide positive drainage. There shall be no abrupt changes in slope.

E. Fill gaps at the edges of paved areas with cut pavers. Use a double bladed breaker or a masonry saw to cut pavers. Lay pavers to avoid cut pieces smaller than 1/3 the size of a paver.

F. The final surface elevation of pavers shall not deviate more than 3/8 in. under a 10 ft long straightedge.

G. The surface elevation of pavers shall be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.

3.3 INSTALLATION – MORTAR SET PAVERS

A. Install pavers in a thin-set mortar bed as specified in the CTMA Handbook. Follow paver manufacturer's instructions for thin-set use.

B. Setting bed: Install mortar bed as specified in the TCA Handbook. Bonding coverage shall be minimum 95% with 100% recommended. Back-buttering of pavers shall be carried out to obtain specified coverage.

C. Clean any mortar off the face of the pavers immediately. Do not leave a 'cement haze' on the concrete paver's surface.

D. Provide for expansion and control joints as specified in the TCA Handbook. Follow expansion and control joint materials manufacturer's instructions.

E. For pavers 2-1/2" and less thickness place grout between pavers as specified in the CTMA Handbook. Follow grout manufacturer's directions for use of grout. Grout must fill joint completely.

F. Seal grouted joints as shown on the Drawings and per sealant manufacturer's instructions.

3.4 CLEANING

A. Clean exposed surfaces of precast concrete paving units. Use cleaning products and method as specified in ICPI Tech Spec No.5. The completed paver installation shall be washed down ad cleaned to provide a clean finished surface.

B. Unsealed Pavers: Apply Sealer after final cleaning and wash down of the paver surface. Follow manufacturer's instructions and ICPI Tech Spec No.5. Protect surrounding areas from over spray. Keep pedestrian and vehicular traffic off the paver surface until initial cure time has been reached.

C. Factory Sealed Pavers: Do not apply sealer in the field.

3.5 CLEAN-UP

A. After completion of all operations, Contractor shall remove all trash, excess soil and other debris. All walks, walls, and pavement shall be swept and washed clean, leaving the entire area in a neat, orderly condition.

B. All planting soil contaminated by mortar, concrete, or grout shall be removed and replaced with top soil to the approval of the Engineer.

END OF SECTION

SECTION 321546

STABILIZED D.G. PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the installation of Stabilized Decomposed Granite (DG) Paving, Crushed Granite, and Crushed Granite with Geocell, as shown on the Drawings and as specified in this Section.

1. All references to DG paving shall also apply to Stabilized DG paving, unless otherwise noted.

B. Related work includes but is not limited to:

1. Earthwork and Grading
2. Site Furnishings

1.3 STANDARDS & DEFINITIONS

A. Unless otherwise shown or specified, all materials and methods shall conform to the appropriate current sections of:

1. The State of California Department of Transportation (CALTRANS) Standard Specifications, latest edition, except for measurement and payment requirements.

B. Applicable ASTM International Standards (latest revisions) as they apply to this work and related test methods, including:

1. C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
2. D2149 Test Method for Sand Equivalent Value of Soils and Fine Aggregate

C. RIS-Redwood Inspection Services Grades of California Redwood.

D. Relative compaction: is defined as the in-place dry density of the compacted soil divided by the laboratory compacted maximum dry density determined according to ASTM D1557-78 (Modified Proctor Density) latest edition, expressed as a percentage.

1.4 SUBMITTALS

A. General: Within fourteen (14) days after Notice to Proceed submit the following:

B. Decomposed Granite: sieve analysis and one quart sample.

C. Crushed Granite: one quart sample

D. Geocell: 12” x 12” sample

E. Mixing Facilities: Method or supplier source for paving product, with sufficient notice so inspection of batching and mixing operations can be made if required by the Engineer.

1.5 QUALITY ASSURANCE

A. Installer qualificatons: installer to provide evidence to indicate at least 3 years of successful experience in providing DG surfacing. Provide a list of three projects and Owner references completd in the last 3 years.

B. Single Source: Decomposed Granite shall be from a single supply source for the entire quantity required

C. Layout Review: Stake and layout all paving areas for review by the Engineer prior to excavation

D. Inspection: Notify the Engineer 24 hours prior to placement of any DG to inspect sub-grade and forms

E. Tolerances: Tolerances for sub-grade, sub-base and finished grade shall be as specified by the Standard Specifications except that Contractor shall install the aggregate base and DG to the minimum thickness shown. No combination of high and low tolerances will be permitted.

1.6 MOCK-UPS

A. Contractor shall stake and layout all paving areas for review by the Engineer prior to excavation.

B. Construct mockup of 3ft x 3ft minimum of decomposed granite and edging, at a location approved by Engineer. Intent of the mockup is to demonstrate surface finish, texture, color and standard of workmanship.

C. Provide one additional mock-up panel if the original mock-up(s) is/are not approved, at no additional cost to the Owner.

D. Approved mock-ups shall be kept at the job site to serve as a demonstration for all finishes. Mock-ups shall be removed at the completion of the DG work.

E. All DG work installed that does not conform to the approved mock-ups shall be removed and replaced by the Contractor at the Contractor's expense.

F. Approved mock-up may remain as first in place construction at the discretion of the Engineer.

1.7 DELIVERY STORAGE AND HANDLING

A. Deliver all binder materials in original, unopened packaging. Protect materials / aggregate from contamination with foreign matter. Store under waterproof cover and protect from dampness.

PART 2 PRODUCTS

2.1 DECOMPOSED GRANITE

A. Decomposed Granite (DG) shall have a 3/8” maximum gradation, produced from naturally friable rock / granite with enough fines to produce a smooth walking surface. Materials should be free from clay lumps, organic matter and deleterious material. Blends of coarse sand and rock dust are not acceptable. Class-IV rock fines are required for this project. Color shall be gold. Gradation in accordance with ASTM C136:

Sieve Size	Percent Passing
3/8” (9.5mm)	100%
#4 (4.75mm)	85-95%
#8 (2.36mm)	70-80%
#16 (1.18mm)	50-60%
#30 (600 um)	40-50%
#50 (300 um)	25-35%
#100 (150 um)	15-25%
#200 (75 um)	10-20%

B. DG: shall be 3/8” minus, ‘Pacific Gold’ / ‘Desert Gold’ / ‘California Gold’ gravel from an approved supplier/quarry as given below.

1. Clark's Rock, American Canyon, CA (707) 252-2044
2. Granite Rock Felton Quarry, Felton CA (831) 471-3480
3. Wheeler Zamaroni, Santa Rosa, CA (707) 543-8400
4. Prior approved equal.

2.2 AGGREGATE

A. Crushed Granite: shall be 3/4" Golden Granite, ‘Pacific Gold’ / ‘Desert Gold’ / ‘California Gold’ gravel from an approved supplier/quarry as given below.

1. Clark's Rock, American Canyon, CA (707) 252-2044
2. Granite Rock Felton Quarry, Felton CA (831) 471-3480
3. Wheeler Zamaroni, Santa Rosa, CA (707) 543-8400
4. Prior approved equal.

2.3 BINDER

A. Binder shall be a non-toxic premium organic soil additive in concentrated powdered form. Pre-approved products:

1. Stabilizer™ by Stabilizer Solutions, Phoenix, AZ (800)336-2468, www.stabilizersolutions.com
2. PHP™ Organic Aggregate Binder by TMT Enterprises, Inc., San Jose, CA (408)432-9040
3. Prior approved equal.

B. Follow manufacturer's recommendations for binder to D.G. ratio. For bid-purposes only, estimate quantity of binder as follows:

1. Pedestrian pathways – 12 lbs per ton
2. Vehicular areas – 15 lbs per ton

2.4 WATER

A. Water shall be free from contaminants that would discolor or be deleterious to D.G. blended with binder surfacing.

2.5 PRE-EMERGENT

A. Granular: Treflan, Ronstar or approved equal.

B. Liquid: Surflan or approved equal.

2.6 EDGE RESTRAINT

A. Pre-manufactured steel product consisting of edging, angle plate fasteners, and stakes, with 2 coats of factory applied paint.

PART 3 EXECUTION

3.1 GENERAL

A. Examine grading and subsoil conditions. Do not install DG surfacing when sub-base is wet at saturated field capacity, during rainy conditions or below 40 degrees Fahrenheit and falling.

B. Excavation: Excavate to depth required so edges of D surfacing will match adjacent grades and have a maximum cross slope as shown on the Drawings.

C. Preparation: Prior to installing paving install pre-emergent herbicide to sub-grade per manufacturer's recommendations. Immediately prior to placing the paving material, the sub-grade shall be thoroughly moistened.

D. Finished Surface: The finish grades of the paving shall conform to the lines, grades, and slopes on the Drawings. Edges of paving shall be flush with adjacent headers, concrete, or other paving. When work is complete, the surface must be smooth, compacted as specified, and uniform.

E. Final Herbicide Treatment: Upon completion of spreading and compacting paving material, apply pre-emergent herbicide to entire paving surface per manufacturer’s instructions.

3.2 STABILIZED D.G. INSTALLATION

A. Mixing: Mix DG and binder per manufacturer's recommendations. In addition mix in granular pre-emergent herbicide per manufacturer's recommendations. The materials shall be mixed in a drum type mixer on the job or a central mixing plant. Rate of mixing shall be per label rates of square foot of D.G. The Contractor shall provide the Engineer sufficient notice of his intent to begin mixing so that the Engineer can provide inspection of the mixing and batching operation.

B. Placement: Place Stabilized DG uniformly in layers no more than 2-inch thick. The Stabilized DG shall be deposited in such a manner as to minimize the necessity for spotting, picking up or otherwise shifting the DG material. The mixing shall not be screeded off or finished by floating. No steel tooling of Stabilized DG shall be done.

C. Compaction: The bottom layer of Stabilized DG shall be compacted to 95% relative compaction prior to the placement of the top layer. The top layer of Stabilized DG shall also be compacted to 95% relative compaction.

D. There shall be a total of three pre-emergent herbicide applications for stabilized DG as specified above.

E. Curing Do not allow traffic on Stabilized DG surfacing for a minimum of five (5) days after placement or until surfacing has fully cured.

F. Protect Stabilized DG surfacing from damage until project completion. Repair damaged areas to match specified requirements.

3.3 EDGE RESTRAINT

A. Alignment and grade of edging shall be staked and limited to accurately reflect the plan layout prior to commencing work. After approval by the Engineer, header boards shall be assembled to form well crafted and securely constructed lines.

B. Backfill all header boards prior to paving operations. Protect and repair all damaged header boards prior to final acceptance.

3.4 CLEAN UP

A. Waste Removal: All waste as a result of paving construction shall be removed from the site and disposed of legally. All excess paving material shall be removed from adjacent planting areas and civil work.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Painted pavement markings.

1.2 REFERENCES

A. California Department of General Services, Roadway Paint Specifications.

B. California Department of General Services, Specification for Reflective Glass Beads.

1.3 DEFINITIONS

A. Lane Width: The lateral width from the edge of the pavement to the center of the lane line, or between centers of successive lane lines.

1.4 SUBMITTALS

A. Submit in accordance with Sections 01 33 00.

B. Submit certification that products meet or exceed specified requirements.

C. Submit manufacturer’s installation instructions.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not perform painting if atmospheric temperature is below 40 degrees F, or when atmospheric temperature is expected to drop below 40 degrees F during the paint drying period.
2. Do not perform painting when freshly painted surfaces may be damaged by rain, fog, snow, ice, or condensation.

B. Do not place markings until layout lines have been approved by the County Representative.

PART 2 PRODUCTS

2.1 PAINT

A. PTWB-01R1 Paint, Rapid Dry, Waterborne Traffic lane, ADA Blue (Color no. 15090, Fed Std 595B). White, Yellow and Black

B. Thinning of paint is not permitted.

2.2 GLASS BEADS

A. Type: 8010-21C-22; Type II.

2.3 EQUIPMENT

A. Striping Machine Used for Paint Application:

1. Commercial type designed for the application specified; with oil extractors, pressure regulators.
2. Spray-gun assemblies and orifices sized as required for specified application.
3. Rubber-tired; minimum 100-inch wheelbase.
4. Maneuverable as required to follow straight lines and true arcs.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove dirt and loose material from surfaces to be painted.

3.2 APPLICATION

A. Apply markings only on dry surfaces during periods of favorable weather in accordance with manufacturer's instructions.

B. Apply paint at the rate of not more than 80 square feet per gallon (approximately 20-mil wet thickness).

C. Apply glass beads for all traffic line paint at the uniform rate of 6 pounds of beads per gallon of paint.

D. Tolerances:

1. Stripe Width: Plus or minus 1/4 inch.
2. Stripe Length: Plus or minus 1 inch per 40 feet of lane line, noncumulative.
3. Lane Width: Plus or minus 4 inches.

3.3 CLEANING

A. Immediately remove drips, overspray, and improper markings from pavement surface by blast cleaning or other method approved by the County Representative.

END OF SECTION

SECTION 32 17 26

TACTILE WARNING SURFACING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Embedded tactile warning surface tile, with an inline dome pattern, for application on ramps and level walking surfaces.

B. Tactile Tile Installation Method: As indicated on Drawings, and as follows:

1. New Concrete: Installation in cast-in-place uncured (wet) concrete.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete.

1.3 REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Division 01 for definitions, acronyms, and abbreviations.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. Referenced Standards:

1. AASHTO HB-17 – Standard Specifications for Highway Bridges.
2. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
3. ASTM C293 – Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
4. ASTM C1028 – Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
5. ASTM D543 – Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
6. ASTM D570 – Standard Test Method for Water Absorption of Plastics.
7. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
8. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
9. ASTM D1037 – Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
10. ASTM D2486 – Standard Test Methods for Scrub Resistance of Wall Paints.
11. ASTM D5420 – Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
12. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

13. ASTM G155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.

1.4 SUBMITTALS

A. Submit under provisions of Division 01.

B. Shop Drawings: Show detailed plans of tile profile, fastener locations, and installation methods.

C. Samples: Furnish two tile samples, minimum 8 inches by 8 inches in size, of the type and color specified in this Section.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm specializing in manufacturing products specified in this Section with a minimum five years experience.

1.6 REGULATORY REQUIREMENTS

A. General: Provide detectable (tactile) warning products in accordance with California Code of Regulations (CCR). Title 24, Part 1, 2013 California Administrative Code, Chapter 5 “Access to Public Buildings by Persons with Disabilities”.

1. Article 3 “Acceptance of Detectable Warning and Directional Surface Products for Manufacturers and Design Professionals”.
2. Article 4 “Application for Independent Entity Evaluation Approval (IEEA)”.

B. Definition of Detectable Warning: Conform to 2013 California Building Code, Chapter 2 “Definitions”, Section 202, “Definitions”.

1. Chapter 11B “Accessibility to Public Buildings, Public Accommodations, Commercial Buildings and Public Housing,” Section 11B-106.5 “Defined Terms” for detectable warning.

C. Detectable Warnings for Site Accessibility: Provide detectable warning system in accordance with 2013 California Building Code, Chapter 11B, “Accessibility to Public Buildings, Public Accommodations, Commercial Buildings and Public Housing”, Section 11B-705.1, Section 11B-705.1.1.4, and the following:

1. Detectable Warnings at Curb Ramps: Chapter 11B, Section 11B-206 “Accessible Routes”, Section 11B-406.5.12, “Detectable Warnings”, and Section 11B-705.1.2.2, “Curb Ramps”.
2. Detectable Warnings at Hazardous Vehicular Areas: Chapter 11B, Section 11B-206, “Accessible Routes”, Section 11B-406.5.12, “Detectable Warnings”, and Section 11B-750.1.2.5, “Hazardous Vehicular Areas”.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle packaged products in original containers with seals unbroken and labels intact until the time of installation.

B. Store delivered products in a clean, safe, dry area.

1.8 WARRANTY

A. Five years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of Design Product: Armor-tile by Engineered Plastics Inc., Williamsville, NY; 800-682-2525, http://www.armor-tile.com.

1. Provide Cast-In-Place Type Armor-Tile for embedding in cast-in-place uncured (wet) concrete.

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Tactile Warning Tiles: An epoxy polymer composite with an ultraviolet stabilized coating containing aluminum oxide particles in the truncated domes.

1. Cast-In-Place Type Tile for Embedding in Cast-In-Place Uncured (Wet) Concrete:

a. Tile thickness to be 0.3875 inch at domes and 0.1875 inch in flat areas between domes. Total thickness at perimeter to be 1.375 inches; dome height to be 0.20 inch.

b. Tile underside to have embedment flanges with 0.625-inch diameter holes; long sides to have 0.1875-inch diameter vent holes.

c. Tile to have sound amplifying plastic plates attached between flanges, with an air space between tile bottom surface and sound amplifying plastic plates.

d. Tile face to have non-slip texture.

B. Color and Size:

1. Safety Yellow, (Federal Color #33538) colorfast, UV stabilized coating. Color shall be uniform throughout the tile.

2. Sizes: As indicated on Drawings.

C. Performance Requirements: Tactile warning tiles shall meet or exceed the following criteria:

1. Water Absorption: 0.05 percent, maximum, when tested in accordance with ASTM D570.

2. Slip Resistance: 0.80, minimum combined wet/dry static coefficient of friction on top of domes and field area, when tested in accordance with ASTM C1028.

3. Compressive Strength: 28,000 psi, minimum, when tested in accordance with ASTM D695.

4. Tensile Strength: 19,000 psi, minimum, when tested in accordance with ASTM D638.

5. Flexural Strength: 25,000 psi, minimum, when tested in accordance with ASTM C293.

6. Gardner Impact: 550 inch-pounds per inch minimum, when tested in accordance with ASTM D5420.

7. Chemical Stain Resistance: No discoloration or staining when exposed to ten percent hydrochloric acid, urine, saturated calcium chloride, black stamp pad ink, chewing gum, red aerosol paint, ten percent ammonium hydroxide, one percent soap solution, turpentine, five percent Urea, diesel fuel, motor oil, and tested in accordance with ASTM D543.
8. Wear Depth: 0.06 inch, maximum, after 1000 abrasion cycles of 40 grit Norton Metallite sandpaper, tested in accordance with ASTM D2486.
9. Flame Spread: 15 maximum, when tested in accordance with ASTM E84.
10. Accelerated Weathering: No deterioration, fading or chalking, when tested for 3,000 hours in accordance with ASTM G155.
11. Accelerated Aging and Freeze Thaw Test of Tile and Adhesive System: No cracking, delamination, warping, checking, blistering, color change, loosening of tiles, or other detrimental defects, when tested in accordance with ASTM D1037.
12. Salt and Spray Performance: No evidence of deterioration or defects after 200 hours of exposure, when tested in accordance with ASTM B117.
13. AASHTO HB-17 Single Wheel HS20-44 Loading Test for Cast-In-Place Type Tile: Mounted on concrete platform with 1/2 inch air space at the underside of tile and subjected to a maximum load of 10,400 pounds, corresponding to 8000 pound individual wheel load and thirty percent impact factor; no visible damage at maximum loading.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install tactile warning surface tiles in accordance with manufacturer’s printed instructions.

B. Install Cast-In-Place Type tiles over cast-in-place, uncured (wet) concrete.

C. Ensure that the surfaces being prepared and fabricated to receive the tiles are constructed correctly and adequately for tile installation.

D. Installation in Cast-In-Place Uncured (Wet) Concrete: Maintain concrete in 4 inch to 7 inch slump range. Lay tactile warning surface tiles (without removing protective plastic wrap) in uncured (wet) concrete and tamp each tile in place. Place weights over tiles to prevent floating, as recommended by the manufacturer. After curing, remove protective plastic wrap, and clean tile surfaces.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chain link fences, gates, grade beams, accessories and hardware.

B. Related Sections:

1. Section 03 20 00 - Concrete Reinforcing.
2. Section 03 30 00 - Cast-In-Place Concrete.
3. Section 08 71 63 - Detention Door Hardware.
4. Section 08 88 53 - Security Glazing.
5. Section 32 31 53 - Electric Sliding Gates.

1.2 REFERENCES

A. ASTM A121 - Metallic-Coated Carbon Steel Barbed Wire.

B. ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A153 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.

E. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM A1011 - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

G. ASTM A817 - Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire.

H. ASTM A824 - Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence.

I. ASTM F1083 - Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded for Fence Structures.

J. California Department of Transportation (Caltrans) Standard Specifications.

K. SSPC - The Society for Protective Coatings.

1.3 SUBMITTALS

A. Submit under provisions of Sections 01 33 00.

B. Shop drawings: Indicate plan layout, spacing of components, post and grade beam details and dimensions, details of post installation and bracing, hardware anchorage, schedule of components, and hardware schedule.

1. Shop drawings, material, fabrication and installation specifications shall be based on hardware templates submitted to the gate fabricator by the lock manufacturer.
2. Indicate surface applied steel frames or shapes necessary for the installation of locks. Show type and spacing of anchorage. Indicate permissible tolerances for each type. Indicate type, size and spacing of field welding required for each item.

C. Product Data: Provide manufacturer's technical data and specifications for products to be installed.

D. Samples:

1. Submit sample of barbed tape; length sufficient to include two barbed clusters, 8-inch minimum length.
2. Submit sample of barbed tape clip.

E. Certificate of Compliance: Prior to incorporation in construction, submit manufacturer's certificate that specific products proposed for use meet or exceed specified requirements.

F. Test Reports: Submit results of specified tests indicating compliance with specified requirements.

G. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. The County will employ and pay for the services of an independent testing laboratory to perform specified testing per CCR Title 24, and any other testing specifically indicated in the Contract Documents to be performed by County-retained testing laboratory, to verify compliance with the Contract Documents

B. Like items of materials shall be the end products of one manufacturer.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

1.6 MOCK-UPS

A. Install one gate latch of each type as a Mock-Up.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaging:

1. Final gate assemblies shall be wrapped in protective material or crated to provide adequate protection during shipment.
2. Units shall be appropriately marked with plan gate numbers, size, handing, and hardware type.

1.9 PROJECT CONDITIONS

A. Do not install security fence until clearing and finish grading on both sides of the intended fence location is approved.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer jointly agree to repair or replace, at no charge, components of chain-link fences, barbed tape, gates, gate operators and hardware, and coatings that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deflection of fence fabric beyond design limits.
   b. Faulty operation of gate hardware, operators and controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: Five years from date of Project completion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framework:

1. Unless specified otherwise, framework shall be Type I pipe or Type II pipe at Contractor's option.
2. Type I Pipe:
   a. ASTM F1083 standard weight (Schedule 40), plain ends.
3. Type II Pipe:
   a. ASTM A1011, or ASTM A653, Grade D; cold formed, electric welded; minimum yield strength 50,000 psi.
   b. Coating shall conform to ASTM A123 or Section 80-4.01 A paragraphs 3 and 4 of the Caltrans Specifications, except the reference to 300 hours in paragraph 3 shall be 650 hours, and reference to the Engineer in paragraph 4 shall be the County Representative.
4. Dimensions and Weights:

Outside Diameter (OD) in inches	Type I Steel Weight/Foot	Type II Steel Weight/Foot
2.375	3.65	3.12
2.875	5.79	4.64
4.000	9.11	6.56
6.625	17.97	Not Permitted
8.625	28.55	Not Permitted

5. Terminal Posts (End, Corner, and Angle Posts):
   a. Minimum 4.000-inch OD at fences with fabric extending 12 feet or less above finish grade.
   b. Minimum 6.625-inch OD elsewhere.
6. Line Posts:

a. Minimum 2.875-inch OD at fences with fabric extending 12 feet or less above finish grade.

b. Minimum 4.000-inch OD elsewhere.

7. Gate Posts: Type I Pipe; minimum 4.000-inch OD where gate leaf width is 6 feet or less and fabric height of fence and gate leaf extends 12 feet or less above finish grade; minimum 6.625-inch OD elsewhere.

8. Rails (Intermediate and Bottom) and Braces: 2.375-inch OD.

9. Tension Wire: ASTM A824; Type II, Class 3.

B. Fabric:

1. Standard:

a. ASTM A392; Class 2 zinc coating.

b. Two inch diamond-mesh, No. 9-gauge wire.

c. Knuckled bottom selvage; twisted and barbed top selvage except knuckled top selvage where indicated.

2. No Climb Fence Fabric:

a. Wire Diameter: 0.192-inch.

b. Mesh Size: 3/8-inch.

c. Weight of Metallic (Zinc) Coating: ASTM A392, Type II, Class 2, 2.0 oz/sq. foot. with zinc coating.

C. Barbed Wire: ASTM A121; 12.5-gauge; 14-gauge four point round barbs, 5-inch spacing; class 3 coating.

D. Barbed Tape:

1. AISI 430 stainless steel hardened to Rockwell (30N) 30-37 minimum; 0.025-inch thick x 1-inch wide before fabrication, die stamped to produce clusters of four needle-sharp barbs at 4 inches on center, minimum 1.2 inches long, offset in alternate directions 0.15 to 0.45 inches.

2. Permanently cold clench stainless steel strip to minimum 230 degree wrap over 300 series austenitic stainless steel spring type reinforcing wire, 0.098-inch diameter, minimum 140,000 psi tensile strength.

3. The stainless steel strip between barb clusters shall be 1/4 inch wide minimum after cold clenching to create a flange extending out from the wire, tapering off adjacent to the barb cluster to allow maximum barb penetration.

4. Coil Diameter: 30 inches, plus or minus two inches, when coil compressed.

5. Each coil shall have 51 loops and cover 25 feet maximum when fully extended.

6. Adjacent coils and individual loops in each coil shall be clipped together in five locations along the circumference to obtain a concertina effect.

7. Clips: Stainless steel, capable of withstanding a minimum pull load of 200 pounds for a minimum of 30 seconds without separation, or other damage.

E. Bottom Rail Anchors: No. 3 reinforcing bars, U-shape with hooks on each end.

F. Concrete:

1. Type specified in Section 03 30 00.
2. Unless otherwise indicated, provide concrete of the following strength:
   a. Grade Beams: Minimum 2,000 psi compressive strength at 28 days.
   b. Post Footings: Minimum 3,000 psi compressive strength at 28 days.

G. Reinforcing Bars: Type specified in Section 03 20 00; Grade 40.

2.2 ACCESSORIES

A. Fittings:

1. Malleable steel, cast iron, or pressed steel.
2. Fittings include extension arms for barbed wire, tension bars and bands, clips, truss rod assemblies, boulevard clamps, brace bands, rail ends, hardware, fabric and barbed tape fastenings and accessories.

B. Tension (Stretcher) Bars: One-piece lengths equal to full height of fabric with a minimum cross-section of 1/4-inch by 3/4-inch.

1. Provide one tension bar for each gate post and end post.
2. Provide two tension bars for each corner post.

C. Tension (Stretcher) Bar Bands: Steel, 3/4-inch x 1/10-inch nominal to secure tension bars to posts.

D. Extension Arms:

1. 18 inches long, 45 degree bracket type; slits at even spacing for three strands of barbed wire.
2. Extension arms shall permit permanent attachment to post without welding. Provide mechanical attachment to prevent unauthorized removal.
3. Locations Other Than Terminal Posts: Breakaway (swing-down) type designed to give way when a torque load of 40 to 50 foot pounds is applied to the arm.
4. Terminal Posts: Match other extension arms, except breakaway feature may be deleted to accommodate erection procedures if required. Extension arms other than break away shall require approval.

E. Post Tops:

1. Weathertight closure cap for tubular posts.
2. One for each exposed tubular post end where equal protection is not afforded by combination post cap/extension arm.
3. Post tops shall permit permanent attachment to post without welding. Provide mechanical attachment to prevent unauthorized removal.

F. Truss Assembly: Capable of withstanding 2,000 pounds tension consisting of minimum 1/2 inch truss rod with truss tightener or turnbuckle.

G. Boulevard Clamps: Two piece clamp, minimum 12 gauge with 5/16 inch carriage bolts and nuts.

H. Brace Bands: One inch size minimum 12 gauge with 5/16 x 1-1/2 inch carriage bolts and nuts.

I. Rail Ends: Weathertight closure for tubular rails and braces.

J. Hog Rings: 18-gauge stainless steel for attachment of barbed tape; 9-gauge galvanized steel at all other locations.

K. Tie Wire: 6-gauge galvanized steel wire, unless otherwise indicated.

2.3 GATES

A. Gate Frames: Type I pipe members, 2.375-inches OD unless otherwise indicated.

B. Provide truss rods of 3/8-inch minimum nominal diameter to prevent sag or twist.

C. Provide vertical intermediate bracing of gate leaves, spaced so that members are no more than 8 feet apart.

D. Provide horizontal gate leave braces as required to provide rigid construction, free from sag or twist.

E. Gate Fabric: Match fence fabric.

F. Attach fabric to frame at intervals not exceeding 12 inches. Secure with tension bars, tension bands, and 6-gauge steel wire.

2.4 GATE HARDWARE

A. Hinges:

1. Rated heavy duty and sized for the supported gate, with large bearing surfaces for clamping in position.
2. Hinges shall not twist or turn under the action of the gate.
3. Hinges shall not allow the gate to be lifted without first removing the hinges.
4. The gates shall be capable of being opened and closed easily by one person.
5. Hinges shall be suitable for exterior use.
6. Weldable Gate Hinges: Butts 205 as specified in Section 08 71 63.

B. Latches:

1. Padlockable vertical slide bolt assembly.
2. Installed assembly shall be capable of retaining gate in a closed position.
3. Installed assembly shall be capable of withstanding a force of 500 pounds in any direction at any point in such a manner as to create the greatest stress on the locked assembly, without releasing the mechanism or allowing the gate to open. After the force is removed, the mechanism and gate shall be without damage and continue to function as designed.
4. Latches shall be arranged for locking with specified locking hardware.
5. Gates and posts shall be modified as required to receive hardware, including locking and operating mechanisms as herein specified.

C. Hold-Open-Stop

1. Mechanical device which automatically engages the free end of the gate leaf when in the full open position and holds it in the open position until manually released.

2. Provide hold open stops for manually operated swinging vehicle gates.

D. Sliding Gates

1. Provide steel heavy-duty track, ball bearing hanger sleeves, overhead framing and supports, guides, stays, bracing, end stops, catches, operating system, and accessories as required for complete operable assembly.
2. The lock shall not be used as the "stop" when closing manual sliding gates.
3. Provide an approved brake such that a continuous 10 to 20 pound force would be required to close the gates, preventing the gate from freely coasting along, or provide a rubber cushioned stop in the bottom guide track to absorb the energy required to stop the sliding gate when slammed closed.
4. Support Posts: Type I pipe; minimum 4.000 inches OD.
5. Coordinate gate fabrication with gate operator installation requirements.

E. Ports

1. Key, gun pass-through and cuff ports shall be constructed as shown on the drawings or required by the County Representative. Steel shall be galvanized.

F. Padlocks

1. Padlocks shall be Master Padlock #6230.

2.5 GATE-HARDWARE GROUPS

A. Single Leaf Vehicle Swing Gate with manual operation, latches, keepers and manual lock - Type G-01

1. Lock: See hardware schedule.
2. Padlock shall lock a gravity drop bar that engages a tongue attached to the gate frame. Drop bar shall have positive stops to prevent opening the gate without first removing the lock and raising the drop bar.
3. Shackle shall allow swinging the lock between gate frame and adjacent post so lock can be opened from either side of fence.

B. Double Leaf Vehicle Swing Gates (12-feet to 18-feet wide) with manual operation and locks - Type G-01

1. Lock: See hardware schedule.
2. Center drop rod or plunger bar shall extend into a metal section set in concrete.
3. Provide lock and padlock eyes as integral part of the latch, requiring one padlock for locking both gate leaves.
4. Locking device shall be constructed so center drop rod or plunger cannot be raised when locked.

C. Pedestrian Manual Swing Gates (4-feet by 7-feet) with manual operation and manual and electric lock - Type G-02.

1. Lock: See hardware schedule for hardware types and if furnished by Bid Package X Contractor.

2. Padlock shall lock a gravity drop bar that engages a tongue attached to the gate frame. Drop bar shall have positive stops to prevent opening the gate without first removing the lock and raising the drop bar.
3. Shackle shall allow swinging the lock between gate frame and adjacent post so lock can be opened from either side of fence.

D. Pedestrian Electric Sliding Gates (4-foot by 7-foot), motor operated and electric lock - Type G-03.

1. Lock shall be part of the operator which includes emergency manual controls to permit operation in event of a power failure.
2. Operator and Housing: See Hardware Schedule for 3165LPK2/CA Gate Operator as specified in Section 32 31 53.

E. Vehicle Electric Sliding Gate, motor operated and electric lock - Type G-04

1. Lock: Lock shall be part of the operator which includes emergency manual controls to permit operation in event of power failure.
2. Operator and Housing:
   a. 1,000 pound capacity: Type 9100 Gate Operator as specified in Section 32 31 53.

F. Vehicle and Pedestrian Sallyport Gate Locks

1. Manual Lock
   a. Lock shall provide two sided key operation.
   b. Lock shall be a manual deadlock 1080-2/T6 as specified in Section 32 31 53 with position indicator and 2 cylinder shields Type 2CS.
2. Electric lock:
   a. Solenoid actuated dead bolt shall retract when solenoid is energized, and remain retracted until solenoid is de-energized.
   b. Lock shall not automatically dead lock when gate is closed if solenoid is still energized.
   c. Do not provide manual key bypass.
   d. Provide access plate accessible from sallyport side.
   e. Locks shall be Type 1050SD-1/T6 Electro-Mechanical Gate Lock as specified in Section 32 31 53 with factory modifications noted above.

2.6 FINISHES

A. Components Not Otherwise Indicated: Zinc-coated ASTM A123.

B. Hardware Not Otherwise Indicated: Zinc-coated ASTM A153.

C. Galvanizing Repair Compound: [ ].

PART 3 EXECUTION

3.1 INSPECTION

A. Verify grade provides flat surface allowing gate and fence construction with gap no more than 1-1/2 inches between bottom of bottom rail and the ground or grade beam.

3.2 INSTALLATION

A. Install chain link fences and gates as indicated on the approved shop drawings and as follows.

B. Erect fencing in straight lines between angle points.

C. Postholes:

1. Depth:
   a. Minimum 24 inches plus 3 inches for each foot or fraction thereof that post exceeds 4-foot projection above grade.
   b. Greater if indicated.
2. Diameter:
   a. Minimum four times post diameter, or 12 inches, whichever is greater.
   b. Greater if indicated.
3. Work concrete into post holes to leave no voids.
4. Provide crown watershed finish on the top surface of concrete.
5. Coordinate with Building Contractor for placement of posthole/sleeve in building foundation where fencepost terminates at or near building.

D. Grade Beams:

1. Size: 24 inches deep, 30 inches wide.
2. Work concrete into grade beams to leave no voids.
3. The top surface of the grade beam shall have a crown watershed finish, unless otherwise indicated or unless field conditions require sloping in one direction in order not to trap water run-off.

E. Posts:

1. Space posts equidistant in the fence-line not more than 10 feet on centers and in true lines.
2. Set posts plumb and with 3 inches of concrete under post.

F. Terminal Posts:

1. Terminal posts shall be used at beginning and end of each continuous length of fence, at changes in vertical or horizontal alignment of 15 degrees or more, and at intervals not exceeding 800 feet.
2. Where straight runs are greater than 800 feet, space terminal posts evenly between corner or end posts.
3. Where posts terminate at or near a building, coordinate with Building Contractor to install fence post sleeves in the building foundation.

G. Tension Wire:

1. Install 1 foot from the top of fence fabric.
2. Pull taut prior to installing chain link fabric.
3. Secure at every post such that there shall be no perceivable movement between the wire and the posts when the fabric is flexed.

4. Fasten to posts with wire ties.

H. Rails, Braces, and Truss Assemblies:

1. Install on the side of the fence least accessible to inmates.
2. Connect rails to posts using boulevard clamps or rail ends with brace bands.
3. Connect pipe braces to posts using rail ends with brace bands.
4. Brace gate and terminal posts to adjacent line posts with a horizontal pipe compression member (intermediate rail), diagonal truss assembly tension member and diagonal pipe compression member as indicated.

I. Bottom Rail:

1. Where grade beam is used, anchor bottom rail to grade beam.
2. Anchor bottom rail to grade beam with 3/8-inch diameter U-shaped hooked anchors extending 6 inches into grade beam.
3. Where longitudinal slope of top of grade beam exceeds 1:12, space anchors 1 foot 2 inches on center maximum.
4. Space anchors 3 feet 4 inches on center maximum at other locations.

J. Intermediate Rail: Install intermediate rail.

K. Threaded Connectors and Accessories

1. Peen threaded connectors and accessories after installation.

L. Fence Fabric:

1. Allow concrete to obtain sufficient strength before installing fence fabric.
2. Fasten fabric to terminal and gate posts with tension bars and tension bar bands.
   a. Stretch fabric taut.
   b. Space tension bar bands not more than 12 inches on center.
3. Secure fabric to rails and line posts with wire ties at maximum 12 inches on centers.
   a. Place tie within 6 inches of top of fabric and within 6 inches of bottom of fabric.
   b. Weave tie wire through the fence fabric completely around the rail or post and twist wire securely with three twists on the rail or post side of the fence. Cut off the tails of the wire to preclude untwisting by hand.
   c. Twist shall be on side of fence least accessible to inmates.
4. Secure fabric to top tension wire with hog rings at 24 inches on center. Cinch hog rings so that ends pass.
5. Horizontal splicing of fabric on 18-foot high fences is permitted as shown on the Contract Documents.
6. Vertical splicing of fabric is permitted if both pieces of fabric are woven together.
7. Completed fabric installation shall pass Fabric Deflection Test.

M. Extension Arms and Post Caps:

1. Anchor to prevent rotation and removal. Welding shall not be acceptable.

N. Barbed Wire:

1. Stretch single strand of barbed wire tight through outer slots of each extension arm and secure.

O. Barbed Tape

1. In addition to the chain link fence, install barbed tape where shown on the Drawings.
2. Install on the top of the extension arm and secure each loop to the single strand of barbed wire and the top of the fence fabric with hog rings clinched so the ends pass.
3. Where 12-foot high fence terminates at a building, a coil of barbed tape shall extend past the building and the face of the coil shall be attached flat to the surface of the building. A second coil of barbed tape shall be installed horizontally beneath the extension arms.
   a. The second coil shall extend 6 feet horizontally from the building and extend vertically down to 10 feet above the adjacent finish grade where possible.
   b. The second coil of barbed tape shall be secured to the single strand of barbed wire to the fabric and to the building.

P. Gates:

1. Modify gates and posts as required to receive hardware as specified. Obtain hardware templates from Building (BP 3) Contractor and fabricate lock pockets and supports for specified lock.
2. The maximum clearance between the bottom of the gate in closed position and finished grade shall be 1 inch. Verify that gates can freely swing or slide into full open position without dragging on finish grade surfaces.
3. Unless otherwise indicated, install gate hardware on the non-secure or outside of gates and fences.
4. Secure gate hardware firmly in position allowing no unintended movement.
5. Use lock manufacturer's hardware for installing electric locks. Welding of locks to fence posts shall not be acceptable.
6. Coordinate delivery of locks with the County Representative. Pulling of wire and connections to locks and control panels is specified under 08 74 63 and Division 26 Electrical.

Q. Temporary Construction Gates

1. Locate where shown or directed by County Representative.
2. Temporary construction gates shall be removed and the openings closed when directed by County Representative.
3. Remove gate posts, end posts not required for completed fence and close openings in fence.
4. Install permanent fence to close openings using line posts and end posts as indicated.
5. Weave together fabric at splices.
6. Completed fence shall not show evidence of temporary openings.

R. Temporary Security Fences

1. Install temporary fence in manner allowing maximum possible material reuse.
2. Temporary security fence shall match other fences specified in this Section, except as specified below.

3. Grade beam is not required.
4. Set terminal posts, gate posts and every tenth line post (maximum 100 feet) in concrete sleeved footings.
5. Set other line posts in soil using backfill for stabilization.
6. Below Grade Barrier: Three foot width of fence fabric with the bottom two feet set in soil and the top foot projecting above grade.
   a. Install at inner (prison side) fence only.
   b. Lap above grade portion of barrier over above grade fence fabric.
   c. Fasten barrier to fabric using hog rings at 12 inches on center longitudinally at grade and at top of barrier. Clinch hog ring so the ends pass.
7. Remove temporary security fencing, except concrete, when directed by County Representative. Salvage removed material, except expendables such as tie wires.
8. Disassemble salvageable materials in manner to avoid damage beyond normal wear and tear. Contractor will be assessed cost of replacement materials.
9. Return salvaged materials to the State at on-site location directed by County Representative.
10. Conduct metal sweep after removal of temporary fence.

S. Electrically ground chain link fences and gates under provisions of Section 26 05 26.

3.3 ERECTION TOLERANCES

A. Maximum variation from plumb: 1/4 inch.

B. Maximum offset from true position: 1 inch.

C. Maximum distance between post and vertical edge of building shall not exceed 3 inches.

D. Maximum clearance between bottom of bottom rail and top of grade or grade beam: 1-1/2 inches.

3.4 BARBED WIRE (BW) AND WIRE MESH (WM) FENCE

A. In accordance with Caltrans Specifications, Sections 80-3.01A, 80-3.01C, 80-3.01D, and 80-3.01F except paragraph two.

3.5 FENCE FABRIC DEFLECTION TEST

A. Contractor shall test fence fabric deflection by applying a force of 30 pounds to the fabric in the center of each panel perpendicular to the plane of the fabric.

B. Deflection of fence fabric shall be no greater than 2 inches during the application of the force.

C. Fabric shall return to original position when force is released.

3.6 GRAVITY BAR TEST

A. County Representative will designate gravity bars to be tested.

B. Contractor shall apply a 500-pound test load to designated gravity bars as directed by the County Representative.

C. Release load and verify proper operation of gravity bar and gate.

D. Replace components damaged by test and retest. Repeat this sequence until components pass test.

3.7 MANUFACTURER'S REPRESENTATIVE

A. Manufacturer's representative of barbed tape shall be on the construction site at the commencement of installation to provide installation instructions and at other times as requested by the County Representative.

3.8 ADJUSTING

A. Adjust operable components for smooth even operation.

B. Field repair damaged galvanized surfaces in accordance with SSPC surface preparation SP1 and SP2 or SP3, and one coat of brush-applied galvanizing repair compound to 3-mil dry film thickness. Application from spray cans is not acceptable.

3.9 SCHEDULE

A. Schedule of fence types, gates, gate operators, and other requirements are indicated in the Contract Documents.

END OF SECTION

SECTION 32 31 13.53

HIGH–SECURITY CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Chain link fence framework, fabric, and accessories.

B. Barbed wire and barbed tape.

C. Excavation and foundation for posts.

D. Gates and related hardware.

1.2 RELATED SECTIONS

A. Section 03 20 00 – Concrete Reinforcing.

B. Section 03 30 00 – Cast-In-Place Concrete.

1.3 REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Division 01 for definitions, acronyms, and abbreviations.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. Referenced Standards and Manuals:

1. ASTM A121 – Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
2. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
3. ASTM A392 – Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
4. ASTM A824 – Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain-Link Fence.
5. ASTM A1011/A1011M – Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, ~~and~~ High Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
6. ASTM F567 – Standard Practice for Installation of Chain-Link Fence.
7. ASTM F626 – Standard Specification for Fence Fittings.
8. ASTM F1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
9. ASTM F1916 – Standard Specifications for Selecting Chain Link Barrier Systems With Coated Chain Link Fence Fabric and Round Posts for Detention Applications.

10. CLFMI Product Manual.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 01.

B. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware, anchorage, gates and schedule of components.

D. Samples: Submit two 12 inch by 12 inch samples of each type of fence fabric.

E. Quality Assurance/Control Submittals

1. Manufacturer's qualifications information.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer Qualifications: Firm specializing in manufacturing products specified in this Section with a minimum five years documented experience. Submit list of past detention or correctional projects (minimum five projects) including contact information.

B. Pre-Installation Meetings

1. Conduct pre-installation meeting in accordance with Division 01.
2. Convene pre-installation meeting one week prior to commencing work of this Section.
3. Coordinate work in this Section with work in related Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 01.

B. Packaging: Final gate assemblies shall be wrapped in protective material or crated to provide adequate protection during shipment.

C. Storage and Protection: Store materials elevated from the ground and covered/protected from the weather, adequately ventilated.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conform to ASTM F1916. Conform to CLFMI Product Manual.

B. Framework:

1. Round Pipe: CLFMI Type I or Type II.
2. Type I: ASTM F1083, standard weight (Schedule 40), plain ends.
3. Type II: ASTM A1011/A1011M structural steel minimum yield strength 50,000 psi; cold formed, electric welded.
4. Zinc Coating: Hot-dipped conforming to ASTM A123/A123M minimum 2.0 ounces per square foot.

5. Dimensions and Weights:

Outside Diameter (inch)	Type I Weight (lbs/ft)	Type II Weight (lbs/ft)
2.375	3.65	3.12
2.875	5.79	4.64
4.000	9.11	6.56
6.625	17.97	-
8.625	28.55	-

6. Terminal Posts (End, Corner, and Angle Posts)
   a. Minimum 4.000 inch outside diameter at fences with fabric extending 12 feet or less above finish grade.
7. Intermediate Posts:
   a. Minimum 2.875 inch outside diameter at fences with fabric extending 12 feet or less above finish grade.
8. Gate Posts: Type I Pipe; minimum 4.000 inch outside diameter where gate leaf width is 6 feet or less and fabric height of fence and gate leaf extends 12 feet or less above finish grade; minimum 8.625 inch outside diameter elsewhere.
9. Rails and Braces: 2.375 inch outside diameter.
10. Tension Wire: ASTM A824; Type II, Class 3.

C. Fabric:
   1. ASTM A392; Class 2 zinc coating.
   2. Mesh Types:
      a. 2 inch diamond mesh, No. 9 gauge wire.
      b. 1/2 inch square x 14 gauge galvanized wire mesh.
   3. Top selvage twisted tight, bottom selvage knuckled end closed.

D. Barbed Wire: ASTM A121; 12.5 gauge; 14 gauge four point round barbs, 5 inch spacing, Class 3 coating.

E. Barbed Tape:
   1. 30 inch (plus or minus 2 inch) diameter coils, fabricated from 0.025 inch thick by 1 inch wide American Iron and Steel Institute (AISI) 430 stainless steel hardened to Rockwell (30N) 30-37 minimum.
   2. Die stamped barb clusters of four needle-sharp barbs at 4 inches on center, minimum 1.2 inch long, offset in alternate direction 0.15 to 0.45 inch, each coil loop shall contain 24 (plus or minus one) barb clusters.
   3. Each coil shall have 51 loops and cover 25 feet maximum when fully extended.
   4. Adjacent coils and individual loops in each coil shall be clipped together in five locations along the circumference to obtain a concertina effect.
   5. Clips: Stainless steel, capable of withstanding a minimum pull load of 200 pounds for a minimum of thirty seconds without separation, or damage.

F. Bottom Rail Anchors: No. 3 reinforcing bars, U-shaped with hooks on each end.

G. Concrete: As specified in Section 03 30 00.

H. Concrete Reinforcing Bars: As specified in Section 03 20 00.

2.2 ACCESSORIES

A. General: Malleable steel, cast iron, or pressed steel conforming to ASTM F626; hot-dipped galvanized, minimum 2.0 ounces per square foot

B. Tension (Stretcher) Bars: One-piece lengths equal to full height of fabric with a minimum cross-section of 1/4 inch by 3/4 inch.

C. Tension (Stretcher) Bar Bands: Steel, 3/4 inch x 1/10 inch nominal to secure tension bars to posts.

D. Extension Arms: 14 inch long with slits at even spacing for two strands barbed wire, extending at a 45 degree angle inside of the fence line. Extension arms shall have a tight press-fit or should be tack welded. Extension arms shall be solid one-piece construction non-breakaway type.

E. Post Tops: Pressed steel, or malleable iron, designed as a weather tight closure cap for tubular post. Provide one cap for each exposed tubular post end, unless equal protection is afforded by combination post top cap and barbed wire supporting arm where barbed wire or barbed tape is required.

F. Truss Assembly: Capable of withstanding 2,000 pounds tension; consisting of minimum 1/2 inch truss rod with truss tightener or turnbuckle.

G. Boulevard Clamps: Two piece clamp, minimum 12 gauge, with 5/16 inch carriage bolts and nuts.

H. Braces: Same material as the rails extending from the terminal, corner, or pull post to the first adjacent line post. Securely fasten braces to posts by heavy pressed steel and malleable fittings (minimum 12 gauge), then securely trussed from line post to base of terminal post with a 3/8 inch truss rod equipped with a galvanized turnbuckle.

I. Rail Ends: Weathertight closure for tubular rails and braces.

J. Hog Rings: 18 gauge stainless steel for attachment of barbed tape; 9 gauge galvanized steel at all other locations.

K. Tie-Wire: 6 gauge galvanized steel wire.

2.3 MANUAL GATES

A. Framework:

1. Gate Frames: Type I pipe members, 2.875 inch outside diameter unless otherwise indicated. Gate sizes as indicated on Drawings.
2. Provide truss rods of 3/8 inch minimum nominal diameter to prevent sag or twist.
3. Provide intermediate bracing of gate leaves, spaced so that members are no more than eight feet apart.
4. Provide horizontal gate leaf braces as required to provide rigid construction, free from sag or twist.
5. Gate Fabric: Match fence fabric.

6. Attach fabric to frame at intervals not exceeding 12 inches. Secure with tension bars, tension bands, and 6 gauge steel wire.

B. Gate Hardware:

1. General: Malleable steel, cast iron, or pressed steel conforming to ASTM F626; hot-dipped galvanized, minimum 2.0 ounces per square foot.
2. Gate Hinges: Heavy duty and appropriately sized for the supported gate with large bearing surfaces for clamping position. Hinges shall not twist or turn under the action of the gate. Gates shall be easily operable by one person. Malleable iron, ball-and-socket type; non-lift-off type, offset to permit 180 degree swing.
3. Latches:
   a. At pairs of gates provide latching as indicated on Drawings with provision for padlock. Latch shall permit operation from either side of gate.
   b. At single gates: Provide positive fork latch with provisions for padlocking.
4. Keeper: Provide automatically engaging keeper for each gate leaf, holding it in the open position until manually released.
5. Double leaf gates: Provide gate stops for all double gates, consisting of mushroom type or flush plate with anchors. Set in concrete to engage the center drop rod or plunger.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions. Verify grade provides flat surface allowing fence construction with gap no more than 1-1/2 inches between bottom of rail and the ground or grade beam.

B. Report unacceptable conditions to the Architect. Begin installation only when unacceptable conditions have been corrected.

3.2 POST SPACING, HOLE DIAMETER, AND SETTING DEPTH

A. General: Conform to ASTM F567.

B. Space line posts equidistant at intervals not exceeding ten feet.

C. Set terminal posts (end, corner, and gate) at the beginning of each continuous length of fence and at abrupt changes in vertical and horizontal alignments.

D. Set posts in concrete in holes of minimum diameter and depth as indicated on Drawings

3.3 INSTALLATION

A. Install in accordance with ASTM F567, manufacturer’s printed instructions, and approved shop drawings.

B. Install units plumb, level, and square, and free from warp or twist while maintaining dimensional tolerances and alignment with adjacent surfaces.

C. Set intermediate, terminal, and gates posts plumb in concrete footings with top of footing height as indicated on Drawings.

D. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay each side from end and gate posts.

E. Provide top rail through line post tops and splice with 6 inch long rail sleeves. Top rails shall be continuous, using 18 foot minimum lengths, except at corner and gate posts.

F. Install center and bottom brace rail on corner gate leaves.

G. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

H. Position bottom of fabric 1/2 inch above grade beam/finished grade.

I. Fasten fabric to top rail, line posts, braces and bottom tension wire with tie wire at maximum 15 inch on centers.

J. Attach fabric to end, corner and gates posts with tension bars and tension bar clips.

K. Install bottom tension wire stretched taut between terminal posts.

L. Do not swing gates from building wall; provide gate posts.

M. Install gates with fabric to match fence. Install three hinges per leaf, latch, catches, retainer and locking clamp.

N. Install extension arms, barbed wire, and barbed tape along top of fence as indicated on Drawings.

3.4 ERECTION TOLERANCES

A. Maximum variation from plumb: 1/4 inch.

B. Maximum offset from true position: 1 inch.

C. Components shall not infringe adjacent property lines.

3.5 ADJUSTING

A. Adjust parts for smooth, uniform operation.

END OF SECTION

SECTION 32 31 19

DECORATIVE METAL FENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ornamental Picket Fencing and Accessories.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete.

1.3 REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Division 01 for definitions, acronyms, and abbreviations.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. Referenced Standards:

1. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM B117 – Standard Practice for Operating Salt Spray (fog) Testing Apparatus.
3. ASTM B695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

1.4 SUBMITTALS

A. Submit under provisions of Division 01.

B. Shop Drawings: Layout of fences with dimensions, details and finishes of components, accessories and post foundations.

C. Product Data: Manufacturer’s catalog cuts indicating material compliance and specified options.

D. Samples: Color selections for finishes. If requested, samples of materials (e.g., caps and accessories).

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Sufficient experience manufacturing similar products.

B. Erector’s Qualifications: Sufficient experience installing similar products.

1.6 PROTECTION

A. Damage to Adjoining Property and Existing Surfaces: Contractor shall assume all responsibility for damage to building surfaces and materials and shall restore them to their original condition should damage occur.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials so as to avoid damage under provisions of Division 01.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Ameristar, Product: Ornamental Picket Fence: Aegis II, Majestic Style three rail.

B. Master Halco, Monumental Iron Works.

C. Substitutions: Under provisions of Division 01.

2.2 ORNAMENTAL PICKET FENCE

A. Materials for fence framework (i.e., pickets, rails and posts) shall be manufactured from coil steel having a minimum yield strength of 50,000 psi. All steel shall be galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 ounces per square foot (coating designation G-90), hot dip process.

B. Pickets: Material for fence pickets shall be 1 inch square x 14 gauge tubing.

C. Rails: The cross-sectional shape of the rails shall conform to the manufacturer's standard design, with outside cross section dimensions of 2.0 inches square and a minimum thickness of 11 gauge. Picket holes in rail shall be spaced 4.98 inches on center.

D. Posts: Posts at fence shall be 4 inches square tube x 11 gauge. Provide flat steel caps.

E. Preassemble panels with rods or rivets supplied by manufacturer.

F. Finish: Galvanized framework shall be subject to six stage pretreatment/wash (with zinc phosphate) followed by an electrostatic spray application of a two coat powder system. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils to 4 mils. Top coat shall be a TGIC polyester powder coat finish with a minimum thickness of 2 mils to 4 mils. The color shall be black. Coated galvanized framework shall have a salt spray resistance of 3500 hours using ASTM B117 without loss of adhesion.

2.3 ACCESSORIES

A. Rail Attachment Brackets: Pressed steel or cast malleable iron.

B. Ornamental Picket Fence Accessories: Provide indicated items required to complete fence system. Galvanize each ferrous metal item in accordance with ASTM B695 and finished to match framing.

C. Post Caps: Formed steel, weathertight, flat closure cap. Provide one standard post cap for each post.

D. Picket Tops: Provide standard steel top.

2.4 SETTING MATERIALS

A. Concrete: Minimum 28 day compressive strength of 3,000 pounds per square inch for setting fence posts. Refer to Section 03 30 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify areas to receive fencing are completed to final grades and elevations.

B. Ensure property lines and legal boundaries of work are clearly established.

3.2 ORNAMENTAL PICKET FENCE INSTALLATION

A. Install fence in accordance with manufacturer's instructions.

B. Space posts uniformly at 8 feet on center maximum, unless otherwise noted.

C. Concrete Footings: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter four times greater than outside dimension of posts and depths approximately 6 inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils and for posts with heavy lateral loads. Set post bottom below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post and slope to direct water away from posts. Refer to Drawings for footing size.

D. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.

E. Align fence panel posts. Panels shall be attached to posts using mechanically fastened panel brackets supplied by the manufacturer.

3.3 ACCESSORIES

A. Install post caps and other accessories to complete fence.

3.4 CLEANING

A. Cleaning and Finishing: Upon completion of the work, clean all exposed surfaces, removing any discoloration or foreign matter.

B. Touch up all abraded or scraped areas with touch-up paint to match fence color. Touch-up shall not be obvious.

C. Protect all installed work against damage from other construction work.

D. Clean Up: Upon completion of the work of this Section, remove all surplus materials, rubbish and debris from the fence installation area.

END OF SECTION

SECTION 32 31 26

WIRE FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wire fencing, gates and accessories; training and reinspection.

B. Related Sections:

1. Section 32 31 13 – Chain Link Fences and Gates.

1.2 REFERENCES

A. AISI - American Iron and Steel Institute.

B. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

C. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

F. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

G. ASTM A475 - Zinc-Coated Steel Wire Strand.

H. ASTM A492 - Stainless Steel Rope Wire.

1.3 SUBMITTALS

A. Submit in accordance with Sections 01 33 00.

B. Product Data: Provide for each component of the netting installation.

C. Samples: Submit four of each sample listed prior to mockup per Section 01 43 63.

1. Tensioning devices - each type.
2. Netting - minimum 2 square feet per sample.
3. Netting zipper.
4. Netting support cable - 24 inches per sample.
5. Hog rings.
6. Fasteners - each type.
7. Break-away bracket.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. The Work of this Section shall be carefully performed by workmen skilled in fence/netting assembly installation, using appropriate tools and equipment; under supervision of a competent foreman at all times.

B. Mockup: In accordance with Section 01 43 63.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum of three years documented experience.

B. The Contractor or his/her lead field person shall have five years minimum of documented related experience in netting construction.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials in areas designated by the County Representative.

B. Do not drag netting on ground.

1.8 EXTRA MATERIALS

A. Submit extra materials as specified in Section 01 78 63.

1.9 OPERATIONAL MATERIALS

A. Deliver operational materials specified in Section 01 78 63.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace netting that deteriorates due to rot, bacteria, mold, mildew, or ultraviolet radiation.

1. Warranty period: Five years from date of Project completion.

PART 2 PRODUCTS

2.1 NETTING SUPPORT POSTS

A. Provide steel tubing conforming to ASTM A500, Grade B steel structural tubing or Type 1 pipe conforming to ASTM F 1083 standard weight (Schedule 40) 2.375-inch O.D.

B. Coating: Hot-dipped galvanized per ASTM A123 after fabrication.

2.2 GLASS BARRIER AND GATE BRACKETS

A. Provide ASTM A240, AISI Type 304 stainless steel hardware or steel galvanized per ASTM A123.

2.3 NETTING

A. 3/4-inch square mesh. Use square in lieu of diamond mesh. Net lines shall run parallel and perpendicular to electrified fence wires.

B. Four strands of 585 denier high density polyethylene wrapped rope-like into one twine. Overall diameter shall not exceed 0.55 mm.

C. Breaking Strength:

1. 25 pounds per twine, maximum for top and side panels.
2. 50 pounds per twine, maximum for bottom panels.

D. Netting shall not melt at 230°F and shall not propagate a flame.

E. Netting cannot be ingested by insects and will maintain its flexibility under any weather condition.

F. Minimum Length per Roll: 100 feet.

G. Color: Black.

H. Manufacturers:

1. Bird Barrier America Inc., Stealthnet, standard duty.
2. Bird Control Products.
3. Nixalite.

I. Weight increase of the treated mesh shall not exceed 25 percent per MIL-C-53004A (ME).

2.4 TENSIONING DEVICES

A. Turnbuckles that permit increasing or decreasing tension of cable without crimping, cutting, or damaging the cable. Turnbuckles shall be stainless steel.

1. Bird Barrier Inc. NT-S100.
2. McMaster-Carr.
3. Nixalite.

B. Tensioners: Without bonding jumper.

2.5 NETTING SUPPORT CABLE

A. Multiple strand, spiral, minimum of seven strands.

B. Strands shall be AISI Type 316 stainless steel.

C. Hard temper conforming to ASTM A492.

D. Minimum Tensile Strength: 920 pounds.

E. Maximum Weight: 16 pounds per 1,000 feet.

F. Overall Diameter: 5/64-inch.

2.6 COMPRESSION FITTINGS

A. Oval sleeve made of copper. Utilize a precision tool to compress the oval sleeve around the cable. Bird Barrier America Inc. NC-N100, Thomas and Betts, or Nixalite.

2.7 FASTENERS

A. Self-Tapping Screws, Split Pins, and Eye Bolts: AISI Type 316 stainless steel to conform to ASTM F593.

B. Bolts, Nuts, and Washers: ASTM A325 galvanized to ASTM A153.

C. Post-Installed Anchors: Proprietary type, designed for intended uses, and ICC ESR evaluated.

1. Manufacturers
   a. ITT Phillips Drill Division, “Red Head Wedge” or “Self-Drill” Anchor.
   b. Ramset Fastener systems “Trubolt” or Remodrill”
   c. Hilti Co.

2.8 NETTING ZIPPER

A. Heavy-duty marine construction.

1. Bird Barrier Inc.
2. Stealthnet Zipper 72 inches.
3. Nixalite.
4. Bird Control Products.
5. Or equal.

2.9 HOG RINGS

A. Galvanized.

B. Bird Barrier America Inc. TH-G100, Nixalite, Bird Control Products, or equal.

C. Apply with hog ring tool designed for the application.

2.10 GALVANIZING REPAIR

A. Accomplish repair of galvanized surfaces by use of DRYGALV; apply in accordance with manufacturer’s instructions. Manufacturers:

1. American Solder and Flux Company
2. ZRC Products Company
3. Sherwin-Williams Zinc-Clad Cold Galvanizing Compound
4. Or equal.

2.11 BREAK-AWAY BRACKET

A. Provide AISI Type 304 spring stainless steel.

B. Provide thickness and dimensions to cause the bracket to break away when 25 pounds ± three pounds of concentrated force is applied 8 inches from the center of break-away bracket attachment with fence netting system installed. Note that total break-away strength will be 25 pounds ± three pounds of concentrated force plus the tension of the netting. Bracket shall show no sign of deforming under normal netting tension.

2.12 SUPPORT SPRING

A. Provide support spring for holding middle netting support cable to netting post.

1. AISI Type 302 or 316 stainless steel, Condition B.
2. Springs shall be 5.5 inches long, including hooks, 0.3-inch minimum diameter, 0.32-inch wire strand, cross center 340-degree hooks.

PART 3 EXECUTION

3.1 NETTING

A. Erect netting taut so that a force of between two and four pounds as measured by a calibrated spring scale is required to deflect netting 3 inches toward detection rings at the midpoint between netting support cables. At the discretion of the County Representative, the deflection may be checked after the installation of each straight run. Deflection is relative to netting position at rest.

B. Seal all openings around the envelope created by the netting. Maximum gap shall be 0.75 inch. This includes the bases of strain posts and connection to glass barrier and sally port gates.

C. Bottom cable shall not be more than 1.5 inches above finished grade. Provide additional bottom netting cable hold downs as required to comply with this requirement.

D. Leave 12 inches of netting below the base cable.

E. The minimum acceptable netting overlap is 2 inches.

3.2 NETTING SUPPORT CABLE

A. Install netting support cable in continuous length, without splices.

B. Netting support cable maximum tensioning: 60 pounds.

3.3 NETTING ZIPPER

A. Provide netting zippers as shown on the Drawings.

B. Zipper to open from bottom to top.

3.4 HOG RINGS

A. Hog rings shall be spaced as follows:

1. At middle support cable: Every 24 inches.
2. At top and bottom support cables: Every 1 inch.
3. At zipper: Every 3/4 inch.
4. At any splice: Every 1 inch.

B. When attaching hog rings to splices, top and bottom support cables, enclose three squares of netting from each netting panel in addition to the cable.

3.5 TESTING

A. Netting:

1. The Contractor shall perform netting deflection tests as described in paragraph 3.1.A above.

2. Tests shall be conducted at a minimum of every 90 feet on both the prison side and free side of the netting installation. The Contractor shall notify the County Representative as he/she may view the tests.
3. The test results shall be recorded in a written log. This log shall be available to the County Representative. In the event all or portions of the netting installation fails this test, additional tests shall be performed as directed by the County Representative. The Contractor must take corrective action to meet test requirements.

B. Break-Away Bracket:

1. Perform break-away support strength test by measuring breaking strength of the support.
2. Break-away support shall fail in 15 seconds maximum when 25 pounds ± three pounds of concentrated downward force is applied at 8 inches from the center of the break-away attachment.
3. Randomly test a minimum of 10 units of the break-away supports, as selected by the County Representative. In the event supports fail tests, additional tests may be taken as directed by the County Representative.

3.6 ADJUSTING AND CLEANING

A. After erection, thoroughly clean surfaces of foreign and deleterious matter such as dirt, mud, oil, and grease.

B. Field repair damaged galvanized surfaces in accordance with Society for Protective Coatings surface preparation SP1 and SP2 or SP3, and one coat of brush-applied galvanizing repair compound to 3-mil dry-film thickness, no exceptions. Application from spray cans is not acceptable.

C. All repaired surfaces must be inspected by the County Representative.

3.7 ERECTION TOLERANCES

A. ±1/4 inch unless otherwise indicated in the Contract Documents.

3.8 CUTTING AND FITTING

A. Cutting, drilling, and fitting required shall be performed for the installation of fabricated metal work. Cutting, drilling, and fitting shall be executed carefully; when required, the Work shall be fitted in place before fastening.

3.9 TRAINING

A. The Contractor shall provide one hour of maintenance training for approximately 15 County staff. Training will consist of:

1. Removal of the net.
2. Netting repair and retensioning.
3. Cable repair and retensioning.
4. Zipper replacement and installation.

3.10 REINSPECTION

A. Netting will be reinspected by the County Representative after completion of the installation to determine any manufacturer and workmanship defects.

B. If workmanship defects are found, the Contractor shall repair them within 24 hours after notification, unless otherwise allowed by the County Representative.

END OF SECTION

SECTION 32 31 33

HIGH SPEED ELECTRONIC SECURITY GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Post driven electrically operated fast-acting bi-fold gate including structural columns, drive unit, controller, and gate panels.

1.2 RELATED SECTIONS

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

B. Division 26 – Electrical service and connections.

C. Section 32 31 13.53 – High Security Chain Link Fences and Gates.

1.3 REFERENCES

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Division 01 for definitions, acronyms, and abbreviations.

B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes as of the date of issue of this Project Manual.

C. Referenced Standards:

1. ASTM A36 – Standard Specification for Carbon Structural Steel.
2. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM F2200 – Standard Specification for Automated Vehicular Gate Construction.
4. AWS D1.1 – Structural Welding Code – Steel.
5. UL 325 – Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.4 SUBMITTALS

A. Shop Drawings:

1. Submit final assembly drawings in accordance with Division 01.
2. Indicate electric power requirements, installation details, wiring diagrams, operator components including controls and switches, gate elevations and sections, hardware, and gate fabrication details.

B. Installation Instructions:

1. Submit two copies of manufacturer's written installation instructions.
2. Submit reference list of five successful installations of the specified gate type within the last two years.

C. Test Reports:

1. Drive unit shall bear a label indicating that the gate controller/operator mechanism has been tested certified to UL 325 standards for all electrical components.

D. Closeout Submittals:

1. Provide operation and maintenance data for gate for incorporation into manual under provisions of Division 01.

1.5 QUALITY ASSURANCE

A. Manufacturer: A company specializing in the manufacture of automated gate systems.

B. Installer: A minimum of three years' experience installing similar equipment and approved by manufacturer.

PART 2 PRODUCTS

2.1 HIGH SPEED ELECTRONIC SECURITY GATE

A. Acceptable Manufacturer:

1. Wallace International, Winnipeg, Manitoba Canada; 866-300-1110, www.wallaceintl.com. Product: FOLDSMART XT.

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Steel Sheet: Hot dipped galvanized to ASTM A653/A653M, ASTM A36 pre galvanized steel.

B. Steel Sections: Conform to ASTM Grade G40.21-350W.

C. Welding Materials: Conform to AWS D1.1.

D. Electrical Components: Complete gate system shall be UL 325 listed and compliant with State and local requirements.

E. Power Supply: 115VAC/230VAC – 20 Amp single phase, 60 hertz power supply.

2.3 COMPONENTS

A. Gate Columns:

1. HSS steel columns, anchored to concrete foundation.
2. Columns shall be 8 inches square with a wall thickness of 0.250 inch.

B. Gate Components:

1. Dimensions: 10 feet high (8 feet with 24 inch panel extensions) x 18 foot clear opening.
2. Panels shall be capable of fully opening within 10 seconds.
3. Panels: 6 gauge welded wire infill.
4. Inter-panel Hinges: Double stacked R16 ball bearing at each hinge point with 1 inch hex bolt and lock nut.

5. Column Hinges: 1 inch alloy rod end bearing and 1 inch SAE 941 graphite impregnated bronze bushings.
6. Fully compliant with ASTM F2200, Class I through Class IV.

C. Safety/Obstruction Devices:

1. Through Beam Photoelectric Transmitter and Receiver: Equip each column with two built-in photocells at 20 inches and 60 inches above the base plate. Device shall be mounted within the columns.
2. Provide obstruction loop relay cards for integration of obstruction loops as required.

D. Drive Unit Shall Have:

1. 24 VDC drive with printed circuit board - integrated motor control circuitry for controlling electro-mechanical drive system. Drive system shall incorporate current sensing resistors and adaptive monitoring software as inherent entrapment protection.
2. All electrical drive components shall be enclosed in weather-resistant housing.
3. Dual 0.5 HP, 24 VDC motors and 600:1 gear reduction box with synthetic lubricant.
4. Integrated battery back up.
5. Emergency Override: Provide point for manual opening and closing of gate in the event of power failure/malfunction.
6. RS232 and USB port for laptop or other computer peripheral connection for diagnostics and programming.

E. Accessories:

1. Anti-climb top guard.
2. Fence Mounting Devices: Provide mounting brackets for mounting adjoining fence material to columns.

2.4 FINISH

A. Powder coated to 80 micron thickness with standard RAL colors. Color as selected by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide concrete foundations as indicated on Drawings.

B. Install high-speed security gate to manufacturer's written instructions and as indicated on Drawings. Installer shall be certified by gate manufacturer.

C. Submit certificate of installation to manufacturer upon completion of installation for warranty validation.

3.2 CLEANING AND MAINTENANCE

A. Perform cleaning and maintenance procedures in strict accordance with manufacturer’s written instructions.

B. Maintain logbook of repairs and maintenance.

3.3 DEMONSTRATION

A. Conduct comprehensive demonstration for maintenance staff on operation and care of gate.

END OF SECTION

SECTION 328400

LANDSCAPE IRRIGATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the installation of a complete and operational automatic Landscape Irrigation system as shown on the Drawings and as specified in this Section. The work includes:

1. Trenching, excavation, backfill including base and backfill materials.
2. Electrical and wiring/conduit work associated with the system.
3. Maintenance of the system during the maintenance period.

B. Related work includes but is not limited to:

1. Earthwork and Grading
2. Landscape Planting
3. Landscape Maintenance
4. Site Electrical System

1.3 STANDARDS

A. Unless otherwise shown or specified, all materials and methods shall conform to the applicable current sections of:

1. National Sanitation Foundation (NSF) Standard 61 Drinking Water System Components
2. California Code of Regulations (CCR) Title 24 Part 5 California Plumbing Code (CPC)
3. California Code of Regulations (CCR) Title 24 Part 3 California Electrical Code (CEC)
4. State of California, Department of Transportation (CALTRANS) Standard Specifications (DTSS), except for measurement and payment requirements.

B. ASTM International Standards (latest revisions) as they apply to this work and related test methods, including:

1. D1784 Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
2. D1785 Specification for Polyvinyl Chloride Plastic Pipe, Schedules 40, 80, and 120
3. D2241 Specification for Polyvinyl Chloride Pressure-Rated Pipe (SDR)
4. D2287 Specification for Non-rigid Vinyl Chloride Polymer, Copolymer Molding, &Extrusion Compounds
5. D2464 Specification for Threaded Polyvinyl Chloride Plastic Pipe Fittings, Schedule 80
6. D2466 Specification for Polyvinyl Chloride Plastic Pipe Fittings, Schedule 40

7. D2467 Specification for Polyvinyl Chloride Plastic Pipe Fittings, Schedule 80
8. D2564 Specification for Solvent Cements for Polyvinyl Chloride Plastic Piping Systems
9. D2609 Specification for Plastic Insert Fittings for Polyethylene Plastic Pipe
10. D2672 Specification for Joints for IPS PVC Pipe Using Solvent Cement
11. D2737 Specification for Polyethylene (PE) Plastic Tubing
12. D2855 Standard Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride Pipe and Fittings
13. D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
14. F656 Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
15. F690 Standard Practice for Underground Installation of Thermoplastic Pressure Piping Irrigation Systems:

C. All materials and methods shall conform to the applicable standards of the following organizations:

1. American Society of Irrigation Consultants (ASIC) Design Guidelines for Earth Grounding Electronic Equipment in Irrigation Systems
2. American Society of Mechanical Engineers (ASME) Standards
3. American Water Works Association (AWWA) Standards
4. American Welding Society (AWS) Specifications
5. Copper Development Association: Copper Tube Handbook.
6. Manufacturers Standardization Society (MSS) Standards
7. National Electrical Manufacturers Association (NEMA) Standards
8. Underwriters Laboratories (UL) Standards

1.4 REVIEWS

A. Contractor shall specifically request at least (2) two days in advance the following reviews prior to progressing with the work:

1. Site Preparation Review - Removal of and adjustments to existing valve boxes and valves and sprinkler heads and drip lines / emitters. Adjustments as needed to make final grade.
2. Preliminary Review-II – Main-line layout, trenching, pressure-test.
3. Intermediate Review - Irrigation coverage, controller location. Requirements for irrigation coverage inspection are specified herein.
4. Substantial Completion Review - valve box inspection, and overall operation of the irrigation system.
5. Final Review (at the completion of Maintenance Period) - all punch-list items identified at Substantial Completion Review.
6. See Specification Sections Earthwork and Grading, Soil Preparation, Landscape Planting, and Landscape Maintenance for other items to be inspected during these reviews.
7. Each review shall be conducted only after all items pertaining to that review as noted above and in related Sections have been completed by the Contractor.

1.5 QUALITY ASSURANCE

A. All materials shall be new and of the best quality available unless otherwise specified. Manufacturer shall be clearly marked on all material, containers, or certificates of contents for inspection.

B. Submittals: Within fourteen (14) days after Notice to Proceed submit:

1. Product data on all specified irrigation equipment, including any proposed substitutions.
2. Controller manufacturer's recommended grounding details.

C. Certification: Prior to the Substantial Completion Review submit to the Engineer:

1. Written statement that the controller has been grounded adequately from the controller manufacturer's representative or other qualified testing professional.

D. Maintenance Binder: As specified herein.

E. Guarantee: Contractor shall guarantee irrigation system for one year from date of acceptance.

F. Unusual Conditions: In the event that any unusual soil conditions are encountered during irrigation trenching operations, the Engineer shall be immediately notified. Unsuitable material encountered below the natural grade shall be excavated and disposed of as directed by the Engineer and paid for as Extra Work. Unsuitable material is defined in Section 19-2.02 of the CALTRANS Standard Specifications.

G. Hazardous Materials: In the event existing asbestos pipe is encountered and needs to be modified and/or removed, Contractor shall comply with the requirements of Federal (OSHA) regulations, and California Code of Regulations Title 8 (Cal/OSHA).

1.6 DELIVERY, STORAGE AND HANDLING

A. General: Exercise care in loading, unloading, storage, and handling of pipe, fittings, and irrigation equipment.

B. Any pipe / fittings that have been cracked, dented, or otherwise damaged shall be removed from the site. If installed, pipe / fittings shall be replaced with undamaged piping / fittings to the satIsfaction of the Engineer at no additional cost to the Owner.

1.7 UTILITIES

A. Contractor shall verify location of all on site utilities prior to trenching. Notify Engineer by telephone and in writing of any conflicts prior to installation. Restoration of damaged utilities shall be made at the Contractor's expense to the satisfaction of the Engineer.

1.8 CODES

A. Irrigation system and electrical power to controller shall be installed and tested in accordance with local codes and manufacturer's specifications.

1.9 TESTING

A. The backflow preventer shall be tested and approved by a licensed testing agency prior to substantial completion. Submit test results certificate to Owner as part of Substantial Completion review for Landscape Maintenance Period authorization.

PART 2 PRODUCTS

2.1 PLASTIC PIPE AND FITTINGS

A. Unless otherwise noted:

1. Lateral line pipes shall be Schedule-40 PVC / Class 200 PVC, solvent weld joints.
2. Mainline pipes up to 2” diameter shall be Schedule-40 PVC, solvent weld joints.
3. Mainline pipes 2-1/2" – 4” diameter shall be Class 315 PVC / SCH-40 PVC, solvent weld joints.
4. Mainline pipes larger than 4” diameter shall be Class 200-PVC Rubber Ring Joint.
5. Lateral line pipe fittings shall be Schedule 40 PVC solvent weld. All threaded fittings for lateral pipe shall be Schedule 40 PVC heavy wall.
6. Mainline pipe fittings shall be Schedule 40 PVC.
7. All mainline threaded fittings shall match the pipe type.
8. All risers and nipples shall be Schedule 80 PVC, molded thread. Machine threaded nipples shall not be allowed.
9. Plastic threaded fittings shall use Permatex Form-A-Gasket No.2 Sealant or approved equal.
10. PVC cement shall be industrial grade, low VOC emission, high strength solvent weld cement, meeting ASTM D2564, IPS Corporation 711 or approved equal.
11. Primer shall be industrial grade, low VOC emission primer, meeting ASTM F656, IPS Corporation P-70 or approved equal.
12. Cans of solvents and primers shall have labels intact and stamped with the date of manufacture. Cans dated over 1-year old shall not be used. Thinning of solvents and primers shall not be allowed.

2.2 DRIP IRRIGATION

A. Approved manufacturers of drip irrigation products:

1. Agrifim by NDS, Fresno CA, (800) 688-8108 www.ndspro.com
2. Netafim, Fresno CA (888)638-2346 www.netafimusa.com
3. Rainbird, Azusa CA (800)458-3005 www.rainbird.com
4. Toro, Riverside CA (877)345-8676 www.toro.com

B. Supply system:

1. Valve Assembly: solenoid valve, filter, and pressure regulator shall be as specified on the Drawings.
2. Laterals, supply / exhaust headers shall be specified under Plastic Pipe and Fittings in this Specification, size per the Drawings.

C. General Drip Accessories:

1. Fittings shall be as provided by the drip irrigation pipe manufacturer or approved equal.
2. Stakes / staples shall be as provided by the drip irrigation pipe manufacturer or approved equal.

3. Flush port / valve by manufacturer or approved equal where shown on the Drawings.
4. In-line spring-type check valve by manufacturer or approved equal on all sloped areas.

D. TYPE-1 (Point-source):

1. Supply: polyethylene pipe ASTM D2737 as shown on the Drawings. 3/4" tubing shall be minimum 0.055" (1.4mm) wall thickness. Color shall be black unless otherwise noted.
2. Distribution: flexible PVC pipe as shown on the Drawings. 1/2" pipe shall be minimum 0.045" (1.2mm) wall thickness. Color shall be black unless otherwise noted. Low-flow bubblers shall be as shown on the Drawings.

E. Sub-surface*:*
1. Dripline: as shown on the Drawings.
2. Use manufacturer's blank tubing to transport water across locations where irrigation is not required and as shown on the Drawings.

F. Sub-Surface Drip Accessories:
1. Manual flushing valve: as shown on the Drawings.
2. Pressure gauge by manufacturer or approved equal where shown on the Drawings.

2.3 BRONZE VALVES

A. Bronze shut-off valves shall be in conformance with the requirements of MSS SP-80 Bronze Gate, Globe Angle and Check Valves, latest edition.

2.4 SLEEVING

A. All main and lateral lines located beneath paving shall be sleeved with Schedule 40 PVC pipe unless otherwise noted.

1. For pipes, sleeves shall be 4" dia. or twice the aggregate diameter of all pipes contained within the sleeve, whichever is greater.

2.5 VALVE BOXES

A. Valve boxes: Pre-cast plastic with bolt-down covers, by NDS, Carson Industries LLC, or approved equal, free of all cracks, chips or structural defects. Size as required by equipment plus adequate clearance to operate valves unless otherwise noted.

1. Boxes subject to vehicular traffic in paved areas shall be concrete and have traffic lid covers.
2. Boxes in turf areas shall have ribbed / reinforced lids capable of withstanding the loads of ride-on lawn mowers.
3. All valve box lids shall be labeled with the valve station number using a weather resistant method. Plastic valve box lids may be labeled with the valve station number using a branding tool / branding iron.
4. Plastic valve boxes in turf areas shall be black color unless otherwise noted.
5. Plastic valve boxes in planting / mulch areas shall be black color unless otherwise noted.
6. Plastic valve boxes for recycled water systems shall be purple color unless otherwise noted.

B. Valve identification tags: as manufactured by Christy Enterprises, Anaheim CA, (800)258-4583, or approved equal.

1. A Valve ID tag, with the valve station # clearly marked with weatherproof method, shall be attached to the inside of each remote control valve, and attached by means of a weatherproof tie.

2.6 IRRIGATION EQUIPMENT

A. General: Shall be as shown on the Drawings, or approved equal.

B. Back-flow Preventer Enclosure: Guardshack or equal, size to fit backflow device plus 6" clearance at the top and sides.

1. Enclosure Pad: Encpad or equal, size to fit backflow enclosure.

C. Bubblers shall include socks by manufacturer, size to match bubbler.

D. See Demolition Plan for removal and salvaging of existing irrigation equipment for relocation on the Irrigation Plan.

2.7 CONDUCTORS

A. Control Wire: Type UF, 600V, copper, common ground white, UL listed for irrigation control use.

1. Minimum wire gauge #14, use gauge appropriate to distance to account for voltage loss.
2. PVC (polyvinyl chloride) or PE (polyethylene) insulation.
3. Splices shall be sealed with Spears DS-100 connectors with Spears DS-300 sealant, or 3M Scotchlok 3570 connector sealing pack.

B. Controller Power: See Electrical Specifications

2.8 CONDUIT

A. Conduits: See Electrical Specifications

PART 3 EXECUTION

3.1 GENERAL

A. Acceptance of Work: Site grading shall be completed and/or accommodated to specified tolerances before trenching. The contractor shall be responsible for verifying the existing conditions on site and the removal and or reinstallation required making the grades.

B. Schematic: System features are shown schematically for graphic clarity. Install all piping and valves in common trenches where feasible and inside planting areas.

C. Coordination: Coordinate trenching as required with trenching contractor as well as with any other trades affected by irrigation installation. Coordinate installation of pipe and other irrigation equipment with other existing and proposed utilities and planting locations.

D. Grading: Contractor shall be responsible for installing all irrigation features to their finished elevation and at depths indicated.

E. Finish Grade: Unless otherwise noted, all heads shall be set at, and perpendicular to, finish grade.

F. Record Drawings of As-Built Conditions: Contractor shall regularly update a print of the system and any changes made to the system throughout the project.

1. Features below ground shall be indicated with at least two measurements from surface features such as pavements, fences and buildings.
2. Indicate actual control and ball valve and quick coupler locations in a similar manner. Indicate locations for valve boxes for intermediate control wire splices.
3. All final changes shall be recorded on a reproducible plan before trenches are backfilled. The as-built plan shall be completed and submitted to the Engineer before final payment shall be made for work installed.

3.2 INSTALLATION – TRENCHING & PIPE

A. Point of Connection: shall be below grade.

B. Excavation: Trenches for mainline, sleeves, and laterals shall be excavated to the depth required for laying pipe or conduit, plus depth of bedding if required as noted below.

1. Depth – pipes 4” dia. and less - level bottom of trenches for a smooth flat grade, and excavate bell holes where necessary to ensure that pipe rests for entire length on solid ground. Should rock or other unsuitable material be encountered, excavate to 6" below bottom of pipe and replace with well tamped and compacted approved backfill material or sand before laying pipe.
2. Depth – pipes greater than 4” dia. – depth of pipe and bedding as shown on the Drawings, or 6” below bottom of pipe whichever is greater.
3. Width - trenches shall be excavated wide enough to provide adequate working space to align and lay pipe or to construct the trench, make up and inspect joints, and allow placing and compaction of bedding material. The maximum trench width at the top of the pipe shall not exceed the pipe outside diameter plus 12- inches on each side of the pipe.
4. Maintain excavations free of water while installing pipe and until backfilled.
5. See Specification Section Tree Protection for trenching within tree protection areas.

C. Bedding; Bedding shall extend upwards from the bottom of the trench to the extent shown on the Drawings.

1. Bedding for pipes shall consist of compacted approved sub-soil or sand as defined herein.
2. In planting areas excluding natural turf sports fields, sand bedding may be jetted or ponded into place and shall be compacted to equal that of the adjacent prepared sub-grade as specified herein. Mechanical compaction may be necessary to achieve this required density. If the bedding is jetted or ponded, the operation should be closely supervised and provisions should be made for the removal of excess water.

D. Backfill: Cover no joints until system has been pressure tested and approved by the Engineer.

1. Backfill material shall consist of selected on-site excavated/sub-soil material, imported sandy soils, subject to prior approval by the Engineer. Backfill with potentially damaging rocks and debris shall not be permitted.
2. When piping has been installed, tested, inspected, and approved, backfill excavations in layers not exceeding 8". Moisten and machine tamp as required.
3. In planting areas, the top 6" of the trenches shall contain on-site near surface soils and shall be compacted to maximum 85% relative compaction per ASTM D698. For trenches in existing planting areas maintain near surface soils as uniform as possible with existing upper stratum soils.

4. In paving areas, the fill shall be placed in maximum 6-inch lifts (compacted layers) and shall be compacted by mechanical means only. Fill shall be conditioned, at time of compaction, to 1% to 3% above the optimum moisture content of the soil, and each lift shall be compacted to at least 90% relative compaction per ASTM D1557.
5. For trenches in existing areas, restore the ground or paving to original condition.
6. After backfilling, remove from the premises all surplus earth resulting from this work and dispose of same, to the satisfaction of the Engineer.

E. Pipe: pipes shown parallel on the Plan may be installed in a common trench. Where required, snake pipe from side to side when trench exceeds 30 feet in length.

1. Where pipes are shown parallel to or adjacent to shrub or ground cover areas, they shall be installed in these areas.
2. Where pipes are shown parallel to or adjacent to lawn areas versus pavement, they shall be installed in the lawn area. All changes in depth of pipe shall be accomplished using 45 degree fittings.

F. Check Valve: On sloped sites, install in-line check-valves in sloped main / lateral / supply lines as required to prevent low head / emitter / bubbler drainage.

1. For sub-surface (Type-2) irrigation, install one in-line check-valve valve on supply / exhaust headers for every 4-1.2’ of elevation change within a circuit or as recommended by the Manufacturer.

G. Sleeves: Contractor shall adequately size sleeves for all wiring and irrigation lines to be placed (with ends clearly marked above grade) under driveways and walks prior to their construction.

1. Install sleeves minimum 24” under paving.
2. Sleeves shall continue a minimum of 1 foot into planting areas.
3. All wiring shall be in a separate sleeve.
4. Install removable non-decaying plugs, expanding insulation foam or equal, at ends of sleeves and conduits to prevent entrance of earth.

H. Fabrication: All manifolds shall be neat, orderly, and constructed for ease in maintenance operations. Install manifolds to allow valve boxes to be parallel to each other and to adjacent walls, walks, and curbs. Cuts and joints shall be free of burrs, smooth and minimum in quantity.

I. Flushing of System: After installation of pipe lines and sprinkler risers, but before installation of sprinkler heads and/or drip irrigation emitters, thoroughly flush the system to remove any foreign material in the pipes.

1. For flushing mainline and sprinkler portions of the system utilize full water main pressure.
2. For flushing downstream of drip irrigation valves via flush ports use drip system design pressure.
3. After flushing, backfill and settle soil. Rake smooth to match surrounding grade.
4. Flushing shall include flushing out the existing mainline by operating one of the existing quick couplers down stream of the new valve installation, prior to operating any portion of the system again.

J. Master Valve Flow Sensor Testing: After installation of system Contractor shall test the operation of the Master Valve in the presence of the Engineer.

1. Prior to testing set the high-flow on the flow sensor to the maximum design GPM shown on the Drawings. In case of a smart controller, run the controller through full cycles so that it learns the flows of individual stations.
2. Test the main-line by removing a quick coupler valve.
3. Test an individual station by turning it on and removing a sprinkler head or nozzle.

3.3 INSTALLATION – EQUIPMENT

A. General: Install irrigation equipment as shown on the Drawings

B. Valve Boxes: Install valve boxes so that the top of box is ½" above finish grade in turf areas and 1-½" above finish grade in mulch areas. Install valve box assembly in ground cover / shrub and not in hard paved areas. Install in lawn area only if groundcover does not exist adjacent to lawn.

1. Each valve shall have a valve-identification tag, the corresponding valve box cover shall be branded with the valve identification number.

3.4 CONTROL WIRE

A. General: Install control wire in pipe trenches wherever practical. All wire shall be installed below or level with the bottom of adjacent pipes. Where pipes are not available, control wire shall be installed inside conduits as specified in this section.

1. Bundle wire and tape to pipe every 10 feet. Conduits or sleeve required shall be sized based on control wires as specified herein.
2. All wiring above finish grade shall be enclosed in steel conduit.
3. Color of control wire shall be different than common wire.
4. One solenoid valve per station unless otherwise indicated on the Drawings or with prior approval of the Engineer.
5. All wiring shall be tested for continuity, open circuits and unintentional grounding prior to connecting.

B. Splices: shall be sealed with direct bury connectors as specified in this section.

1. All wire splices shall be installed in a valve box, locations as approved by the Engineer. Install traffic rated boxes in vehicular areas.

C. Additional wire:

1. Control wire for unused stations shall be pulled as noted on the Drawings.
2. Control wire and common shall be pulled to each stub-out as shown on the Drawings. Minimum one control wire and common if not indicated on the Drawings.
3. For 2-wire systems decoder wire shall be pulled to each stub-out as shown on the Drawings
4. Provide 24" excess wiring in each valve box / pull box and in the nearest project valve box at 100-ft intervals on wire runs of greater than 100-ft. Neatly coil in valve box or pull box.

3.5 DRIP IRRIGATION TYPE-1 (POINT-SOURCE) INSTALLATION

A. Install all drip line and equipment as indicated on drawings. Follow equipment Manufacturers Instructions.

B. Bury all supply and distribution pipes to the depths shown on the Drawings.

C. Snake the supply and distribution pipes through the planting to allow for expansion and movement. Do not kink the pipes, use right angle connectors in tight corners.

D. Install metal wire staples / anchors at 3' on center, and two (2) staples / anchors on each change of direction (tee, elbow, or cross).

E. Locate emitters / low-flow bubblers at top of mulch. Adjust or cut length of distribution pipes as necessary. Verify that locations of and flow from emitters / low-flow bubblers is optimum for each root ball watering.

F. On sloped areas, install supply pipes parallel to the slope wherever possible. Emitters / low-flow bubblers shall be placed on the uphill side of the plant.

3.6 CONTROLLER

A. General: The Contractor is advised that based on existing soil types, soil imports, and final ground conditions, additional grounding equipment may require to be installed at no extra cost to the Owner.

1. Submit manufacturers grounding equipment details recommended for the Project.

B. Installation: controller onto concrete base or on to wall per the Drawings.

C. Power: Install power to controller following all applicable electrical codes. Install GFCI switch and 9-volt battery.

1. For multiple controllers – each controller shall have a separate, dedicated common.

D. Grounding: Contractor shall bear responsibility for determining, from the Controller manufacturer, the grounding equipment recommended for the specific project soil and weather conditions. The guidelines below are provided for information only.

1. Each controller shall be grounded individually, unless otherwise noted by the Controller manufacturer.
2. Grounding rods, where required, shall be of copper-clad steel type and grounding plates where required, shall be of solid-copper type.
3. A typical installation requires the installation of a 5/8" dia. x 8' long UL listed grounding rod embedded in the soil per Controller manufacturer's instructions.
4. For sandy, dry, and/or loose soils, a grounding plate set in appropriate earth contact material may be required per Controller manufacturer's instructions.
5. For rocky soils, one or two grounding plates may be required per Controller manufacturer's recommendations.
6. For areas known to be prone to lightning, a transient protection board and surge protector may be required inside the controller(s) per Controller manufacturer's instructions.
7. Contractor shall demonstrate, at Final Completion that the Controller has been adequately grounded for the specific project soil and weather conditions and provide a written statement to this effect from the Controller Manufacturers representative or other qualified testing professional

3.7 VALVE STATIONING

A. Contractor shall clearly label and sequence stations according to the assigned valve identification numbers shown on the Drawings. In case valve sequencing needs to be changed for ease in maintenance operations, verify changes in advance with the Engineer. Final valve stationing shall be marked clearly on the as-built Drawings.

1. For modifications/additions to existing irrigation systems, obtain clear copies of the Irrigation Drawings or existing Valve Stationing Plans and mark-up as required to reflect changes and color code to indicate valve zones. Submit modified plan to the Engineer for approval prior to laminating and replacing inside the controller.

3.8 PRESSURE TEST

A. Pressure Test:

1. Notify the Owner a minimum of two (2) working days prior to pressure test.
2. Contractor shall furnish all equipment and temporary connections required for tests at no additional cost to the Owner.
3. Exercise caution in filling the system to prevent excessive surge pressure and water hammer.
4. Pipe subject to continuous water pressure (pressure lines) shall be tested at 125 lbs. of hydro-static pressure for two hours with a maximum 5 PSI drop. Repair any leaks, if necessary, and re-test.
5. Pressure test all lateral supply lines (non-pressurized) with joints under paving that are connected to planters.

B. Closing in Un-inspected Work: The Contractor shall pay all costs necessitated by requiring opening, restoration and correction of all work closed in or concealed before inspection, testing as required and approval by Engineer. Notify Engineer 48 hours in advance of required testing.

3.9 IRRIGATION COVERAGE

A. Inspection of irrigation coverage shall take place during the Intermediate Review, as specified herein.

1. The Contractor shall, in the presence of the Engineer, perform a coverage and operation test to determine if the system is fully operational.
2. If it is determined that adjustments in the irrigation equipment and the re-spacing of heads and/or relocation of emitters / low-flow bubblers will provide more complete coverage, the Contractor shall make such adjustments prior to planting. Adjustments may also include changes in nozzle or emitter / low-flow bubbler sizes, and degrees of nozzle arc as necessary.
3. The Contractor shall be responsible for making changes and obtaining complete and adequate coverage in all irrigated areas at no additional cost to the Owner.

3.10 HARDWARE

A. See Specification Section Landscape Maintenance for items to be handed over to the Owner at the in-service meeting.

3.11 MAINTENANCE BINDER

A. Submit at the time of Substantial Completion Review, a Maintenance Binder with the following documents:

1. Sheet containing:
    a. Contractor's name, address, and phone number.
    b. Controller assembly manufacturer's name, address, and phone number – if applicable
    c. Controller manufacturer's service address, and phone number
2. Copies of the following documents:
    a. Valve-stationing Plan
    b. Existing soils test report – see Specification Section Soil Preparation.
3. Warranties and Certificates. Warranty documents or accompanying letters on company letterhead shall note project name and location and effective start date for warranties.
    a. Irrigation Controller Assembly Warranty.
    b. Irrigation Controller Warranty.
    c. Backflow Prevention Device testing certificate.
4. Statement of verification of correct installation and operation:
    a. Controller grounding verification

B. The Maintenance Period shall not commence until the Maintenance Binder has been reviewed and approved by the Engineer.

3.12 CLEAN-UP

A. Keep project area clean on a daily basis, removing debris from the site.

END OF SECTION

SOIL PREPARATION - SECTION 329113

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for Soil Preparation of planting areas as shown on the Drawings and as specified in this Section. The work includes installation of soil amendments, finish grading and plant pit backfill.

B. Related work includes but is not limited to:

1. Demolition

2. Earthwork and Grading

3. Landscape Planting

1.3 DEFINITIONS

A. Finish Grade: is defined as the finished top surface of the soil after all grading and soil preparation activities, and prior to installation of mulch.

1.4 SUBMITTALS

A. Test Samples: Contractor shall provide samples, as specified herein, to an agricultural soils testing laboratory approved by the Engineer, referred to herein as the Testing Lab, unless delivered to the site in original, unopened containers, each bearing the manufacturer guaranteed analysis.

1. Testing Lab - Soil & Plant Laboratory, Inc., 1101 South Winchester Blvd., Suite G173, San Jose, CA 95128, (408) 727-0330or prior approved equal.

2. Use of an alternate soil testing lab without prior approval shall be cause for rejection of the submitted analysis.

3. No material shall be delivered to the site until the Engineer approves the material.

4. The same Testing Lab shall be used for all tests specified herein.

5. Contractor shall pay for all testing fees from the Testing Lab for all tests specified herein.

B. Product Certificates: Certification stating quantity, type, and composition, weight and origin for all amendments and chemicals shall be delivered to the Engineer within fourteen (14) days of the Notice to Proceed and before the material is delivered to the site.

C. Testing – Existing Soil: Prior to finish grading operations or at least four weeks before proposed planting operations, Contractor shall take a sample each of the topsoil and sub-soil, from 0”-12" deep, in three separate locations across the site after rough grading, as directed by the Engineer. Topsoil stockpiled from the same site is to be considered as one of the locations. Samples shall be mixed from the three locations to provide a composite sample, representative of the entire site, combined volume of samples not less than 2 quarts. Soil samples shall be

forwarded to the Testing Lab by the Contractor for testing and recommendations as to exact fertilizers and soil amendments to be used in planting, A05 analysis or approved equal.

1. Amendment and fertilizer recommendations by the Testing Lab shall be specific to the proposed amendments to be used. Generic recommendations will require the Contractor to re-obtain specific recommendations from the Testing Lab.
2. Soils report shall include an estimated infiltration rate for the tested soils.
3. Representative samples of sub-soil shall additionally be supplied to the Testing Lab from areas previously covered by paving for contamination testing. Allow six weeks for testing procedures.

D. Testing – Amendments: Contractor shall provide, along with a sample, latest analysis of amendments / bulk organic materials by the Testing Lab for verification of conformance to this specification, and specific recommendations as to exact quantities to be used in planting.

1. Analysis shall conform to physical and chemical properties specified herein.
2. Analysis shall not be more than three months old at the time of submitting sample.
3. Analysis shall assume tilling of the amendments into the soil as described elsewhere in this Specification
4. Analysis shall be approved by the Engineer / Architect prior to use on the project.

E. Testing – Imported Topsoil: Contractor shall provide, along with sample, latest analysis of soil proposed to be imported by the Testing Lab for testing as to exact fertilizers and soil amendments to be used in planting

1. Submit certificate or sample of any proposed bulk organic materials simultaneously for testing with soil samples for optimum amendment recommendations.
2. Analysis shall not be more than three months old at the time of submitting sample.
3. Should the final soil mixture be a combination of existing soil and imported topsoil, Contractor shall provide additional lab recommendations on method of mixing and exact fertilizers and soil amendments to be used in planting for the mixture.

F. Submit delivery tags for all amendments and fertilizers delivered to the Site for the Project.

1.5 REVIEWS

A. Contractor shall specifically request at least (2) two days in advance the following review prior to progressing with the work:

1. Intermediate Review – completion of site grading, amendment depths, finish grade.
2. See Specification Sections Landscape Irrigation and Landscape Planting for other items to be inspected during this review.
3. The review shall be conducted only after all items pertaining to the review as noted above and in related Sections have been completed by the Contractor.

1.6 PROTECTION

A. Protect concrete from any sulfate-based amendments that may be specified from soils analysis to avoid staining. Concrete damaged from amendment placement shall be replaced at the Contractor's expense.

PART 2 – PRODUCTS

2.1 EXISTING SOIL

A. Topsoil: The top layer of existing soil in planting areas, containing minerals and organic materials including humus, and completely free of weeds, roots, rocks/clods over one cubic inch and other objectionable material. Depth of topsoil shall be taken to be 4-6 inches deep or as determined by the Engineer at the time of construction after clearing and grubbing.

1. Topsoil is a [ ] type.

2. At turf areas topsoil starts below the grass root zone.

3. At planting areas other than turf, topsoil starts below the mulch and organic matter layer.

4. Soil underneath paving and aggregate base areas shall not be considered as top soil.

B. Sub-soil: Shall be the remaining existing soil on the site after clearing & grubbing, after topsoil has been removed, and after all rocks over one cubic inch and all foreign debris and organic material have been removed.

1. Soil under paving and aggregate base areas shall be considered as subsoil provided contamination testing as specified elsewhere in this section indicates that it is free of contaminants that are harmful to plant growth.

2.2 IMPORTED TOPSOIL

A. Imported Topsoil: Topsoil blends shall consist of rich sandy loam with organic materials with out mushroom compost. Reference blend shall be the Screened Topsoil Mix as supplied by Pacific Coast Soils Landscape Supplies, (831) 724-8032, www.pacificcoastsoils.com, or approved equal.

2.3 FERTILIZER

A. Soil amendment fertilizer shall be commercial fertilizer, 16-6-8 (N-P-K) uniform pellet. For bidding purposes only, exact fertilizer type and quantity to be determined by Testing Lab analysis.

B. Plant fertilizer shall be commercial fertilizer packets / tablets, controlled-release three-year 16-8-8 (N-P-K) by Nutri Pak, or approved equal.

2.4 SOIL AMENDMENTS

A. Nitrogen Stabilized Organic Amendment: shall be mineralized and nitrogen stabilized bark or sawdust humus, with wetting agent and properly pulverized and shall have a minimum of 270 lbs. per cubic yard of amendment. Submit sample analysis for approval.

B. Gypsum: Agricultural Grade, if needed.

2.5 CHEMICALS

A. The following brand names of various chemicals to be used in this Section are provided for ease of specifying; equals or brands with similar chemicals that will match or improve performance may be used at the Contractor's discretion. Contractor shall verify use of any chemicals with Owner prior to application:

1. Pre-emergent herbicides - (granular form only) Treflan, Ronstar, or prior approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Limits and Grades: Prior to commencing soil preparation operations, Contractor shall request a review by the Engineer to verify grading work completed to date and verify specified limits of soil preparation work to commence.

B. Contractor shall complete the site grading necessary to smoothly integrate newly graded areas with the existing grades.

3.2 Topsoil Placement

A. Stockpiled and imported topsoil shall be installed and completed as necessary to produce final finish grade requirement, minimum depth 6" (six inches) / 12” (twelve inches)

1. Existing undisturbed landscape areas that are to be replanted (excluding bio-retention areas) as shown on the Drawings, do not require topsoil across the areas, only individual plant pit preparation per Specifications.

2. Proposed landscape areas including areas to be graded or that have been disturbed by construction that are to be planted as shown on the Drawings require topsoil across the entire planting areas. Amended excavated subsoil cannot be used as topsoil for these areas.

B. Sub-grade shall be cross-ripped or cultivated to a depth of 10 inches. Water shall be added and ripping or cultivation shall be continued until the entire 10 inch depth is loose and friable. Place two inches of topsoil uniformly over sub-grade and thoroughly cultivate before placing remaining topsoil. Place topsoil and bring to a smooth, even grade. Soil shall be thoroughly water settled and high/low areas re-graded in accordance with paragraph "Finish Grading" this Section.

C. Stockpiled Topsoil: See Specification Section Earthwork and Grading

3.3 AMENDMENT PLACEMENT

A. The requirements below are for bidding purposes only, adjustments to the bidding formula shall be determined by the Testing Lab analysis.

B. All planting areas shall be thoroughly cross-ripped to a minimum 10 inch depth. Upon completion of cross-ripping the amendments shall be applied, as follows:

Amount/1000 Square Feet

6 cubic yards Nitrogen Stabilized Organic Amendment

12 lbs. Commercial Fertilizer

50 lbs Gypsum

C. The materials shall then be uniformly spread and incorporated to obtain a homogeneously blended soil, six inches in depth.

D. Plant pits: Soil which has been amended in the above manner shall be used as the backfill mix around the sides of the root balls. See Specification Section Landscape Planting for plant pit requirements.

3.4 FINISH GRADING

A. Contractor shall finish grade all areas, including those indicated to be planted on the Drawings, and shall remove all rocks and clods over one cubic inch. All areas shall be smooth and uniformly graded. All erosion damage during the construction period shall be repaired by the Contractor.

B. Unless otherwise shown on the Drawings, all soil finish grades shall be one-inch (1”) below finish surface of walks, pavements, and curbs.

3.5 CHEMICALS

A. Herbicides and pesticides: Contractor shall verify compatibility, dosage and other application procedures with the manufacturer. All chemicals shall be applied by a pest control operator licensed in the State of California.

B. Planting areas: Treat all ground cover and non-naturalized areas for weed control with pre-emergent herbicide, as recommended by the manufacturer. See Specification Section Landscape Maintenance for related work.

C. Include copies of documentation of pesticide and herbicide applications, countersigned by the Owner, in the Maintenance Binder – see Specification Section Landscape Maintenance.

3.6 PLANT FERTILIZER

A. All container stock shall receive additional fertilizer, in the form of commercial fertilizer packets / tablets at the rate of:

Container size	Fertilizer Packets / Tablets
4-inch pot	one (1)
1-gallon plant	two (2)
5-gallon plant	four (4)
15-gallon plant	ten (10)
24" box	fifteen (15)

1. Space the packets / tablets evenly around the ball halfway up backfill touching side of root ball.
2. The additional fertilizer requirement is independent of the Testing Lab analysis.

END OF SECTION

SECTION 32 92 00

TURF AND GRASSES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Turf sod and hydroseeding.

B. Related Sections:

1. Section 32 84 00 – Landscape Irrigation.
2. Section 32 91 13 – Soil Preparation.
3. Section 32 93 03 – Landscape Planting.

1.2 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Submit seed mix and fertilizer certificates of compliance including seed inspection certificates by State or Federal Authorities.

1.3 PROJECT CONDITIONS

A. Do not place hydroseed materials prior to October 1, nor later than May 31, unless otherwise approved by the County Representative.

B. Do not place any plant materials in areas designated to receive irrigation systems until the irrigation system has been installed and tested, unless otherwise approved by the County Representative.

PART 2 PRODUCTS

2.1 TURF SOD MATERIALS

A. Turf Sod: Turf Sod shall be Hybrid Bermuda grown from high quality propagative material (seed, stolons, or plugs); be free from weeds, diseases, and insects; and meet or exceed the standards of the State of California Regulations for Nursery Inspection.

1. Turf Sod shall be machine cut at a uniform thickness of 5/8 inch. Measurement for thickness shall exclude top growth and thatch.
2. Broken rolls or pads and torn or uneven ends will not be acceptable.
3. Rolls or pads of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically.
4. Before harvesting, sod shall be mowed uniformly at a height of 1/2 inch on and all clippings removed.
5. Turf Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect its survival.
6. Turf Sod shall be harvested, delivered, and installed within a period of 24 hours. Turf Sod not installed within this period shall be removed from site.

2.2 HYDROSEEDING MATERIALS

A. Wildflower Seed Mixture: Seed mixture varieties as indicated in the Contract Documents.

1. Wildflower seed germination rate shall be 90 percent minimum.
2. Seed shall be as supplied by Applewood Seed Company, S & S Seeds, or [.].

B. Dryland Grass Seed Mixture: Seed mixture varieties as indicated in the Contract Documents.

1. Dryland Grass seed germination rate shall be 90 percent minimum.

C. Lawn Seed Mixture: Seed mixture varieties as indicated in the Contract Documents.

1. Grass seed germination rate shall be 90 percent minimum.
2. Seed shall be as supplied by Seed Research of Oregon, Automatic Rain, or Sprinkler Irrigation Specialist.

D. Wood Fiber Mulch: Produced from natural or recycled (pulp) fiber such as wood chips or similar wood materials or from newsprint, chipboard, corrugated cardboard or a combination of these processed materials, free of synthetic or plastic materials.

1. Wood fiber mulch material shall not contain more than 7 percent ash as determined by the Technical Association of the Pulp and Paper Industry (TAPPI) Standard T 413, shall contain less than 25 parts per million boron, and shall be otherwise nontoxic to plant or animal life.
2. Fiber shall have a water-holding capacity by weight of not less than 400 percent and shall be an existing commercial product routinely used for supporting the hydroseeding establishment of soil erosion control grasses.
3. Material shall be of such character that it will readily disperse into a uniform slurry when mixed with water, but water content of material before mixing into slurry shall not exceed 10 percent of the dry weight of the material. Commercially packaged material shall have moisture content of the fiber marked on the package.
4. Fiber shall be colored to contrast with the area on which the fiber is to be applied.
5. Submit a Certificate of Compliance for wood fiber mulch.

E. Fungicide: “Subdue,” or [.].

1. Binder: Binder for hydroseeding shall be concentrated liquid chemical that forms a plastic film upon drying and allows water and air to penetrate.
2. Binder film shall be nonflammable, shall have an effective life of at least one year, shall be miscible with water at the time of mixing application, shall be nontoxic to plant or animal life, and shall be nonstaining to concrete or painted surfaces.
3. In cured state, binder shall not be re-emulsifiable.
4. Binder Material shall be registered with and licensed by the State of California, Department of Food and Agriculture, as an “auxiliary soil chemical.”
5. Submit a Certificate of Compliance for binder.

2.3 OTHER LANDSCAPE MATERIALS

A. Pre-emergent herbicide: Shall be “Treflan EC,” “Tupersan,” or [.].

B. Ammonium Phosphate: Shall be 16-29-0 commercial ammonium phosphate fertlizer with nitrogen.

C. NPK Fertlizer: Shall be 18-18-6 commercial fertilizer with micronutrients

PART 3 EXECUTION

3.1 TURF SOD

A. Turf Sod Installation

1. Prepare turf planting area as described in Section 32 93 03 Landscape Planting.
2. Fine grade. Provide drainage away from buildings.
3. Area shall be free from weeds and other vegetation.
4. Roll with a 250-pound water ballast roller.
5. Grade shall be 2 inches below walks or curbs.
6. Finish grade of sod, in place, shall be 1 inch below adjoining walk, curb, header, and/or other hard surface.
7. Finished soil surface shall make positive contact with sod soil with a minimum of air spaces.
8. Apply ammonium phosphate (16-20-0) at the rate of 10 pounds per 1,000 square feet.
9. Place Turf Sod in sections no smaller than 1 foot square and lay parallel to the contour. Stagger joints between rolls and butt ends tight. Sift soil (use soil waste that has fallen from sod) into joints to fill any voids.
10. Water Turf Sod immediately after laying and roll with a 250-pound water ballast roller. Water the new lawn to a minimum depth of 8 inches. Keep sod moist for two weeks.
11. Install 2-inch by x 4-inch redwood header board along edge of all grassed and landscaped areas that do not abut to a concrete sidewalk or other hard surface.

3.2 HYDROSEED

A. Hydroseed Installation

1. Soil in all Lawn areas shall be cultivated with soil amendment and fertilizer prior to hydroseeding as specified in Section 32 93 03 Landscape Planting. Rocks and debris larger than 1 inch in diameter which are brought to the surface during cultivation shall be removed from the site.
2. The finish grade of hydroseeded areas shall be as shown on the grading plans (per the Contract Documents) and smooth, with no abrupt change in surface appearance unless otherwise noted on the Contract Documents. Finished grade shall allow for positive drainage without ponding.
3. Hydroseeding shall not commence until all other planting has been completed, and finish grades have been approved by the County Representative.
4. Hydromulch slurry preparation shall take place at the site. Begin with adding water to the tank with engine at half throttle. When water level has reached the height of the agitator shaft, and good recirculation is established, add seed mixture, chemical additives, then fertilizer. Pulp shall be added after the tank is at least one third full, and engine shall be opened to full throttle when tank is half full. Spraying shall commence only after all materials are thoroughly mixed.
5. Hydromulch slurry:

a. Seed Mixture 0.50 lbs/1000 SF (Turf) / 0.25 lbs/1000 SF (Wildflower and Dryland Grass)
b. Fiber 46 lbs/1000 SF
c. Fungicide 2 oz /1000 SF
d. NPK Fertilizer 7 lbs/1000 SF
e. Binder 5 lbs/1000 SF

6. Mix to homogenous slurry.
7. Moisten areas to be hydroseeded to 2-inch depth just prior to application of slurry.
8. Slurry shall be evenly applied under high pressure in a uniform coating. Exercise care around plants and structures. Immediately remove any oversprayed slurry from walks or buildings that are inadvertently sprayed.
9. Irrigation during the germination period shall keep the hydromulch sufficiently moist at all times to promote dense uniform establishment of grass, without creating washouts. Irrigation system shall be tested for proper coverage prior to hydroseeding.
10. Re-seed bare spots until an even stand of grass results and is approved by the County Representative.

END OF SECTION

LANDSCAPE PLANTING - SECTION 329303

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the provision and installation of plant materials as shown on the Drawings and as specified in this Section.

B. Related work includes but is not limited to:

1. Soil Preparation

2. Landscape Irrigation

3. Landscape Maintenance

1.3 QUALITY ASSURANCE

A. Quality: Minimum quality of all plant material shall unless otherwise indicated conform to:

1. ANSI Z60.1-2004 American Standard for Nursery Stock, Sponsored by the American Nursery and Landscape Association (ANLA)

2. Prevailing published specifications of the California Association of Nurserymen.

3. Additional standards as indicated on the Drawings and as specified herein.

B. Applicable ASTM International Standards (latest revisions) as they apply to this work and related test methods, including:

1. D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

2. C602 Specification for Agricultural Liming Materials

3. D5268 Specification for Topsoil Used for Landscaping Purposes

1.4 SUBMITTALS

A. General: Within fourteen (14) days after Notice to Proceed submit the following:

1. Documentation certifying quantity and species of plant material ordered, the nursery supplier(s), *any* plant material not available at that time, or proposed substitutions to be reviewed.

2. Product data on all associated planting products specified herein.

3. 4-ounce sample of mulch.

1.5 REVIEWS

A. Contractor shall specifically request at least (2) two days in advance the following review prior to progressing with the work:

1. Intermediate Review – plant material approval and layout/locations. See Specification Sections Landscape Irrigation and Soil Preparation for other items to be inspected during this review.

B. Contractor shall specifically request at least (5) five days in advance the following reviews prior to progressing with the work:

1. Substantial Completion Review (to initiate Maintenance Period) – all planting areas including turf and naturalized grass if applicable. See Specification Section Landscape Maintenance.

2. Final Review (at the completion of Maintenance Period) - all planting areas including turf and naturalized grass if applicable, including all punch-list items identified at Substantial Completion Review. See Specification Section Landscape Maintenance.

C. Each review shall be conducted only after all items pertaining to that review as noted above and in related Sections have been completed by the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Nomenclature and Labels: Plant botanical names conform to "Standardized Plant Names," second edition, and secondly, "A Checklist of Woody Ornamental Plants of California, " Manual 32, University of California. All plants of each clone, species, and cultivar shall be delivered to the site labeled with their full botanical name. Every plant species shall be labeled with no less than one label for every ten plants of a species.

B. Quantities: The quantities shown on the plant list and in labels are for the Engineer's use and are not to be construed as the complete and accurate limits of the Contract. Contractor shall furnish and install all plants shown schematically on the Drawings.

C. Root Systems: All container-grown stock shall be grown in its container for at least six months prior to its planting. Contractor shall allow one percent of the quantity of plants for removal and inspection. Any plant material, within two years following the final acceptance of the project, determined by the Engineer to be defective, restricted, declining or otherwise deficient due to abnormal root growth, shall be replaced by the Contractor, to the equal condition of the adjacent plants, at the time of replacement.

D. Health: Foliage, roots and stems of all plants shall be of vigorous health and normal habit of growth for its species. All plants shall be free of all disease, insect stages, burns or disfiguring characteristics.

E. Untrue Species: All plant material, within two years following the final acceptance of the Project, determined by the Owner to be untrue to the species, clone, and/or variety specified, shall be replaced by the Contractor, to the equal condition of adjacent plants at the time of replacement.

2.2 TREES

A. All trees shall have straight trunks of uniform taper, larger at the bottom. Trunks shall be free of damaged bark, with all minor abrasions and cuts showing healing tissue. Sucker basal growth and lateral growth shall be removed and treated to eliminate re-sprouting. Normal lower side branching shall remain. Trees unable to stand upright without support shall be rejected.

2.3 FERTILIZER *(FOR TURF AND GROUNDCOVER AREAS)*

A. 20-10-15 (N-P-K) Commercial Fertilizer, uniform pellet.

1. The requirements above are for bidding purposes only, exact fertilizer types per Testing Lab analysis.

2.4 MULCH

A. Mulch: shall be shredded redwood or fir bark as approved by the Engineer.

1. Pre-approved product: 80% redwood & 20% fir bark Mulch by Lyngso Garden Materials, Inc. Redwood City CA

2.5 TREE STAKES AND GUYING

A. Wood Pole Staking

1. Stakes: Peeled and pressure-treated (EPA approved chemical not containing arsenic) lodgepole pine tree stakes, by Bourbon Valley Co, Sullivan & Mann Lumber Co., or approved equal, and sized as follows:

a. 2” dia x 8’ long for trees less than 8’ height

b. 3” dia. x 10’ long for trees between 8’-10’ height.

c. Poles shall be smooth, clean, and new.

2. Ties: Flat rubber / vinyl ties with U.V. inhibitors, meeting ASTM D-412, minimum 1” wide & 24” minimum length, by Gro Strait Products, Walnut Creek, CA / V.I.T Products, Escondido CA, or approved equal.

a. Use roofing nails of adequate length to firmly attach ties to stake.

B. Guying

1. Wire: 1/16" galvanized aircraft cable with 1/16" cable clamp

2. Tubing: 12" long PVC tubing

3. Model 40 duckbill earth anchor or equal

2.6 HEADER BOARD

A. Header board and stakes hall be redwood, grade conforming to "Standard Specifications for Grading of California Redwood Lumber," as published by the Redwood Inspection Service.

1. Redwood grade shall be Construction Heart

2. See the Drawings for installation and sizes of header board and stakes..

3. Fasteners shall be hot dipped galvanized 16D nails.

PART 3 - EXECUTION

3.1 GENERAL

A. Plant Material Approvals: Before planting operations commence, all plant material shall be reviewed by the Engineer. Defective plants shall be removed from the site and acceptable material substituted in its place. The review does not accept defective plants which may be installed.

B. Layout: Only those plants to be planted in any single day should be laid out. Locations of all plants shall be reviewed prior to planting. Plants installed without this review may be transplanted/relocated as directed by the Engineer.

C. Protection of Plants: Contractor shall maintain all plant material in a healthy growing condition prior to and during planting operation. Contractor shall be responsible for vandalism, theft, and damage to plant material until commencement of the maintenance period.

D. Pruning: Contractor shall do no pruning without specific authorization of the Engineer. Plants pruned without authorization shall be replaced by the Contractor if necessary.

3.2 PLANT PITS

A. Rootball shall rest only on undisturbed soil, or in the case of fill areas, on compacted, un-amended sub-grade. See Specification Section Soil Preparation for backfill mix requirements. Plant rootball and pits shall have their sides and bottoms loosened and otherwise broken to prevent glazing or compaction.

1. Plant pit sizes shall be as shown on the Drawings.

2. Plant pits in paved areas shall extend to the edge of the planter opening in all directions unless otherwise noted on the Drawings.

3.3 TREE AND SHRUB INSTALLATION

A. Watering basins: Construct basins as required to water plants during establishment period. Basin bottoms shall drain away from plant stems. See Specification Section Landscape Maintenance for removal of basins.

B. Wood Pole Staking: All trees shall be staked unless otherwise noted on the Drawings. Install stakes as per the Details.

1. Stakes shall be driven securely into existing soil on the windward side of the tree. A minimum of two figure-eight, rubber tree ties shall be required.

2. If using rubber ties without wire, nail rubber ties to the back of stakes in areas of severe wind conditions

C. Guying: Multi-stem trees 24” box and larger, shall be guyed unless otherwise noted on the Drawings. Install guys as per the Details.

1. A total of three (3) guys shall be installed spaced at 120 degrees.

3.4 CHEMICALS

A. Pesticide: Contractor shall verify compatibility, dosage and other application procedures with the manufacturer. All pesticides shall be applied by a pest control operator licensed in the State of California.

B. Include copies of documentation of pesticide applications, countersigned by the Owner, in the Maintenance Binder – see Specification Section Landscape Maintenance.

3.5 FERTILIZER

A. Apply Commercial Fertilizer at 5 pounds per 1,000 square feet to all planting areas, 30 days after planting. Re-application shall be scheduled at 45 day intervals until completion of Landscape Maintenance.

1. The requirements above are for bidding purposes only, exact application rates per Testing Lab analysis.

B. Include copies of documentation of fertilizer applications, countersigned by the Owner, in the Maintenance Binder – see Specification Section Landscape Maintenance.

3.6 MULCH

A. Install mulch to a minimum depth of 2-inches – see the Drawings for areas to be covered. See finish grading in Specification Section Soil Preparation.

3.7 HEADER BOARD

A. Wood header board shall have straight-line joints less than three feet long; curved-line joints being laminated in a staggered pattern with ends no closer than eighteen inches.

1. Stakes shall be not further than five feet on center at all ends, splices and joints.

2. All joints shall be spliced with 2 x 4 x 24" with top of splice plate 1" below top of header.

3. Stakes shall be located at all ends, joints, and splices. All nails shall be clinched over.

B. Backfill all header boards prior to paving operations. Protect and repair all damaged header boards prior to final acceptance.

3.8 MAINTENANCE

A. See Specification Section Landscape Maintenance

3.9 CLEAN UP

A. After completion of all operations, Contractor shall remove all trash, excess soil and other debris. All walks, walls, and pavement shall be swept and washed clean. Leave the entire area in a neat, orderly condition.

END OF SECTION

DIVISION 33
UTILITIES

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manholes for water, storm drain and sanitary sewer systems.

B. Related Sections:

1. Section 03 20 00 - Concrete Reinforcing.
2. Section 03 30 00 - Cast-in-Place Concrete.
3. Section 05 05 55 - Tamper-Proof Metal Fastenings.
4. Section 05 50 00 - Metal Fabrications.
5. Section 31 20 00 - Earth Moving.
6. Section 31 23 33 - Trenching and Backfill.
7. Section 33 41 00 - Storm Utility Drainage Piping.

1.2 REFERENCES

A. ASTM C478 - Precast Reinforced Concrete Manhole Sections.

B. ASTM C387 - Packaged, Dry, Combined Materials for Mortar and Concrete.

C. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

D. ASTM A48 - Gray Iron Castings.

E. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service or High-Pressure Service and Other Special Purpose Applications.

F. ASTM C990 - Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Flexible Joint Sealants.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Submit details for all precast concrete units.

C. Submit data on products and materials specified.

PART 2 PRODUCTS

2.1 MANHOLES

A. The base of all manholes shall be either cast-in-place concrete or precast concrete, except for manholes housing air and vacuum release valve assemblies.

1. Precast concrete bases shall have the base slab integral with the sidewalls. The base slab shall be 8 inches minimum thickness with No. 4 reinforcement steel bars at 8 inches

on centers each way in the center of the slab. The base reinforcement steel shall be tied to the wall steel.

2. Bases for manholes housing air and vacuum release valve assemblies shall consist of a drain gravel base and precast or cast-in-place concrete ring foundation.

B. Precast manhole sections conforming to ASTM C478 shall be 48-inch, 60-inch, 72-inch, or 84-inch internal diameter with 5-inch minimum walls or as otherwise shown for special purposes. The top and bottom of all sections shall be parallel.

C. Eccentric cones shall be provided for all manholes except as otherwise shown on the Contract Documents. Cones shall have the same wall thickness and reinforcement as the precast manhole section.

D. Manhole grade rings for extensions shall be a maximum 6 inches high. Extensions will be limited to 15 inches. Finish grade for solid covers shall be set flush within 1/4” maximum of final grade in all accessible routes. Holes, grates or other openings shall no exceed 1/2” in direction of travel when located in any accessible routes and 6 inches above finish grade in unpaved areas, except flush where gated covers are specified. Grade rings shall have anchor bolt holes for bolt-down frames and covers.

E. Factory Testing: Prior to delivery of any precast manhole section, yard tests shall be conducted at the point of manufacture. Precast sections to be tested shall be selected at random from stockpiled material to be supplied for the job. All test specimens shall be mat tested, and shall meet the permeability test requirements of ASTM C14.

F. Joints of manhole sections shall be tongue-and-groove type sealed with either mortar or preformed plastic joint material.

1. Mortar: Standard premixed mortar conforming to ASTM C387 or proportion one part portland cement to two parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the manhole section if using the standard tongue-and-groove type joint. Mortar mixed for longer than 30 minutes shall not be used.

2. Preformed Plastic Gaskets: Preformed plastic gaskets may be used in lieu of mortar type joints and shall be Kent-Seal No. 2 manufactured by Hamilton Kent Manufacturing Company, Box 178, Kent, OH 44240; Ram-Nek, manufactured by K. T. Snyder Company, Inc., Central National Bank Building, Houston, TX 77002; or equal, meeting all requirements of Federal Specification SS-S-00210.

G. Pipe connections to manholes shall be as specified by the pipe manufacturer. Inlet and outlet pipes shall extend through the walls of the structures for a sufficient distance beyond the outside surface to allow for connections, but shall be cut off flush with the wall on the inside surface. For concrete structures, the mortar shall be placed around these pipes so as to form a tight, neat connection.

H. Manhole steps shall be provided when manhole depth exceeds 30 inches. Manhole steps shall be copolymer polypropylene encapsulated 1/2-inch diameter Grade 60 steel rod steps. There shall be a 3-inch minimum embedment in precast concrete manhole sections and 4-1/2 inch minimum projection from the face of concrete at point of embedment. The installed steps shall be located so as to provide a continuous ladder with steps equally spaced vertically in the assembled manhole at 12 inches, plus or minus 3/4 inch. They shall be capable of withstanding a force of 350 pounds, applied at any place on the step and in any direction

which projects from the point of application through a diameter of the step cross-section at that point, with no permanent deformation resulting. Steps may be cast in manhole sections by the manufacturer.

I. Manhole frames and covers shall be cast iron as detailed on the Contract Documents. Covers shall have the word “STORM DRAIN”, or “SANITARY SEWER”, or “WATER”, in 2-inch raised letters. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and all defects, and shall conform to ASTM A48, Class 30B. Plane or grind bearing surfaces to ensure flat, true surfaces. Covers shall be true and seat within ring at all points.

1. Bolt-down covers shall be used on all manholes within the double perimeter security fence and shall have either six 3/8-inch or four 1/2-inch diameter by 1-1/2 inch long capscrews with washers. Capscrews and washers shall be Type 316 stainless steel conforming to ASTM A193 and the requirements for Removable Screws in accordance with Section 05 05 55. Countersink bolt holes in cover so that the top of the capscrews are below the top plane of the cover. Bolt hole sizes shall be compatible with size of security capscrews used. Frames for bolt-down covers shall be supplied with four 3/4-inch diameter Type 316 stainless steel anchor bolts, nuts, and washer as detailed on the Contract Documents.
2. Nominal inside opening of the frame shall be 24 inches. Provide a blind pick hole or lifting lug in the cover. Do not provide lifting rings or vent holes in covers unless specifically required.
3. Standard manhole frames and covers shall be Pinkerton Foundry No. A-104 as modified above, Phoenix Iron Works No. P-1001. Bolt-down manhole frames and covers shall be Pinkerton Foundry A-477 as modified above, Phoenix Iron Works No. P-1002.

J. Fabricated Outlet Grill: ASTM A193 stainless steel, Grade 304, in manhole or inlet, as per details shown on the Contract Documents.

2.2 INLETS

A. At the option of the Contractor, approved precast units or cast-in-place units may be used. Submit details of proposed precast units for review. Precast concrete risers for extensions shall be a maximum of 6 inches high and of the same quality as the sections.

B. Frames and grate inlets shall be fabricated of galvanized steel. Conform to Section 05 50 00. Grated inlets within the double perimeter fence shall be bolted down with ½-inch diameter removable anchor bolts conforming to Section 05 05 55. Anchor bolts, nuts, and washers shall be Type 304 stainless steel conforming to ASTM A193.

C. In each catch basin or drop inlet exceeding 30 inches deep, install steps so as to provide a continuous ladder with steps equally spaced vertically every 12 inches.

D. CMP risers shall be 12-gauge (0.109 inch minimum) galvanized corrugated steel pipe conforming to the requirements of AASHTO M36. Fabricate in accordance with Section 05 50 00.

E. Conform to the requirements of Paragraph 2.1, MANHOLES, for steps, mortar, and pipe connections.

2.3 CLEANOUTS

A. Frames and Grates: Cast iron. Castings shall be close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and all defects, and shall conform to ASTM A48, Class 30B. Plane or grind bearing surfaces to ensure flat, true surfaces. Covers shall be true and seat within frame at all points. Cleanout frames and covers shall be Pinkerton Foundry No. A-469 or D&L Supply No. H-8024, or equal. All cleanout frames and covers within the double security fence shall be provided with either three 3/8-inch or two 1/2-inch stainless steel pentagonal head security capscrews and washers. Countersink bolt holes in cover so that the top of the capscrews are below the top plane of the cover. Bolt hole sizes shall be compatible with the size of security capscrew used.

2.4 PRECAST CONCRETE BOX

A. Precast Concrete Boxes for Blow-Off Assemblies: The box shall consist of a precast concrete top section, precast concrete extension sections as required, and a cast iron bolt-down cover. The cover shall have the word “WATER” in 1/4-inch raised letters, 2 inches tall. The complete box assembly shall be capable of safely supporting H-20 traffic loads. All exposed steel shall be hot-dip galvanized. Bolt-down screws shall be security-head Type 3 stainless steel. Attach covers with six 3/8” or four ½” diameter by 1-1/2” long capscrews. Precast concrete boxes and covers shall be equivalent to N9 Electrical Box as manufactured by Christy Concrete Products, Inc., Brooks Products, Inc., or [.].

PART 3 EXECUTION

3.1 MANHOLES

A. Remove water from excavation.

B. Concrete Base: Vibrate to densify poured in-place concrete and screed so that the first precast manhole section to be placed has a level, uniform bearing for the full circumference.

C. Deposit sufficient mortar on base to assure watertight seal between base and manhole wall or place the first precast section of manhole in concrete base before concrete has set. First section shall be properly located and plumb. Carefully inspect precast manhole sections to be joined. Sections with chips or cracks in the tongue shall not be used. Clean ends of sections before assembly. Align manhole steps vertically.

1. Joints with preformed plastic gaskets shall be installed in strict conformance with the manufacturer’s recommendations. Only pipe primer furnished by the gasket manufacturer will be approved.

2. For mortar joints, thoroughly wet joint with water prior to placing mortar. Place mortar on groove of lower section. Set next section in place. Fill joint completely with mortar of the proper consistency. Trowel interior and exterior surfaces smooth on standard tongue-and-groove joints. Prevent mortar from drying out, and cure by applying an approved curing compound or comparable approved method. Chip out and replace all cracked or defective mortar.

D. Construct manhole inverts with smooth transitions to ensure an unobstructed flow through manhole. Remove all sharp edges or rough sections which tend to obstruct flow. Do not lay pipe through manholes. Trowel all mortar surfaces smooth.

E. For sanitary sewer manholes, the manhole base shall be formed with flow channels. Refer to the Contract Documents for inverts of pipes into the manholes to determine channel layouts. Channels may be formed using a continuous piece of PVC plastic pipe. No bends or wyes shall be used. Channel bottom shall not be formed using VCP.

F. For sanitary sewer drop manholes, construct drop assemblies inside of manholes and at locations indicated. The lower pipe elbow shall be supported by concrete poured monolithically with the manhole base. Attach the riser to the inside of the manhole as shown on the Contract Documents. Install drop assemblies whenever the drop through a manhole is 2 feet or greater.

G. Install frames and covers. Frames shall be set in a bed of mortar with the mortar carried over the flange of the ring. Install bolt-down manholes as shown or as recommended by manufacturer. Provide a minimum of one 6-inch high grade ring under the frame and cover. Extend anchor bolts through the grade ring to the frame. Hook the anchor bolt under the grade ring.

H. Manholes to be vacuum tested.

3.2 CATCH BASINS AND INLETS

A. If material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with acceptable fill material as specified in Sections 31 23 33. Refer to Section 31 23 33 for acceptable fill requirements. Set units to grade at locations shown on Contract Documents.

B. Install extensions as required. Lay risers in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar with interior and exterior troweled smooth. Prevent mortar from drying out and cure by applying a curing compound. Extensions shall be watertight.

C. Set frames and grates at elevations indicated or as determined in the field and in accordance with the Contract Documents. Frames shall be cast-in.

3.3 CLEANOUTS AND VAULTS

A. Construct in accordance with details as shown on the Contract Documents.

3.4 CLEANING

A. Construction debris and other foreign matter shall be removed to the satisfaction of the County Representative.

END OF SECTION

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Potable water system piping and fittings.

B. Related Sections
   1. Section 03 30 00 - Cast-In-Place Concrete.
   2. Section 05 05 55 - Tamper Proof Metal Fastenings.
   3. Section 09 96 00 - High Performance Coatings.
   4. Section 22 05 10 - Basic Piping Installation Requirements.
   5. Section 22 05 23 - General-Duty Valves for Plumbing Piping.
   6. Section 26 42 00 - Cathodic Protection.
   7. Section 31 20 00 - Earth Moving.
   8. Section 31 23 33 - Trenching and Backfill.
   9. Section 33 05 13 - Manholes and Structures.
   10. Section 33 12 16 - Water Utility Distribution Valves.

1.2 REFERENCES

A. ASME Standards:
   1. ASME/ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
   2. ASME/ANSI B16.3 - Malleable Iron Threaded Fittings.
   3. ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
   4. ASME/ANSI B16.9 - Factory Made Wrought Steel Buttwelding Fittings.
   5. AASME/ANSI B16.11 - Forged Fittings, Socket-Welding and Threaded.
   6. ASME/ANSI B18.2 - Square and Hex Bolts and Nuts.
   7. ASME/ANSI B31.1 - Power Piping.
   8. ASME/ANSI B36.10 - Welded and Seamless Wrought Steel Pipe.

B. ASME B16.3-[Date] - Malleable Iron Threaded Fittings: Classes 150 and 300.

C. ASTM References:
   1. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   2. ASTM D1784 –Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Compounds.
   3. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
   4. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.
   5. ASTM D2464 - Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   6. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

7. ASTM D2467 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
8. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
9. ASTM F439 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
10. ASTM F441 - Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
11. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic pipe.
12. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

D. AWWA References:

1. Manual M-11 - Steel Water Pipe: A Guide to Design and Installation.
2. AWWA C104/ANSI A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
3. AWWA C110/ANSI A21.10 - Ductile Iron and Gray-Iron Fittings.
4. AWWA C111/ANSI A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115/ANSI A21.15 - Flanged Ductile Iron Pipe With Threaded Flanges.
6. AWWA C153/ANSI A21.53 - Ductile-Iron Compact Fittings.
7. AWWA C200 - Steel Water Pipe, 6 inches (150 mm) and larger.
8. AWWA C205 - Cement Mortar Protective Lining and Coating for Steel Water Pipe.
9. AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 Inch Through 144 Inch (100 mm through 3600 mm).
10. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
11. AWWA C606 - Grooved and Shouldered Joints.
12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches through 12 Inches (100 mm through 300 mm), for Water Transmission and Distribution.
13. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inches through 48 inches (350 mm through 1,200 mm), for Water Transmission and Distribution.

1.3 SYSTEM DESCRIPTION

A. Provide materials, services, and equipment required to install and make ready the potable water distribution system, complete in place. The potable water distribution system includes the fire water piping supply lines up to the indicated building connection points if not otherwise indicated.

B. The class of pipe shown in the Contract Documents is the minimum required static internal design pressure in pounds per square inch. When the class of pipe is not otherwise called out the minimum pressure rating shall be 200 psi. The pipe shall be designed for this internal pressure plus transient pressure or the specified test pressure, whichever pressure is greater, for earth loads, and for an AASHTO H-20 wheel load, all without exceeding the allowable design stresses. Pipe shall be designed for earth and wheel load both with and without internal pressure. The minimum design transient pressure shall be 50 percent of the static internal design pressure unless otherwise specified.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Product Data, Drawing and Literature
   1. Product data on all pipe materials.
   2. Manufacturer's catalog information.
   3. Submittal data as required by referenced Specification sections.

C. Quality Control Submittals
   1. Manufacturer's Affidavit of Compliance as specified in AWWA C200, Section 1.12.
   2. Nondestructive weld test method and results on fabricated fittings.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE AND FITTINGS (PVC)

A. Smaller than 4 inches: PVC pressure pipe Schedule 80, iron pipe size PVC, Type 1, Grade 1, or Class 12454-B in accordance with ASTM D1784 and ASTM D1785.
   1. Fittings shall be in accordance with ASTM D2467 for socket-type and ASTM D2464 for threaded type.
   2. Joints shall be socket-type, solvent welded, except that threaded connections shall be used to connect to unions and valves that may require future disassembly.

B. 4 inches through 12 inches in diameter: PVC pressure pipe in accordance with AWWA C900, Class 200, ductile iron pipe size.
   1. The PVC compounds used to make pipe shall contain no ingredient in an amount that has been demonstrated to migrate into water in quantities considered to be toxic.
   2. The PVC products shall be tested for chemical extractants and certified as suitable for potable water distribution service.

C. Larger than 12 inches: In accordance with AWWA C905 for PVC water transmission pipe. It shall have a dimension ratio not more than 18 (DR-18) and shall be rated for 235 psi at 73 degrees F. Diameter shall be cast iron pipe O.D.
   1. Joints shall be rubber ring gasket, bell and spigot.

D. Pipe joints shall be rubber gasketed bell and spigot or rubber gasketed couplings except where otherwise called for on the Contract Documents. Gaskets shall conform to ASTM F477. Furnish sufficient feeler gages of the proper size, type, and shape for use by the installation contractor to check the rubber gaskets.
   1. Where solvent welded type joints are specifically called for in the Contract Documents, provide solvent-cement type bell-ended pipe. Primer and solvent shall be provided by the pipe manufacturer.

E. Lubricants intended for use with PVC pipe and couplings shall be made from materials that are compatible with the plastic material and gasket material. The lubricant shall not support the growth of bacteria nor adversely affect the potable quality of the water that is to be transported.

F. Fittings, unless otherwise shown on the Contract Documents, shall be ductile iron, conforming to the same class and rating as the pipe. Fitting joints shall be as required for the pipe being connected. Transition fittings necessary for proper connection shall be the standard of, and provided by, the manufacturer of the fittings.
   1. Ductile iron fittings shall be mechanical flanged or push-on joint in conformance with AWWA C110, and shall be mortar-lined in accordance with AWWA C104. Joints shall be

rubber gasketed in accordance with AWWA C111. Ductile iron fittings shall be coal tar epoxy coated.

2.2 DUCTILE IRON PIPE AND FITTINGS (DIP)

A. Pipe

1. Centrifugally cast, Grade 60-42-10 iron, ANSI A21.51, AWWA C151.
2. Cement-lined and coal-tar pitch varnish coated.
3. 250 psi minimum working pressure.
4. Grooved end pipe and threaded flanged pipe shall be Class 53 minimum.

B. Joints

1. Grooved end, flanged, mechanical joint, push-on, or proprietary restrained as specified herein and as shown on the Contract Documents.
2. Grooved end joints shall conform to AWWA C606.
3. Flanged joint pipe shall conform to ANSI/AWWA C115 and shall use ductile iron flanges.

C. Fittings

1. Gray or ductile iron, 250 psi working pressure. Where taps are shown on fittings, tapping bosses shall be provided.
2. Grooved End: ANSI/AWWA C110, AWWA C606 and ANSI B16.1, radius cut grooved rigid joint, as manufactured by Victaulic Company of America, Gustin-Bacon, or equal.
3. Flanged: ANSI/AWWA C110 and ANSI B16.1, faced and drilled 125-pound ANSI standard.
4. Mechanical Joint: ANSI/AWWA C110, ANSI/AWWA C111, and ANSI/AWWA C153.
5. Push-On: ANSI/AWWA C110 and ANSI/AWWA C111, American Cast Iron Pipe Company, Fastite Joint; U.S. Pipe and Foundry, Tyton joint; or equal.
6. Proprietary Restrained: Clow Corp., Super-Lock Joint; American Cast Iron Pipe Co., Flex-Ring Joint or Lok-Ring Joint; U.S. Pipe, TR Flex. Any joint employing setscrews, anchor pins, or field welded retainers is unacceptable.

D. Flanges: Ductile iron, ANSI A21.15/AWWA C115, threaded, 250 psi working pressure, 125-pound ANSI drilling.

E. Bolts: For Class 125 FF Flanges: Carbon Steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.

F. Gaskets

1. Gaskets for grooved end joints shall be manufacturer's flush-seal type specifically designed for cast surfaces. Properties shall be as designated in ASTM D2000 for the required service. Dimensions shall conform to AWWA C606.
2. Gaskets for mechanical, push-on, and proprietary restrained joints shall be rubber conforming to ANSI A21.11, AWWA C111.
3. Gaskets for flanged joints shall be 1/8-inch thick, full-face cloth-inserted rubber conforming to applicable parts of ANSI B16.1 and AWWA C207, unless otherwise specified. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in sewage or potable waterlines.

2.3 WELDED STEEL PIPING (WSP)

A. Pipe
   1. Pipe shall conform to AWWA C200 and as specified herein.
   2. Pipe Diameter
      a. Steel Cylinder: Nominal diameters established for schedule pipe.
   3. Pipe shall be designed by the manufacturer for the following design conditions:
      a. Internal design pressure shall be 200 psi minimum.
      b. Allowable stress at internal design pressure shall not exceed 50 percent of the minimum yield point of the steel, 18,000 psi maximum.
      c. Wall thickness not less than standard weight per ANSI B36.10, minimum.
      d. Fusion bonded Epoxy Lining and Coating
         1) Steel pipe shall be fusion bonded epoxy lined and coated per Section 09 96 00, System 29. In addition to fusion bonded epoxy coating, coat pipe exposed to sunlight per Section 09 96 00.
         2) Steel cylinder thickness shall limit design deflection to not more than 2 percent of pipe diameter.

B. Joints
   1. Rubber ring gasket joints, grooved end, flanged, or welded as shown.
   2. Rubber Ring Gasket Joints
      a. Carnegie shape spigot.
      b. Separate, weld-on, bell rings.
   3. Grooved end joints shall be Type B, C, or D as specified in AWWA C606.
   4. Shop welded joints shall be butt welded.
   5. Flanges
      a. Flat-faced steel ring or hub flanges Class D, in accordance with AWWA C207.
      b. Gaskets shall be 1/8 inch, one-piece, full-face, cloth-inserted rubber.
      c. Bolts shall be carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563 Grade A hex head nuts.
      d. Buried bolts and nuts shall be Type 304 SST.

C. Fittings
   1. Carbon steel fabricated from pipe in accordance with AWWA C200 with dimensions as specified in AWWA C208.
      a. Minimum thickness equal to adjoining pipe.
      b. Forged fittings in accordance with ASTM A234 may be substituted for fabricated fittings.
      c. Test in accordance with AWWA C200. Nondestructive weld test method shall be submitted to the County Representative for review.
      d. Fabricated fittings that are to be encased in concrete or installed beneath structures shall be hydrostatic tested as specified in AWWA C200 to 0.75 of yield or design pressure +50 psi, whichever is smaller.
   2. Tees and Laterals

a. On 14-Inch and Smaller Pipe: Nonreinforced or reinforcing pad type designed in accordance with ANSI B31.1.

b. On 16-Inch and Larger Pipe: Collar plate, wrapper plate, or crotch plate type or may be fabricated with extra thick steel cylinders. Design shall be in accordance with AWWA Manual M11.

c. Small branch connections may be made with forged saddle or extra heavy half coupling.

3. Elbows

a. Maximum miter angle 15 degrees.

b. For elbows that have a radius less than 2.5 diameters and would have excessive hoop tension on the inside as determined by AWWA C208, increase steel thickness or increase radius (when layout permits).

D. Cement Lining and Coatings

1. Cement lining and coatings in accordance with AWWA C205.

2. Unless otherwise specified, holdback areas for joints to be field mortared shall be shop primed with the manufacturer's recommended primer.

E. Painted Lining and Coatings: Line and coat painted pipes in accordance with Section 09 96 00.

1. Linings shall be a potable grade polyamide epoxy Paint System No. 1.

2. Holdback areas for pipe joints shall be shop primed with a polyamide anticorrosive epoxy primer and field coated with polyurethane enamel, all Paint System No. 5.

3. Prime coats that have overcured because of time and/or temperature and will not bond the top coats shall be softened in accordance with Section 09 96 00.

4. Holdback areas for flexible couplings and for all other pipe joints shall be coated with Paint System No. 1.

F. Bare Exterior Pipe: Blast clean pipe specified to be bare exterior to remove all rust and mill scale, Society for Protective Coatings SP 7 Brush Off Blast.

2.4 STEEL PIPE (GSP) (BSP)

A. Pipe and fittings shall be galvanized (GSP) or nongalvanized (BSP) as shown on the Contract Documents.

B. Steel Pipe: ASTM A53 (Type E or S) or ASTM A106, Schedule 40.

C. Fittings: Malleable iron ASTM A47 or ASTM A197, dimensions in accordance with ANSI B16.3.

D. Unions: 300-pound malleable iron, ASTM A197 or ASTM A47, dimensions in accordance with ANSI B16.3, brass to iron seat.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Section 31 23 33 for trenching and backfill.

B. Wrap all steel pipe, coat all iron, and heat shrink wrap pipe joints after assembly where buried or concrete encased.

C. Cathodically protect steel and DIP pipe but not concrete-encased pipe.

3.2 PVC PIPE

A. All rigid PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Plastic pipe shall be laid by snaking the pipe from one side of the trench to the other. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of solvent welding and during operation.

B. Schedule 40 pipe shall not be threaded. Use Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.

C. Only strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to overtighten these fittings. Pipe shall not be laid when the temperature is below 40 degrees F, nor above 90 degrees F when exposed to direct sunlight. Ends to be joined shall be shielded from direct sunlight prior to and during the laying operation.

D. Provide adequate ventilation when working with pipe joint solvent cement.

3.3 DUCTILE IRON PIPE

A. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.

B. Dressing Cut Ends

1. Dress cut ends of pipe in accordance with the type of joint to be made.
2. Dress cut ends of buried pipe joints to remove sharp edges or projections which may damage the rubber gasket.
3. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer.
4. Dress cut ends of pipe for flexible couplings, flanged coupling adapters, and grooved end pipe couplings as recommended by the coupling or adapter manufacturer.

C. Fabrication of Flanged Pipe

1. Fabricate flanged pipe in the shop, not in the field, and deliver to the jobsite with flanges in place and properly faced.
2. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.
3. Face flanges after fabrication in accordance with ANSI A21.15/AWWA C115.
4. Hydrostatically shop test a sufficient number of selected flange-to-pipe threaded joints to ensure joint integrity.

D. Jointing Pipe

1. Grooved End: Install in accordance with the manufacturer's printed instructions.
2. Flanged
    a. Prior to connecting flanged pipe, thoroughly clean the faces of the flanges of all oil, grease, and foreign material.
    b. Check the rubber gaskets for proper fit and thoroughly clean.
    c. Take care to assure proper seating of the flange gasket.
    d. Tighten bolts so that the pressure on the gasket is uniform. Use torque-limiting wrenches to ensure uniform bearing insofar as possible.
    e. If joints leak when the hydrostatic test is applied, remove and reset gaskets and retighten bolts.

3. Mechanical, Proprietary Restrained, and Push-On Joint

a. Join pipe with mechanical, proprietary restrained, and push-on type joints in accordance with the manufacturer's recommendations.

b. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation.

c. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstances.

E. Encapsulate all buried ductile iron pipe and/or fittings in polyethylene bagging in accordance with AWWA C105.

3.4 INSTALLING MAGNESIUM ANODES ON BURIED DUCTILE IRON PIPE

A. In accordance with Section 26 42 00.

3.5 WELDED STEEL PIPE

A. Linings and Coatings

1. The interior of the pipe will be cement lined in accordance with AWWA C205.

2. The exterior of buried pipe will be polyurethane coated, 25 mils DFT, in accordance with AWWA C222.

3. Buried Joints will be covered with a heat shrink sleeve in accordance with AWWA C216.

3.6 THRUST RESTRAINT

A. Anchor all pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.

B. Determine dimensions of thrust blocks based upon the pipeline maximum design pressure.

C. Pipe anchorage and expansion provisions are not completely detailed. The absence of these details on any Contract Document shall not relieve the Contractor of the responsibility for providing them where required, and at his sole expense.

D. Place thrust blocking between undisturbed ground and the fitting to be anchored. Place blocking so that pipe and fitting joints will be accessible for repairs. Place concrete in accordance with Section 03 30 00.

3.7 SYSTEM TESTING

A. Conform to requirements of Section 22 05 10 for piping systems testing.

B. Potable water distribution system shall be hydrostatic leak tested to 50 psi above the class rating of the pipe at the lowest point in the section being tested.

3.8 DISINFECTION

A. Disinfect system under provisions of Section 22 05 10.

END OF SECTION

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Air Release Valve Assemblies.
2. Blow-Off Assemblies.
3. Accessories

B. Related Sections

1. Section 05 05 23 - Tamper Proof Metal Fasteners.
2. Section 05 50 00 - Metal Fabrications.
3. Section 09 96 00 - High-Performance Coatings.
4. Section 22 05 00 - Common Work Results for Plumbing.
5. Section 22 05 10 - Basic Piping Installation Requirements.
6. Section 22 05 23 - General Duty Valves for Plumbing Piping.
7. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
8. Section 22 11 16 - Domestic Water Piping.
9. Section 33 11 00 - Water Utility Distribution Piping.

1.2 SYSTEM 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, Below Ground: 160 psig.
2. Domestic Water Piping, Above Ground: 125 psig.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Section 01 33 00.

B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application. Include pressure drop curve or chart for each type and size of valve.

C. Maintenance Data for valves to include in the operating and maintenance manuals as specified in Division 1.

D. Include detailed manufacturer’s instructions on adjusting, servicing, disassembling, and repairing. Submit spare parts list for each type of valve. Include this data in Maintenance Manual.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 1.

B. Valves: In accordance with Section 22 05 23. Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ASME SEC IX and applicable state regulations.

D. Welders Certification: In accordance with ASME SEC IX.

E. NSF Compliance:

1. Comply with NSF/ANSI 61, Drinking Water System Components - Health Effects, for potable domestic water plumbing specialties.

F. Valve Identification: Comply with MSS SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

1.6 EXTRA MATERIALS

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

1. of identical units not less than 10 percent of amount of each type and size installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Release Valve Assemblies:
   a. APCO 50 or 200 Series.
   b. Crispin PL Series.
   c. Val-matic.
2. Blow-Off Assemblies:
   a. Jones model No. J-344 or equivalent.

2.2 ACCESSORIES

A. Valve Operator Tags

1. Provide valve operator with 1-1/2 inch minimum diameter heavy brass or stainless steel tag.
2. Tag shall bear valve number.
3. Attach tags to operator with key rings so that ring and tag cannot be removed.
4. Numbers and letters block type, 1/4 inch high.

B. T-Handled Operating Wrenches: Provide two galvanized operating wrenches, four feet long. Provide two galvanized operating keys for cross handled valves.

1. Manufacturers:
   a. Mueller, Model H-18090.
   b. Clow Corp

C. Precast Concrete Valve Boxes

1. Precast concrete boxes for blow-off assemblies shall be of the size shown on the Contract Documents. The box shall consist of a precast concrete top section, precast concrete extension sections as required, and a cast iron bolt-down cover. The cover shall have the word WATER in two inch raised letters. The complete box assembly shall be capable of safely supporting H-20 traffic loads. All exposed steel shall be hot-dip galvanized. Bolt-down screws shall be security-head Type 303 stainless steel. Precast concrete boxes and covers shall be equivalent to N9 Electrical Box.
2. Complete with all necessary bases and accessories.
3. Manufacturers:
   a. Christy Concrete Products, Inc.
   b. Brooks Products, Inc., Model F or G series.
   c. AMORCAST.

D. Extension Stems for Valve Operators

1. Where depth of valve is such that centerline is more than three feet below grade, provide operating extension stems to bring operating nut six inches below surface of ground and/or box cover.
2. Construct extension stems of steel, complete with two inch square operating nut.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 ERECTION TOLERANCES

A. Erection tolerances shall be in accordance with Section 22 05 23.

3.3 AIR RELEASE VALVE ASSEMBLIES

A. Install in accordance with manufacturer's written instructions and in accordance with Section 22 05 23. Refer to the Contract Documents for valve locations.

B. Valves

1. In accordance with Section 22 05 23.
2. Air Valves: Combination type, Designation V746.
3. Corporation Stops: Designation V464.
4. Angle Valve: Designation V201.

C. Manhole

1. In accordance with Section 33 05 13.
2. Gravel for base shall be clean, hard, open-graded crushed gravel or crushed rock, 3/8-inch minimum particle size and two inch maximum particle size.

3.4 BLOW-OFF ASSEMBLY

A. Install in accordance with manufacturer's written instructions and in accordance with Section 22 05 23. Refer to the Contract Documents for valve locations.

B. Assembly shall be in a level section of pipe.

C. Blow-offs shall not be installed in any manner that would permit siphoning back into the distribution system.

D. Gravel for assembly box shall be clean, hard, open-graded crushed gravel or crushed rock, 3/8-inch minimum particle size to 2-inch maximum particle size.

3.5 PIPING CONNECTIONS

A. Piping connections shall be in accordance with Section 22 05 23.

3.6 PROTECTION AND CLEANING

A. Clean interior and exterior of valves prior to installation. Remove dirt and debris as work progresses.

B. Protect valves 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 valves at end of day and when work stops.

3.7 ADJUSTING

A. Adjust valves and correct deficiencies discovered during commissioning.

3.8 START UP SERVICES

A. Before operating systems, perform these steps:

1. Remove all plugs used during testing of piping systems and plugs used for temporary sealing of piping and valves during installation.
2. Open all valves.
3. Remove and clean all debris from inside and outside of valves.

B. Check valves and verify proper settings, adjustments, and operation.

END OF SECTION

SECTION 33 12 19

WATER UTILITY DISTIBUTION FIRE HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Fire Hydrants and accessories.

B. Related Sections

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 09 96 00 - High-Performance Coatings.
3. Section 22 05 00 - Common Work Results for Plumbing.
4. Section 22 05 23 - General Duty Valves for Plumbing Piping.
5. Section 33 11 00 - Water Utility Distribution Piping.

1.2 REFERENCES

A. AWWA C502-2005 - Dry Barrel Fire Hydrants.

B. AWWA C550-2001 - Protective Interior Coatings for Valves and Hydrants.

C. AWWA C800-2005 - Underground Service Line Valves and Fittings.

1.3 SUBMITTALS

A. General: Submit in accordance with the Conditions of the Contract and Division 1.

B. Product Data for each fire hydrant type. Include body material, design, pressure classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include pressure drop curve or chart for each type and size of hydrant.

C. Maintenance Data, including operating and maintenance manuals.

D. Include detailed manufacturer’s instructions on adjusting, servicing, disassembling, and repairing. Submit spare parts list for fire hydrant and accessories; include this data in Maintenance Manual.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare hydrants for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Protect hydrants during shipping in such a way that there is no contact made between hydrants or other objects.

B. Use the following precautions during storage:

1. Maintain end protection.
2. Store indoors and maintain hydrant temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store hydrants off the ground in watertight enclosures.

1.6 EXTRA MATERIALS

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

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

A. Manufacturers: Subject to compliance with AWWA requirements, provide products by one of the following:

1. Mueller.
2. Kennedy.
3. Clow.

B. Nominal 5-1/2-inch main valve with 6-inch mechanical joint inlet connections with thrust legs.

C. Outlet nozzles: Two 2-1/2 inch hose nozzles and one 4-1/2 inch pumper nozzle with National (American) Fire Hose Coupling Screw Threads.

D. Main valve equipped with O-ring seals; open counterclockwise.

E. Hydrants shall be of break-flange or safety-top type.

F. Painting and coating shall be in accordance with AWWA requirements. Hydrants shall be painted yellow above ground line.

2.2 ACCESSORIES

A. Barrel Extension

1. Barrel extensions, if required, shall be in accordance with AWWA requirements.

B. T-Handled Operating Wrenches: Provide two galvanized operating wrenches, four feet long, Mueller, Model H-18090, Clow Corp., or approved equal.

C. Indicator Posts: Buried valves on fire protection service shall be equipped with indicator post operators.

1. UL listed, FM approved.
2. Manufacturers
   a. Stockham, Model G-951A.
   b. Nibco, Model NIP-1AJ.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of hydrants. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine hydrant interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate hydrant from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on hydrant and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective fire hydrants; replace with new fire hydrants.

3.2 FIRE HYDRANT INSTALLATION

A. Remove the hydrant drain plugs, if any, prior to installation.

B. Install fire hydrant as indicated, according to manufacturer's written instructions.

C. Piping installation requirements are specified in other Division 22 Sections. Contract Documents indicate the general arrangement of piping, fittings, and specialties.

3.3 GUARD POSTS

A. Install guard posts around the fire hydrant as shown on the Contract Documents.

3.4 HYDRANT ACCESS PADS

A. Install concrete access pad around the fire hydrant as shown on the Contract Documents. Concrete shall be in accordance with Section 03 30 00.

3.5 PROTECTION AND CLEANING

A. Clean interior and exterior of fire hydrant prior to installation. Remove dirt and debris as work progresses.

B. Protect fire hydrants 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.

3.6 ADJUSTING

A. Adjust fire hydrants and correct deficiencies discovered during commissioning. Notify the County Representative of any deficiencies.

3.7 START UP SERVICES

A. Before operating systems, perform these steps:

1. Remove all plugs used during testing of piping systems and plugs used for temporary sealing of piping and valves during installation.
2. Open all hydrants.
3. Remove and clean all debris from inside and outside of fire hydrants.

B. Check hydrants and verify proper settings, adjustments, and operation.

END OF SECTION

SECTION 33 31 00

SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Sanitary sewer piping.

B. Related Sections

1. Section 22 05 10 - Basic Piping Installation Requirements.
2. Section 31 23 33 - Trenching and Backfill.
3. Section 33 05 13 - Manholes and Structures.

1.2 REFERENCES

A. ASTM D2321 - Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

B. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

C. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

D. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

E. ASTM F481 - Practice for Installation of Thermoplastic Pipe and Corrugated Tubing in Septic Tank Leach Fields.

F. ASTM F679 - Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.

G. ASTM F891 - Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Provide data on pipe materials, pipe fittings, and accessories, and certificates of tests.

PART 2 PRODUCTS

2.1 SANITARY SEWER GRAVITY PIPE

A. Sanitary Sewer Pipe and Fittings: PVC 4 inches through 15 inches in diameter, conforming to either modulus indicator wall thickness T-1 of ASTM F789 or SDR 35 of ASTM D3034.

B. PVC Pipe Joints: Rubber gasketed conforming to ASTM D3212. Joints may be push-on joint or mechanical joint.

C. Gaskets: Conform to ASTM F477.

D. Fitting Bends: Long-radius unless otherwise approved by the County Representative.

E. Pipe-to-Pipe connections: Make with 45-degree wyes and long radius bends. Tees are not permitted.

F. Caps may be used on temporary pipe closures.

G. Pipe adaptors: As recommended by pipe manufacturer, for connecting PVC pipe to manholes, and end enclosures.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine the Contract Documents and determine that the sanitary sewer collection system will not interfere with other utilities, including the storm drain system, potable water distribution system, electric and communication conduit systems, and return systems.

B. Criteria for the sanitary sewer collection system:

1. Sanitary sewers shall have minimum pipe slopes as shown on the Contract Documents.
2. All sanitary sewer laterals shall be stubbed up, capped and tagged to the indicated building utility point of connection, except that sanitary sewer laterals shall be connected to the building or facility sewers that are constructed by the Contractor of this Contract. The Contractor shall confirm the location and elevation of each building or facility sewer connection point, with the applicable building or facility contractor who will be responsible for connecting the building or facility sewer to the stubbed-up sanitary sewer lateral.

C. Sanitary sewers adjacent to or crossing potable water distribution mains shall conform to the following requirements:

1. Sanitary sewers crossing above water mains will not be permitted.
2. Sanitary sewers shall be installed at least ten feet horizontally from and 1 foot vertically below any water main located parallel to the sanitary sewer, and at least 1 foot vertically below any water main crossing the sanitary sewer either perpendicularly or at an askew angle.

D. Propose field adjustments in sanitary sewer routing or grade changes to achieve non-interference with other utility systems.

E. Discuss proposed field adjustments with the County Representative prior to implementation.

3.2 EXECUTION

A. Installation of sanitary sewers shall comply with ASTM D2321.

B. Place pipe and fittings to accommodate sanitary sewer laterals.

C. Place sanitary sewer pipe and fittings to line and grade.

D. Provide stub ups and plugs at building sewer connection points. Connections to sewer laterals to building sewers will be by others.

E. Coat all buried, submerged, and concrete-encased metal pipe in accordance with Section 22 05 10.

F. Construct manholes and cleanouts in accordance with Section 33 05 13.

G. Mandrel test after backfilling pipe. The mandrel shall be commercially manufactured with a circular cross section of diameter equal to at least 95 percent of the specified average inside diameter of the pipe, and a length equal to at least the nominal diameter of the pipe. The mandrel shall be rigid with an odd number of legs, nine leg minimum.

1. Notify the County Representative of pending mandrel test.
2. Pull mandrel through sanitary sewer by hand.
3. Obstructions encountered by the mandrel shall be corrected by the Contractor.
4. Sanitary sewer pipe that does not meet the mandrel test shall be reinstalled.
5. Rerounding will not be allowed.

H. Perform air tests on all sections of the sanitary sewer piping system, including all sanitary sewer laterals to the points of building sewer connection in accordance with Section 22 05 10.

I. Perform interim cleaning and flushing in accordance with Section 22 05 10, prior to final acceptance.

J. Install security cages for all sanitary sewer pipe 12 inches or greater.

3.3 SYSTEM TESTING

A. In accordance with Section 22 05 10 for piping systems testing.

B. Sanitary sewer collection system shall be air tested to five psi.

C. Force main - Testing sewer force mains shall be hydrostatically tested at 150 percent of the design operating pressure or maintain a minimum pressure of 50 psi for at least 30 minutes. Allowable leakage shall be in accordance with Section 22 05 10.

END OF SECTION

SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storm drainage piping.

B. Related Section:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 22 05 10 - Basic Piping Installation Requirements.
3. Section 31 20 00 - Earth Moving.
4. Section 31 23 33 - Trenching and Backfill.
5. Section 33 05 13 - Manholes and Structures.

1.2 REFERENCES

A. California Department of Transportation (Caltrans) Standard Plans.

B. ASTM C76 - Reinforced Concrete Storm Drain and Sewer Pipe.

C. ASTM C150 - Portland Cement.

D. ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

E. ASTM D2321 - Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

F. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

G. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

H. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

I. ASTM F679 - Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.

J. ASTM C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

K. AASHTO M294 - Corrugated Polyethylene Pipe, 300.

1.3 DESCRIPTION

A. Storm drain pipe shall be reinforced concrete pipe (RCP), polyvinyl chloride pipe (PVC) or high density polyethylene pipe (HDPE) unless indicated otherwise.

1.4 SUBMITTALS

A. Submit under provisions of 01 33 00.

B. Product Data: Certificate of Compliance from pipe manufacturer for pipe, plant load bearing tests, and applicable requirements of referenced specifications.

PART 2 PRODUCTS

2.1 REINFORCED CONCRETE PIPE (RCP)

A. Reinforced concrete pipe shall conform to ASTM C76 Class III or Class IV, except as modified herein. Class IV pipe shall be used when the minimum cover over the top of pipe beneath asphalt paved surfaces is less than 30 inches or when depth of cover over the top of pipe exceeds 10 feet; Class III pipe may be used at all other locations.

B. Cement shall be Type V conforming to ASTM C150.

C. The minimum Portland Cement content or combined Portland Cement and fly ash content shall be 564 pounds per cubic yard.

D. The water-cement ratio shall not exceed 0.45.

E. Elliptical reinforcement is not permitted.

F. The cross section area of the outer cage circular reinforcement shall not be less than 75 percent of the inner cage circular reinforcement.

G. Joints for reinforced concrete pipe shall be rubber gasketed conforming to ASTM C443.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

A. PVC Pipe and fittings 12-inch diameter and smaller for general service shall conform to ASTM D3034, standard dimension ratio not to exceed 35, except that the cell classification shall be 12454-B or 12454-C as defined in ASTM D1784.

B. Joints shall be rubber gasketed type conforming in all respects to the requirements of ASTM D3212 for gravity sewers. Gaskets shall conform to ASTM F477. Lubricant for jointing shall be as approved by the pipe manufacturer. An adapter as recommended by the pipe manufacturer shall be used for connecting PVC pipe to manholes.

2.3 HIGH DENISTY POLYETHYLENE PIPE & FITTING FOR STROM DRAIN

A. HDPE Pipe and fittings of 12-inch diameter and larger Type S or Type D high density polyethylene (HDPE) pipe manufactured per ASTM F894, AASHTO M-252 or AASHTO M-294 for gravity flow, low pressure storm drain.

B. Joints for the piping system and fitting shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastometric location on the spigot is compressed radially on the pipe or fitting bell to for a water tight seal. The joint shall be designed to prevent displacement of the gasket from the joint during assembly and when in service. The elastometric gasket shall meet the provisions of ASTM F477.

PART 3 EXECUTION

3.1 INSTALLATION

A. Conform to the requirements of Section 22 05 10 and Section 31 23 33.

B. Install PVC storm drain pipe in accordance with ASTM D2321, except where superseded by the specified requirements herein.

C. Install security cages for all storm drain pipe 12 inches or greater in diameter.

3.2 CLEANING

A. All construction debris and other foreign matter shall be removed to the satisfaction of the County Representative.

3.3 SYSTEM TESTING

A. No pressure test is required.

END OF SECTION

SECTION 33 51 00

NATURAL-GAS DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Natural gas piping system

B. Related Sections

1. Section 09 96 00 - High-Performance Coatings.
2. Section 22 05 10 - Basic Piping Installation Requirements.
3. Section 31 23 33 - Trenching and Backfill.

1.2 REFERENCES

A. AASHTO T180 - Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18-in.) Drop.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

C. ASME B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.

D. ASME B31.8 - Gas Transmission and Distribution Piping Systems.

E. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

F. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

H. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

I. ASTM B32 - Solder Metal.

J. ASTM D698 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

K. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

L. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.

M. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

N. ASTM D6938 - Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

O. AWS A5.8 - Filler Metals for Brazing and Braze Welding.

P. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

Q. NFPA 54 - National Fuel Gas Code.

1.3 SUBMITTALS

A. Submit in accordance with Sections 01 33 00.

B. Product Data and Shop drawings: Submit Data on pipe materials, pipe fittings, valves, coatings, cathodic protection and accessories. Provide layout shop drawings showing pipe stationing, radii, pipe segments, fittings and valve locations.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Test Procedures.

1.4 CLOSEOUT SUBMITTALS

A. Submit in accordance with Section 01 78 00.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Welding Materials and Procedures: In accordance with ASME Section IX and applicable state regulations.

B. Welders Certification: In accordance with ASME Section IX.

C. Perform the Work in accordance with NFPA 54 and ASME B31.8.

1.6 PREINSTALLATION MEETINGS

A. Conduct Pre-installation Meetings in accordance with Section 01 31 19.

B. Convene minimum one week prior to commencing the Work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with Section 01 65 00.

B. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Steel Pipe Above Ground: ASTM A53, Grade B, Schedule 40 black:

1. Fittings: ASME B16.11, forged steel, or ASTM A234 forged steel welding type.
2. Joints: welded.
3. Jackets: AWWA C105 polyethylene jacket or Double layer, half lapped, 10 mil polyethylene tape.

B. Polyethylene Pipe Below Grade: ASTM D2513, SDR 11.5

1. Fittings: ASTM D2683.
2. Joints: Fusion Welded.

2.2 VALVES

A. 2-1/2 inches and Larger: 125 psig WOG, Steel body and tapered plug, lubricated, Teflon packing, threaded ends, with cast iron curb box, cover, and key.

B. Furnish valves with manufacturer's name and pressure rating marked on valve body.

C. Provide coating or wrapping for buried valves and fittings.

2.3 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 4 inches wide, 4-mil thick, manufactured for direct burial service.

B. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Natural Gas Service" in large letters.

2.4 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 23 33.

B. Cover: As specified in Section 31 23 33.

C. Soil Backfill from Above Pipe to Finish Grade: As specified in Section 31 23 33.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting the Work.

B. Verify building service connection and utility gas main size, location and invert are as shown on the Contract Documents.

3.2 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Bevel plain end ferrous pipe 2-1/2 inches diameter and larger.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections with flanges and unions.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 31 23 33.

B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding six inches compacted depth, compact to 95 percent.

C. Backfill around sides and to top of pipe with cover fill, tamped in place and compacted to 95 percent.

D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPING

A. Group piping with other site piping work whenever practical.

B. Route piping as indicated on the Contract Documents.

C. Install piping to conserve space and not interfere with use of site space.

D. Install piping to allow for expansion and contraction without stressing pipe or joints.

E. Install valves and other fittings as indicated on the Contract Documents.

F. Establish elevations of buried piping with not less than 36 inches of cover in non-traveled areas and 48 inches of cover in driveways and parking areas.

G. Lay pipe on bedding.

H. Wrap couplings and fittings of steel pipe with polyethylene tape and heat shrink over pipe.

I. Install plastic ribbon tape continuous buried 6 inches below finish grade, above pipe line; coordinate with Section 22 05 10.

J. Install trace wire continuous over top of pipe, above pipe line; coordinate with Section 22 05 10.

K. Backfill trench in accordance with Section 31 23 33.

L. Center and plumb valve box over valve. Set box cover flush with finished ground surface. Prevent shock or stress from being transmitted through valve box to valve.

M. Wrap valve and valve box with polyethylene tape and heat shrink.

3.5 FIELD QUALITY CONTROL

A. Perform field inspecting testing, adjusting, and balancing per Division 1 requirements.

B. Pressure test gas lines to 100 psi.

C. If tests indicate the Work does not meet specified requirements the County Representative shall be notified. With approval of the County Representative, the Work shall be removed, replaced, and retested.

D. Compaction Testing: In accordance with Section 31 23 33.

E. Frequency of Compaction Tests: 100 feet.

END OF SECTION

SECTION 33 71 19

ELECTRICAL MANHOLES AND HANDHOLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Precast Concrete Manholes, Handholes, and Pullboxes (MHP) for exterior installation.

B. Related Sections

1. Section 26 05 00 - Common Work Results for Electrical.
2. Section 26 05 35 - Raceway for Electrical Systems.

1.2 DEFINITIONS

A. Manhole: An access opening or an enclosure (generally subsurface) into which personnel may enter. Manhole opening is used for the purpose of full-physical-access installation, operation, and maintenance.

B. Handhole: An access opening provided in equipment or enclosure in connection with underground lines, into which personnel reach but do not enter. Handhole opening is used for the purpose of hand-access installation, operation, or maintenance.

1. Electrical vault covers shall not exceed the maximum allowable 1/2” opening or 1/4” vertical level change per CBC and ADA when located in accessible routes.

C. Pullbox: A box with a blank cover that is inserted into one or more runs of raceway to facilitate installation (pulling) of the conductors. Pullboxes may also serve the purpose of distributing the conductors.

1.3 SUBMITTALS

A. Submit in accordance with Sections 01 33 00.

B. Product Data:

1. Provide dimensions, knockout sizes and locations, materials and accessories.

C. Submit documentation confirming compliance with Regulatory Requirements in Section 26 05 00.

PART 2 PRODUCTS

2.1 PRECAST MANHOLES, HANDHOLES, AND PULLBOXES

A. Acceptable manufacturers:

1. Associated Concrete Products, Inc.
2. Brooks Products, Inc.
3. Christy Box, Inc.
4. Oldcastle Precast

B. Concrete for precast MHP shall be 3,000 psi minimum 28-day compressive strength concrete designed for AASHTO H-20 loading. Minimum dimensions are shown on the Contract Documents. Increase these as required by use of extension sections to accommodate the several raceway entrances at their required elevations.

C. Provide a pulling iron embedded in the concrete wall opposite each raceway entrance for pullboxes. Utilize 7/8-inch round stock securely fastened to the overall steel reinforcement before concrete is poured.

D. Slope floors toward drain points, leaving no pockets or other nondraining areas. Provide drainage sufficient to maintain the floors in a water free state as follows:

1. Type 1 - Sump and Automatic Sump Pump. Install a 12-inch x 12-inch x 12-inch deep concrete sump at one corner of the floor. Install and connect electrical power, an automatic submersible sump pump, and piping to a proper drainage area or connection in order to keep the floor level water free.
2. Type 2 - Floor Drain and Storm Sewer Connection (for low to moderate ground water elevation areas). Provide a minimum 4-inch diameter floor drain and PVC storm sewer line and connections.
3. Type 3 - Dry Well (for extremely low ground water elevation areas). Provide a 6-inch diameter hole in the floor of the pullbox, excavated to a depth of 2 feet, and filled flush to floor surface with stones of a minimum diameter of 1 inch.

E. Provide raceway entrances on all four sides, except for communication handholes and pullboxes which are to have entrances on the ends only.

F. Utilize heavy-duty type frames, suitable for H-20 loading. Provide indented type covers, solid top design, with two drop handles each. On the upper side of each cover, cast or burn by welder, in integral letters not less than 2 inches high appropriate titles, indicate: ELECTRIC HV (for above 600 volts), ELECTRIC LV (for 600 volts and below), or COMMUNICATION. Field stamp covers with MHP numbers as shown on the Contract Documents. Provide covers with locking hold-down bolts and gaskets. Bolts to be pentahead.

2.2 ACCESSORIES

A. Provide heavy weight cable racks with adjustable arms with insulators for all cables in each manhole and pullbox. Set vertically adjustable inserts in the concrete walls for the attachment of racks. Do not use bolts or studs embedded in concrete for attaching racks. Set racks and inserts on not greater than 3-foot centers around the entire inside perimeter of the manholes and pullbox, arranged so that all spare conduit ends are clear for future cable installation. Provide racks with a sufficient number of arms and insulators to accommodate cables for each conduit entering or leaving the manhole and pullbox, including spares. Provide a minimum of four arms with insulators per rack.

B. In each manhole and in any pullbox deeper than 4 feet 6 inches, include a permanent metal access ladder. The ladder shall slope at 5 degrees from vertical.

C. MHP hardware: steel, hot-dip galvanized after fabrication.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install as indicated on the approved submittals and the Contract Documents.

B. Do not install MHP until final conduit grading, including field changes, has been determined. Set frames to final grades as required.

C. Install MHP so that raceways shall enter at nearly right angles and as near as possible to one end of a wall, unless otherwise indicated.

D. Identify the interior of low voltage handholes and pullboxes as being used for NORMAL or EMERGENCY power circuits. Identify by using permanent ink stenciled lettering. Lettering size shall be no smaller than 2 inches high.

E. Install one ground rod in each MHP. Connect all non-current carrying metal parts in MHP and any metallic raceway grounding bushings to this ground rod with copper conductor.

3.2 DUCT BANK/RACEWAY IDENTIFICATION

A. In each MHP provide a duct bank or raceway identification stating destination of a duct or conduit run.

1. Identification shall be made using permanent black ink stenciled in 2-inch-high letters.

a. Where ducts/conduits are too close together to permit stenciling, provide mylar key attached to wall.

END OF SECTION