PROJECT MANUAL

CONSTRUCTION SET

DIVISIONS 22,23,26

OPS NORTH AND NORTHWEST HIGH SCHOOL

COOLING TOWER REPLACEMENT

OMAHA, NE

BID No: 26-004

Prepared By:

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SECTION 22 0000
PLUMBING GENERAL PROVISIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section includes general requirements for plumbing systems.

1.03 CONTRACT DOCUMENT COORDINATION

A. Contract Drawings are diagrammatic in showing certain physical relationships between architectural, structural, plumbing, mechanical and electrical work.
   1. Verification and coordination of these relationships is the responsibility of the Contractor.
   2. Verify all existing conditions before starting work.
   3. Floor plan drawings do not necessarily indicate all required offsets, fittings, valves, etc.
   4. Provide all necessary piping, fittings, valves, offsets, and other specialties required without additional cost to the Owner.

B. Should Contract Document requirements appear to make it impossible in providing a complete and operational system, or should discrepancies appear among Contract Documents, Contractor shall request clarification before proceeding with work.

1.04 QUALITY ASSURANCE

A. Comply with all State, and local codes and ordinances.

B. Obtain and pay for all required permits, fees and certificates of inspection of the work.

C. Install equipment and devices to provide required access for servicing and maintenance.

D. Comply with applicable portions of Local, City, and State Plumbing Code pertaining to plumbing materials construction and installation of products.

E. Fabricate and install potable water and natural gas systems in accordance with Local Utility Company requirements.

F. Do not interrupt plumbing services to occupied facilities without written permission from Owner and a minimum three (3) days' notice.

1.05 SUBMITTALS

A. General:
   1. See Division 01 Submittal Procedures.
   2. Shop Drawing Submittals shall include specially prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information.
   3. Shop Drawing Submittals may also include product data which includes standard printed information on materials, products and systems; not specially prepared for this project, but with the designation of selections from among available choices for this project clearly identified.

B. Submittal Requirements:
   1. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect/Engineer's review with another.
   2. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, submittal name, specification section and similar information to distinguish it from other submittals.

3. Provide General Contractor's and Subcontractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Contract Documents. Submittals which are received from sources other than through Contractor's office will be returned by Architect/Engineer "Without Action".
4. Items from each specification section shall be prepared as separate submittals, not grouped or bound with other items. Submittals shall clearly indicate the applicable specification section.

C. Alternate Equipment Submittal by Contractor:
1. Equipment of greater or larger dimensions, weight, capacity, or rated performance than that which is specified may be submitted provided all connecting mechanical and electrical services, including ductwork and piping connections, circuit breakers, electrical conduit and conductors, motors, equipment supports, building structure, and equipment spaces are modified as required by the proposed equipment. If performance ratings or efficiencies of the equipment are specified, the equipment must meet or exceed these design requirements as well as any specified commissioning requirements. **NO ADDITIONAL COST WILL BE APPROVED FOR ANY SUCH CHANGES RELATED TO THE ALTERNATE EQUIPMENT.**
2. Should proposed alternate equipment involve rearrangement of other designed equipment, a complete layout of the area involved shall be submitted by the Contractor along with the alternate equipment submittal, and shall be approved in writing by the Architect/Engineer prior to ordering, purchasing, delivery or installation of any such items of equipment.
3. **CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ADDITIONAL EXPENSE AND COORDINATION WITH OTHER TRADES RESULTING FROM THE SUBSTITUTION OF EQUIPMENT OTHER THAN THAT SPECIFIED IN THE CONTRACT DOCUMENTS.**

D. Submittal Review:
1. Review of submittal data is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications.
2. Review of submittal data does not release the Contractor from further satisfactory equipment operating responsibilities. Equipment shall be approved for final acceptance when installation is completed and all equipment and systems have been operated, tested and adjusted in compliance with the contract documents.
3. Re-submittals: When revised for resubmission, clearly indicate all changes since previous submission. Only those items required to be resubmitted shall be included.

E. Operation and Maintenance (O&M) Manuals:
1. Prepare and submit three copies of operation and maintenance instructions for all Division 22 equipment and fixtures furnished.
   a. Provide individual 3-ring binders with a table of contents and tabbed sections for each specification section.
   b. Identify equipment and fixtures included in the manuals by the equipment or fixture mark used in the contract drawings.
   c. Include emergency instructions, spare parts listing, copies of warranties, wiring diagrams, shop drawings, product data, signed letters of certification of inspection and similar information.
   d. Provide documentation that training was performed for each item specified to include Owner training. Include name of Owner's representative(s) present, date and time of training.
   e. Provide a list of manufacturer's representatives for each item of equipment including company name, address and phone number.
   f. Provide documentation that Extra Materials were received by the Owner for each section requiring Extra Materials.

2. All information contained in equipment and fixture manufacturer's operation and maintenance manual shall be specific to equipment and fixtures provided. Contractor shall mark out or not include all unrelated information.
3. Electronic O&M Manuals: Provide electronic version of project O&M Manuals in pdf format in addition to hardcopy version of the manuals.

F. Contractor shall be responsible for all additional expense and coordination with other trades resulting from the substitution of equipment to that specified in the Contract Documents.

G. Review of shop drawings does not release the Contractor from further satisfactory operating responsibilities. Material and equipment shall be approved for final acceptance when construction is completed and all equipment and systems have been operated, tested, adjusted and balanced to the satisfaction of the Architect/Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before installation of any such items of equipment.

H. Required Submittals List:
1. Shop Drawings shall be submitted for the items listed in each section of the specifications. Submittals in addition to those listed may be required by the Architect/Engineer.

1.06 RECORD DRAWINGS

A. See Division 01 "Project Record Documents".

B. Provide a set of plumbing drawings marked-up with actual as-built conditions for Division 22 work. Record drawings shall include all addenda and change orders.

1.07 UTILITY CONNECTION CHARGES AND UTILITY COSTS

A. Contractor shall pay for all utility connection charges (water, sanitary sewer, storm sewer and gas) and utility cost for services to the building required. Capital facilities utility service charges will be paid directly by the Owner and are not part of the Construction Contract.

1.08 CONTRACT DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, Farris Engineering (FEI) will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an officer of the requesting firm. FEI does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals. The drawing files will be "cleaned-up" by having the FEI logo, Professional Engineer seal, and all extraneous notes and details removed. FEI must be compensated for this additional service by the requesting firm. A minimum fee of $400.00 for up to eight (8) sheets and $50.00 per sheet for each additional requested drawing will be invoiced to the requesting firm once the signed agreement is received.

1.09 PLUMBING/ELECTRICAL COORDINATION

A. See Division 01 "Multiple Contract Summary".

B. Plumbing Contractor shall coordinate with Electrical Contractor and verify that proper electrical power connections to plumbing equipment which requires electrical power is provided. Unless specifically shown otherwise Electrical Contractor shall provide power connections to the equipment and Plumbing Contractor shall provide wiring required for start-stop, control and safety interlock functions.

C. If plumbing contractor has proposed alternate equipment to that specified in the contract documents, and such alternate equipment requires modified electrical power connections, mechanical contractor shall coordinate these requirements with electrical contractor prior to ordering, purchasing, delivery or installation of any electrical conduits, conductors, circuit breakers and other electrical devices serving the alternate equipment.

D. Types of work, normally recognized as electrical but provided as plumbing include but are not necessarily limited to the following:
   1. Motors for plumbing equipment.
   2. Starters for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
   3. Wiring from motors to disconnect switches or junction boxes for motors of plumbing equipment, when specifically indicated to be furnished integrally with equipment.
   4. Electrical power connections for plumbing equipment and fixtures that are not indicated on the electrical drawings.

1.10 CLEANING AND PROTECTION

A. During the construction period the Plumbing Contractor shall clean and protect work in progress and adjoining work on a basis of perpetual maintenance.

1.11 FINAL COMPLETION

A. The Plumbing Contractor shall not call for a final completion check until Plumbing Systems have been installed, adjusted, tested and in full and complete satisfactory operation and the following certifications of inspection from equipment suppliers have been completed. Certifications of Inspection are required on the following equipment:
   1. Domestic Water Mixing Valves.
   2. Plumbing Pumps.
   3. Sensor Operated Flush Valves and Faucets.
   4. Domestic Water Heaters.

B. The Certifications shall consist of letters signed by Factory-Trained and -Authorized Service Personnel stating the following:
   1. They have inspected their equipment on the project.
   2. They approve the condition of the equipment and its installation.
   3. They have checked its operation and certify that it is operating properly.
   4. They have noted any problems, conditions or objections that could lead to future operating problems.

C. Documentation of the signed letters of Certification of Inspection shall be furnished in the Operations and Maintenance Manuals, included with the associated equipment.

1.12 GUARANTEE

A. The one year guarantee period shall not start until the project is completed and the Contractor has received the Final Payment and Certificate of Completion.

B. Equipment and work shall be guaranteed, parts and labor, for one full year from the date of the Certificate of Completion. Repairs made during this period shall be fully guaranteed for an additional one year period from the date of repairs.

C. Plumbing Contractor has the responsibility to guarantee equipment and work and shall assume responsibility to repair any equipment at his cost that the manufacturer refuses to guarantee.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 ELECTRICAL WORK PROVIDED BY PLUMBING CONTRACTOR

A. Electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of the equipment manufacturer, this Section, and Division 26.

3.02 PIPE HANGING AND SUPPORT

A. Piping systems shall be supported from building structural systems capable of supporting the applied load.

B. Piping shall not be supported from metal roof decking.

3.03 PAINTING AND FINISHING

A. Painting of exposed plumbing work is specified and performed under other divisions of these specifications, or as indicated on the drawings.

B. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

3.04 WORK IN EXISTING BUILDINGS

A. Work under this Contract includes additions and/or renovations to an existing building. It shall be the responsibility of each Bidder to inform himself of all conditions which affect the work contemplated by these Contract Documents. The submission of proposal by any Bidder will be construed as an admission by him that he has examined and is familiar with the premises and all conditions thereon and adjacent thereto, and has included in this proposal a proper and adequate amount to cover rearrangement of existing work for the proper installation and operation of the new and existing equipment as shown on the drawings or as required by these specifications.

B. Maintain existing plumbing services to occupied areas and operational facilities unless otherwise indicated or when otherwise authorized in writing by Owner and Architect.

C. The operation of existing equipment, fixtures and devices designated to remain shall be maintained. Provide temporary connections and devices as necessary to maintain the operation of the equipment designated to remain as required during construction.

3.05 REBATES

A. Contractor shall assist the Owner with filing of applicable forms to obtain rebates. This shall include but not be limited to determination of qualifying equipment, fixtures and materials and furnishing invoices for equipment, fixtures and materials as required to support the rebate application.

END OF SECTION

SECTION 22 0010
PLUMBING SUBMITTALS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 GENERAL

A. Submittals shall include specially prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.

B. Submittals shall also include product data which includes standard printed information on materials, products and systems; not specially prepared for this project, but with the designation of selections from among available choices for this project clearly identified.

1.03 SUBMITTAL REQUIREMENTS

A. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect/Engineer's review with another.

B. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and providing space for Architect's/Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned by Architect/Engineer "Without Action".

C. Provide Contractor's certification on form, ready for execution, stating that information submitted complies with requirements of contract documents.

D. The Contractor shall be responsible for and bear any expense of alterations to the building or its appurtenances resulting from the substitution of equipment to that specified in the Contract Documents.

E. Review of submittals does not release the Contractor from further satisfactory operating responsibilities. Material and equipment shall be approved for final acceptance when construction is completed and all units and systems have been operated, tested, adjusted and balanced to the satisfaction of the Architect/Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before installation of any such items of equipment. Any additional expense involved shall be a Contractor-borne expense.

F. Electronic Submittals: All submittals for shop drawings, O & M Manuals and Record Drawings shall be in electronic PDF format. Identify and incorporate information in each electronic submittal file as follows:
   1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
   2. Name file with submittal number or other unique identifier, including revision identifier.
      a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., Bryan MS-22 05 00). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., Bryan MS-22 05 00-A).
   3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and/or Construction Manager.

4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Architect, Engineer and Owner**,** containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

1.04 SUBMITTAL LIST

A. Submittals shall be submitted for, but not limited to, the items listed in each section of the specifications. Submittals, in addition to those listed, may be required by the Architect/Engineer. The following submittal register is a summary list of submittals required for the project.

SUBMITTAL REGISTER	
SECTION	ITEM
22 0000	O&M Manuals
22 0000	Record Drawings
22 0000	Certification of Inspection
22 0500	Plumbing Pipe and Fittings
22 0500	Plumbing Valves and Specialties
22 0500	Meters and Gauges
22 0500	Plumbing Support and Anchors
22 0500	Plumbing Identification
22 0500	Joint Sealants
22 0700	Plumbing Insulation Product Data & Installation Instructions
22 1116	Pipe and Fittings
22 1116	Plumbing Valves, Meters, Mixing Valves, Trap Primers, Interceptors
22 1116	Natural Gas Piping and Fittings
22 1116	Natural Gas Valves
22 1119	Plumbing Specialties

END OF SECTION

SECTION 22 0500
COMMON PLUMBING MATERIALS AND REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following common plumbing materials and requirements.
   1. Valves:
      a. Ball
      b. Check
   2. Valve Tags and Schedules.
   3. Piping Specialties:
      a. Pipe escutcheons
      b. Pipeline strainers
      c. Pipe sleeves
      d. Dielectric fittings
      e. Transition fittings
   4. Supports and Anchors:
      a. Piping hangers and supports
      b. Saddles and shields
   5. Plumbing Identification.
   6. Installation requirements common to piping and equipment specification Sections.
   7. Plumbing demolition.
   8. Piping tests.

1.03 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.04 SUBMITTALS

A. Submittals:
   1. General: Submit the following according to the Conditions of the Contract.
   2. Product data for following piping specialties:
      a. Valves.
      b. Pressure gauges.
      c. Identification materials and devices.
      d. Vibration Isolators.
   3. Coordination drawings for access panel and access door locations.

1.05 QUALITY ASSURANCE

A. All plumbing piping, fixtures, specialties, equipment and connections shall be installed per requirements of the applicable code.

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions."

D. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves."

E. FCI Compliance: Test and rate Y-type strainers in accordance with FCI 73-l "Pressure Rating Standard for Y-type strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than Y-type".

F. UL and FM Compliance: Provide meters, gauges, and supports which are UL-listed and FM approved.

G. MSS Standard Compliance: Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

H. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

I. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements. No additional cost will be approved for any such changes.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate plumbing fixture and equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of plumbing systems with exterior site utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where plumbing items requiring access are concealed behind finished surfaces.

H. Perform demolition and new plumbing work in phases as indicated.

1.08 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   2. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Conditions Affecting Excavations:
   1. Maintain and protect existing building services which transit the area affected by excavations.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
   3. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
   4. Remove existing underground utilities indicated to be removed.
      a. Uncharted or Incorrectly Charted Utilities: Contact Utility Owner immediately for instructions.
      b. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to Owner and Engineer prior to utility interruption.
   5. Use of explosives is not permitted.

PART 2 PRODUCTS

2.01 PIPE AND PIPE FITTINGS

A. For pipe and fitting materials and joining methods refer to plumbing piping system specification sections.

2.02 PIPING SPECIALTIES

A. Dielectric Fittings:
   1. Description: Assembly of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
      a. Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
      b. Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure and temperature.
   2. Insulating Material: Suitable for system fluid, pressure, and temperature.
   3. Dielectric Unions: Factory-fabricated, union assembly for 250 PSIG minimum working pressure at a 180°F temperature.
   4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150 or 300 PSIG minimum pressure to suit system pressures.
   5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
      a. Provide separate companion flanges and steel bolts and nuts for 150 or 300 PSIG minimum working pressure to suit system pressures.
   6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300 PSIG minimum working pressure at 225°F temperature.

7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300 PSIG working pressure at 225°F temperature.

B. Transition Fittings
   1. General Requirements:
      a. Same size as pipes to be joined.
      b. Pressure rating at least equal to pipes to be joined.
      c. End connections compatible with pipes to be joined.

2.03 VALVES

A. General: Provide factory-fabricated valves recommended by Manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with Installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Ball Valves: Comply with the following requirements:
   1. Ball valves - 1-inch and Smaller:
      a. Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure;
      b. 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port.
      c. 316 stainless steel ball
      d. Reinforced "Teflon" or "TFE" seats and seals
      e. Blowout proof stem
      f. Vinyl-covered steel handle.
      g. Extended solder ends for domestic hot and cold water service.
      h. 2-inch extended handles of non-thermal conductive material. Valve pressure ratings shall be cast into the body of the valve.
   2. Ball Valves - 1-1/4-Inches to 2-Inches:
      a. Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure.
      b. 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port.
      c. 316 stainless steel ball.
      d. reinforced and replaceable "Teflon" or "TFE" seats and seals.
      e. Blowout proof stem.
      f. Vinyl-covered steel handle.
      g. Extended solder ends for domestic hot and cold water service.
      h. 2-inch extended handles of non-thermal conductive material.
      i. Valve pressure ratings shall be cast into the body of the valve.

2.04 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags for all valves with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2-inch high, and with 5/32-inch hole for fastener.
   1. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
   2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.05 VALVE SCHEDULES

A. General: Provide a valve schedule for each piping system in electronic form and printed out on standard size bond paper for inclusion in Operation and Maintenance manual.
   1. Schedule shall include valve identification number, piping system, size and location of valve, normal operating position and additional remarks as required.
   2. Identify valve use for emergency shutoff or similar special use.

2.06 SUPPORTS AND ANCHORS

A. Horizontal-Piping Hangers and Supports:
   1. General: Provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information.
   2. Adjustable Steel Clevis Hangers: MSS Type 1.
   3. Yoke Type Pipe Clamps: MSS Type 2.
   4. Steel Double Bolt Pipe Clamps: MSS Type 3.
   5. Steel Pipe Clamps: MSS Type 4.
   6. Pipe Hangers: MSS Type 5.
   7. Trapeze type with horizontal angle iron.
   8. Use only one type by one manufacturer for each piping service.
   9. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.
   10. Provide copper-plated hangers and supports for copper-piping systems.

B. Saddles and Shields:
   1. General: Provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
   2. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
   3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.
   4. Thermal Hanger Shields: Constructed of 360 degree insert of high density, 100 PSI, water-proofed calcium silicate, encased in 360 degree sheet metal shield. Provide assembly of same thickness as adjoining insulation.

2.07 PLUMBING IDENTIFICATION

A. Equipment Markers:
   1. General: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive or fasteners to mount on equipment.
   2. Terminology: Match drawing schedules as closely as possible unless directed otherwise by Owner.
   3. Data Required:
      a. Equipment Description, (i.e. Domestic Water Heater).
      b. Schedule Mark, (i.e. DWH-1).
   4. Marker Size: 2-1/2- by 4-inches for main control valves; 4-1/2- by 6-inches for equipment.

B. Plastic Pipe Markers:
   1. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
   2. Small Pipes: For external diameters less than 6-inches (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by the following method:
      a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2-inches.
   3. Large Pipes: For external diameters of 6-inch and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:
      a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2-inches wide, full circle at both ends of pipe marker, tape lapped 3 inches.

4. Lettering: Comply with piping system nomenclature as specified, scheduled or shown on drawings, and abbreviate only as necessary for each application length.
   a. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

C. Plastic Tape:
1. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick, complying with ANSI A13.1.
2. Width: Provide 1-1/2-inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6-inches, 2-1/2-inch wide tape for larger pipes.

D. Color Scheme: Comply with ANSI A13.1, or as scheduled below:

PIPE CONTENTS	COLOR SCHEME
Domestic Cold Water	White text on Green
Domestic Hot and Recirculated Water	Black text on Yellow
Natural Gas and Propane Gas	Black text on Yellow

2.8 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:
1. One-part, non-acid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and non-porous joint substrates; formulated with fungicide; intended for sealing interior joints with non-porous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5%.

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistant ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

PART 3 EXECUTION

3.01 PIPING SYSTEMS-COMMON REQUIREMENTS

A. General: Install piping as described below, except where system Sections specify otherwise.

B. General Locations and Arrangements: Drawings (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, except where deviations to layout are approved on coordination drawings.

C. Install piping at indicated slope.

D. Install components having pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

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

L. Transition Fitting Installation:
   1. Install transition couplings at joints of dissimilar piping.
   2. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.
      a. Dielectric Fitting Installation:
         1) Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
         2) Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
         3) Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
         4) Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

M. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
   1. Install steel pipe for sleeves smaller than 6-inch.
   2. Install cast-iron wall pipes for sleeves 6-inch and larger.
   3. Assemble and install mechanical seals according to manufacturer's printed instructions.

N. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
   1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
   2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
   3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
   4. 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 inside diameter. Join pipe fittings and valves as follows:
      a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
      b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
      c. Align threads at point of assembly.
      d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
      e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
   5. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
   6. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
   7. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:

a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
b. Chlorinated Polyvinylchloride (CPVC): ASTM D 2846 and ASTM F 493.
c. Polyvinylchloride (PVC) Pressure Application: ASTM D 2672.
d. Polyvinylchloride (PVC) Non-Pressure Application: ASTM D 2855.

8. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to manufacturer's printed instructions.
   a. Plain-End Pipe and Fittings: Butt joining.
   b. Plain-End Pipe and Socket-Type Fittings: Socket joining.

O. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions in piping 2-inch and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
2. Install flanges in piping 2-1/2-inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
5. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.
6. Install isolation valves upstream of all dielectric unions and flanges.

3.02 VALVE INSTALLATIONS

A. General Application: Use ball and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

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

C. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gauge, and test tee with valve, inside the building at each domestic water service entrance.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Locate valves for easy access.

G. Install valves in horizontal piping with stem at or above the center of the pipe, and to allow full stem movement.

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. Valve Locations:
1. Plumbing Piping:
   a. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two or more plumbing fixtures or equipment connections, and elsewhere as indicated.
   b. Shut-off Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.
   c. Throttling Valves: As required on plans.
2. Valve Tags:
   a. Provide valve tags for all valves and list on Valve Schedule.
   b. Install tags on valves in piping systems, except check valves, valves within factory-fabricated equipment units and plumbing fixture supply stops.

J. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

K. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
   2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.03 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

	VALVES 2-INCHES AND SMALLER			
SERVICE	GATE	GLOBE	BALL	CHECK
Domestic Hot & Cold Water	125	125	150	125
	VALVES 2-1/2-INCHES AND LARGER			
SERVICE	GATE	GLOBE	BUTTERFLY	CHECK
Domestic Hot & Cold Water	125	125	200	125

3.04 DOMESTIC WATER 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 valves for piping NPS 2 and smaller. Use butterfly or ball 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: Automatic flow control valves.
   4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. PVC valves matching piping materials may be used.

3.05 PIPING SPECIALTIES INSTALLATION

A. Dielectric Unions: Install at each piping joint between ferrous and nonferrous piping. Comply with manufacturer's installation instructions.
   1. Install isolation valves on each side of all dielectric unions.

3.06 SUPPORTS AND ANCHORS INSTALLATION

A. Hangers and Supports:
   1. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69.
      a. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69.
      b. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
      c. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
      d. Do not support piping from bottom cord of bar joist or from metal roof deck, unless approved by Structural Engineer.
      e. Piping may be supported at panel points of bar joists.
   2. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. For exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent and similar piping.
   3. Use powder-actuated fasteners only for installation where load will be applied perpendicular to the fasteners. Do not use powder-actuated fasteners where load will be applied axially to the fasteners.

4. Support fire-water piping independently of other piping.
5. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

B. Saddles and Shields:
1. Insulated Piping: Comply with the following installation requirements:
a. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold water piping, install coated protective shields. For pipe 8-inch and over, install wood insulation saddles.
b. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

C. Pipe hanger and support products.
1. 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 Requiring Vibration Isolation: MSS Type 49, spring cushion rolls.
2. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
3. Vertical Piping: MSS Type 8 or 42, clamps.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8-inch.

F. 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.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

G. Install supports for vertical copper tubing every 10 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84-inches with 3/8-inch rod.
2. NPS 1-1/2: 108-inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 and Smaller: 48-inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3: 48-inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48-inches with 5/8-inch rod.
4. NPS 6: 48-inches with 3/4-inch rod.
5. NPS 8: 48-inches with 7/8-inch rod.

K. Install supports for vertical PVC piping every 48 inches.

L. 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: 60-inches with 3/4-inch rod.
   5. NPS 8 to NPS 12: 60-inches with 7/8-inch rod.

M. Install supports for vertical cast-iron soil piping every 15 feet.

N. Install vinyl-coated hangers for PEX tubing at 32-inches maximum horizontal spacing with 3/8-inch rod.

O. Install supports for vertical PEX tubing every 48-inches.

P. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 PLUMBING IDENTIFICATION INSTALLATION

A. Install equipment markers with permanent adhesive or appropriate fasteners on or near each major item of mechanical equipment
   1. Locate markers where accessible and visible.
   2. Include markers for the following categories of equipment:
      a. Main control and operating valves.
      b. Pumps, water heaters, tanks, pressure vessels, humidifiers, water-treatment systems, and similar equipment.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   1. Near each valve and control device.
   2. Near each branch, excluding short take-offs for fixtures; mark each pipe at branch, where there could be question of flow pattern.
   3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
   4. At access doors, manholes and similar access points which permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced intermediately at maximum spacing of 50-feet along each piping run, except reduce spacing to 25-feet in congested areas of piping and equipment.
   7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code-Steel."

3.9 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned plumbing piping, materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment designated for Salvage: Remove, demount, and disconnect existing plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage by Owner.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings and specialties, equipment, controls, fixtures, and insulation.
   a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings. Drain and cap piping allowed to remain.

3.10 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.11 GROUTING

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

3.12 PIPING TESTS

A. No piping work, fixtures, or equipment shall be concealed or covered until they have been observed by the Engineer's representative, who shall be notified by the Contractor when the work is ready for inspection. All work shall be completely installed, tested as required by this Section and by all applicable local and State Ordinances and Safety Orders, and shall be leak-tight before inspection is requested. All tests shall be repeated upon request to the satisfaction of those making the inspection.

B. All domestic water piping shall be flushed, tested and shall be left under pressure of supply main or a minimum of 40 PSI for the balance of the construction period.

C. Piping tests shall be made with the test medium and under test pressures listed in the following table. Use a calibrated Bristol Pressure Recorder, or equal, on all tests. Engineer's representative shall install and remove each chart. Recorder range shall be 0-300 pounds or required range for specific test.

PIPING TESTS

Type of Piping	Test Pressure	Test Medium	Test Period
Domestic Water			
1. Pressure Regulated to and including 80 PSI	150 PSIG	Water	Two Hours

D. Test pressure in lbs. per square inch, or inches of vacuum, gauge, are given as an initial pressure to be applied to lines being tested, together with test medium.

E. Final pressures at the end of test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.

F. Check of systems during application of test pressures should include visual check for water medium leakage and soap bubble or similar for air and nitrogen medium.

G. During heating and cooling cycles, linear expansion shall be checked at all elbows, U-bends, expansion joints, etc., for proper clearance.

END OF SECTION

SECTION 22 0700
PLUMBING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Plumbing Insulation.
   2. Insulation Accessories.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation and accessory.
   1. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

1.04 QUALITY ASSURANCE

A. Furnish insulation and materials bearing the manufacturer's label. Only mechanics skilled at such work shall apply materials. Insulation and materials shall be by one of the manufacturers listed. Specialty material shall be of the manufacturer indicated or approved equal. Fire and smoke hazard classification ratings on insulation, jacket, and adhesive shall conform to NFPA 255, ASTM E 84, or UL-723 as follows:
   1. Flame Spread Index not exceeding 25.
   2. Smoke Developed Index not exceeding 50.

B. Certifications: Submit certifications or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

1.05 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.

1.06 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. 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.

1.07 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one (1) of the following:
   1. Armacell LLC.
   2. Dow Chemical Company.
   3. Johns-Manville Corp.
   4. Keene Corp.

5. Knauf Fiber Glass.
6. Nomaco K-Flex.
7. Owens-Corning Fiberglass Corp.
8. Pittsburg Corning Corp.

2.02 MATERIALS

A. Thermal Conductivity Average Maximum in Btu-in/hr-ft² at 75ºF Mean Temperature:
   1. Fiberglass Board = 0.26.
   2. Fiberglass Blanket = 0.30.
   3. Fiberglass Preformed Pipe Insulation = 0.26.
   4. Cellular Glass = 0.30.
   5. Flexible Elastomeric Cellular = 0.27.
   6. Polyisocyanurate = 0.19.
   7. Calcium Silicate = 0.60 @ 500ºF.

B. Vapor retarder film and tape shall have a maximum permeance of 0.030 perm.

C. Provide pre-formed fiberglass and elastomeric closed-cell plastic foam pipe insulation with self-adhering and self-sealing overlapping flap.

PART 3 EXECUTION

3.01 PIPING INSULATION SCHEDULE

A. Exposed Piping.
   1. Pipe insulation exposed in finished areas shall be protected with 0.030-inches thick PVC plastic jacketing covers, Ceel-Co 100 Series or approved equal.
   2. Pipe insulation exposed in mechanical and electrical equipment rooms, indoor parking garages and other unfinished areas 8-feet 0-inches or less above finish floor shall be protected with 0.030-inches thick, ultraviolet resistant, PVC plastic jacketing covers, Ceel-Co 300 Series or approved equal.
   3. Pipe insulation exposed to weather or abuse shall be protected with a factory-fabricated aluminum jacket, 0.032-inch thick. Moisture barrier membrane for insulation exposed to weather shall be 3-mil thick polyethylene and kraft paper, installed according to manufacturer's recommendations for the application at hand.

B. Domestic Cold Water - 1-1/4-inch and smaller.
   1. Fiberglass: 1/2-inch thick 4-pcf density with fire-resistive ASJ vapor barrier jacket.
   2. Elastomeric closed-cell plastic foam: 1/2-inch thick.
   3. Polyisocyanurate closed-cell: 1-inch thick with vapor retarder film.

3.02 EXAMINATION

A. Examine substrates and condition for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment 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.

3.03 PREPARATION

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

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

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with the MICA National Commercial and Industrial Insulation Standards to ensure that insulation serves its intended purpose.

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

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

D. 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.

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

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

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

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. 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.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

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. Manholes.
   5. Handholes.
   6. Cleanouts.

P. Provide neatly beveled edge at interruptions of insulation.

3.05 INSTALLATION OF PIPING INSULATION

A. Install insulation on pipe systems subsequent to testing and acceptance of tests.

B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. The appearance of the completed insulation shall be a significant factor in determining the acceptability of the work.

C. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

E. Where vapor retarders are specified, elbows and fittings shall be wrapped with vapor retarder tape 3-inches wide or shall have PVC jacketing.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation applied to adjoining pipe run. Install factory-molded, pre-cut or job-fabricated units (at installer's option) except where specific form or type is indicated.

G. Insulation of Piping Specialties on Cold Piping Services: Insulate union, flanges, strainers, flexible connections, hoses, and expansion joints on cold piping services with flexible elastomeric cellular insulation. Thickness of flexible elastomeric cellular insulation shall be equivalent to thickness of insulation on the piping service as specified in this Section or as shown on the drawings. Insulation shall be sealed to provide a vapor tight barrier. Cold piping services include domestic cold water systems.

H. Piping Insulation Omitted: Omit insulation on exposed plumbing fixture runouts from faces of wall or floor to fixture; on unions, flanges, strainers, flexible connections, and expansion joints.

I. Insulated piping systems shall be supported on the exterior of the insulation surface. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

J. Metal shields: Conform to table below for minimum length of shield:

PIPE SIZE	INSULATION THICKNESS	LENGTH OF SHIELD
Less than 1"	Up to 1"	3"
1"-2"	1"	4-1/2"
2-1/2"-4"	1"	6-1/2"
5" and Larger	1"	13"

K. Pipe Hanger, Trapeze, and Roller Support Insulation Inserts: Butt pipe insulation against pipe hanger insulation inserts. Apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.

3.06 PROTECTION AND REPLACEMENT

A. Protection: Provide protection for insulation work during remainder of construction period, to avoid damage and deterioration.

B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

END OF SECTION

SECTION 22 1116
PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes piping tubing and fittings inside building:
   1. Domestic water.
   2. Connectors.
   3. Hangers and supports.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure:
   1. Natural gas piping, valves and regulators: 100 PSIG minimum unless otherwise indicated.

1.04 SUBMITTALS

A. Product Data: For the following products:
   1. Pipe
   2. Fittings.
   3. Connectors.

1.05 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

C. Utility Compliance: Comply with requirements of natural gas utility provider for installation of natural gas piping and specialties.

PART 2 PRODUCTS

2.01 JOINING MATERIALS

A. Solder Filler Metal: ASTM B 32.
   1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95%) and silver (approximately 5%), having 0.10% lead content.
   2. Alloy Sn50: Tin (50%) and lead (50%) (for use on nonpotable water systems only).

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
   1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

PART 3 EXECUTION

3.01 GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of plumbing 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.

3.02 DOMESTIC WATER PIPING INSTALLATION

A. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

B. Install domestic water piping level and plumb.

C. Install piping concealed from view and protected from physical contact by building occupants 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 piping to permit valve servicing.

H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

I. Install piping free of sags and bends.

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

K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

L. Install escutcheons for piping penetrations of walls, ceilings, floors, cabinetry and casework.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 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. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: 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."

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 CONNECTIONS

A. General:
   1. Install piping adjacent to equipment, appliances, fixtures and machines to allow service and maintenance.
   2. Use transition fitting to join dissimilar piping materials.

B. Connect domestic water piping water-service main to exterior water-service piping with shutoff valve.
   1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
   3. 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.

C. Connections to equipment and fixtures furnished by others:
   1. Provide rough-in connections, P-traps, tailpieces, supplies and stops as required for connection to the plumbing system.
   2. Pipes and fittings exposed in finished areas shall be chrome plated.

3.05 EXISTING TO REMAIN PIPING

A. Inspect all existing to remain piping within building for blockage or existing damage.

B. Alert GC/Owner of any existing piping system damage prior to performing any work associated with repairs.

C. Failure to alert owner/GC prior to start of work may result in additional services being denied for work not given prior approval.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one (1) day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Test domestic water piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. 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.

3. 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.
4. Cap and subject piping to static water pressure of 50 PSIG above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
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 for corrective action required.

D. Plumbing piping shall be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.07 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. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.8 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

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.

D. Clean interior of piping system. Remove dirt and debris as work progresses.

E. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

F. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING APPLICATIONS

A. General:
   1. Pipe material selected shall be in compliance with all applicable codes.
   2. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
   3. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
   4. Fitting Option: Extruded-tee connections with brazed joints may be used on aboveground copper tubing.

B. Domestic Water:
   1. Aboveground domestic water piping shall be one of the following:
      a. Hard copper tube, ASTM B 88, Type L wrought-copper solder-joint fittings; and soldered joints.
      b. Tube Size 2-1/2-inch and larger only: Hard copper tube, ASTM B 88, Type L, grooved joint; grooved joint couplings and fittings.

END OF SECTION

SECTION 22 1119
PLUMBING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following plumbing specialties:
   1. Pressure Reducing and regulator valves.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Plumbing Specialties: 125 PSIG, unless otherwise indicated.

1.04 SUBMITTALS

A. Shop Drawing Submittals:
   1. Product Data: For each type of product indicated.
   2. Shop Drawings: Diagram power, signal, and control wiring.

B. Closeout Submittals:
   1. Operation and Maintenance Data: For plumbing specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

B. Reduced-Pressure-Principle Backflow Preventers shall be listed as approved by the University of Southern California Foundation for Cross Connection Control and shall be approved by the local water utility provider.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.01 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
      a. Watts Industries, Inc.; Water Products Div.
      b. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1013.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 12 PSIG maximum, through middle 1/3 of flow range.
   5. Body: Bronze for NPS 2 and smaller; epoxy coated ductile iron 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. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.02 PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
   a. Honeywell Water Controls.
   b. Watts Industries, Inc.; Water Products Div.
   c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 PSIG.
4. Body: Bronze [with chrome-plated finish] for NPS 2 and smaller; cast iron [with interior lining complying with AWWA C550 or that is FDA approved] for NPS 2-1/2 and NPS 3.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install water control valves with inlet and outlet shutoff valves [and bypass with globe valve]. Install pressure gages on inlet and outlet.

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

3.02 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Primary, thermostatic, water mixing valves.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each reduced-pressure-principle backflow preventer and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

3.06 PROTECTION

A. Protect drains during 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 23 0000
HVAC GENERAL PROVISIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section includes general requirements for HVAC systems and HVAC motors.

1.03 CONTRACT DOCUMENT COORDINATION

A. Contract Documents are diagrammatic in showing certain physical relationships between architectural, structural, mechanical, plumbing and electrical work.
   1. Verification and coordination of these relationships is the responsibility of the Contractor.
   2. Contractor shall verify existing conditions before starting work.
   3. Floor plan drawings do not necessarily indicate all required offsets, fittings, valves, etc.
   4. Provide all necessary piping, fittings, valves, ducts, offsets, and other specialties required without additional cost to the Owner.

B. Should Contract Document requirements appear to make it impossible to provide a complete and operational system, or should discrepancies appear among Contract Documents, Contractor shall request clarification before proceeding with work.

1.04 QUALITY ASSURANCE

A. Comply with all State, and local codes and ordinances.

B. Obtain and pay for all required permits, fees and certificates of inspection of the work.

C. Install equipment and devices to provide required access for servicing and maintenance.

D. Mechanical Code Compliance: Comply with applicable portions of Local, City, and State Mechanical Code pertaining to mechanical materials construction and installation of products.

1.05 SUBMITTALS

A. General: See Division 01, Section Submittal Procedures.
   1. Shop Drawing Submittals shall include specially prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information.
   2. Shop Drawing Submittals may also include product data which includes standard printed information on materials, products and systems; not specially prepared for this project, but with the designation of selections from among available choices for this project clearly identified.

B. Submittal Requirements:
   1. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect/Engineer's review with another.
   2. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, submittal name, specification section and similar information to distinguish it from other submittals.
   3. Provide General Contractor’s and Subcontractor’s stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Contract Documents. Submittals which are received from sources other than through Contractor's office will be returned by Architect/Engineer "Without Action".

4. Items from each specification section shall be prepared as separate submittals, not grouped or bound with other items. Submittals shall clearly indicate the applicable specification section.

C. Alternate Equipment Submittal by Contractor:
1. Equipment of greater or larger dimensions, weight, capacity, or rated performance than that which is specified may be submitted provided all connecting mechanical and electrical services, including ductwork and piping connections, circuit breakers, electrical conduit and conductors, motors, equipment supports, building structure, and equipment spaces are modified as required by the proposed equipment. If performance ratings or efficiencies of the equipment are specified, the equipment must meet or exceed these design requirements as well as any specified commissioning requirements. **NO ADDITIONAL COST WILL BE APPROVED FOR ANY SUCH CHANGES RELATED TO THE ALTERNATE EQUIPMENT.**
2. Should proposed alternate equipment involve rearrangement of other designed equipment, a complete layout of the area involved shall be submitted by the Contractor along with the alternate equipment submittal, and shall be approved in writing by the Architect/Engineer prior to ordering, purchasing, delivery or installation of any such items of equipment.
3. **CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ADDITIONAL EXPENSE AND COORDINATION WITH OTHER TRADES RESULTING FROM THE SUBSTITUTION OF EQUIPMENT OTHER THAN THAT SPECIFIED IN THE CONTRACT DOCUMENTS.**

D. Submittal Review:
1. Review of submittal data is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications.
2. Review of shop drawings does not release the Contractor from further satisfactory equipment operating responsibilities. Equipment shall be approved for final acceptance when installation is completed and all equipment and systems have been operated, tested, adjusted and balanced in compliance with the contract documents.
3. Re-submittals: When revised for resubmission, clearly indicate all changes since previous submission. Only those items required to be resubmitted shall be included.

E. Operation and Maintenance (O&M) Manuals:
1. Prepare and submit three (3) copies of operation and maintenance instructions for all Division 23 equipment furnished.
   a. Provide individual 3-ring binders with a table of contents and tabbed sections for each specification section.
   b. Identify equipment included in the manuals by the equipment mark used in the contract drawings.
   c. Include emergency instructions, spare parts listing, copies of warranties, wiring diagrams, shop drawings, product data, signed letters of certification of inspection and similar information.
   d. Provide documentation that training was performed for each item specified to include Owner training. Include name of Owner's representative(s) present, date and time of training.
   e. Provide a list of manufacturer's representatives for each item of equipment including company name, address and phone number.
   f. Provide documentation that Extra Materials were received by the Owner for each section requiring Extra Materials.
2. All information contained in equipment manufacturer's operation and maintenance manual shall be specific to equipment provided. Contractor shall mark out or not include all unrelated information.
3. Electronic O&M Manuals: Provide electronic version of project O&M Manuals in pdf format in addition to hardcopy version of the manuals.

F. Required Submittals List:
   1. Shop Drawings shall be submitted for the items listed in each section of the specifications. Submittals in addition to those listed may be required by the Architect/Engineer.

1.06 RECORD DRAWINGS

A. See Division 01, Section Project Record Documents.

B. Provide a set of mechanical drawings marked-up with actual as-built conditions for Division 23 work. Record drawings shall include all addenda and change orders.

1.07 CONTRACT DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, Farris Engineering (FEI) will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an officer of the requesting firm. FEI does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals. The drawing files will be "cleaned-up" by having the FEI logo, Professional Engineer seal, and all extraneous notes and details removed. FEI must be compensated for this additional service by the requesting firm. A minimum fee of $400.00 for up to eight (8) sheets and $50.00 per sheet for each additional requested drawing will be invoiced to the requesting firm once the signed agreement is received.

1.08 MECHANICAL/ELECTRICAL COORDINATION

A. General: See Division 01, Multiple Contract Summary.

B. Mechanical Contractor shall coordinate with Electrical Contractor and verify that proper electrical power connections to mechanical equipment which requires electrical power is provided. Unless specifically shown otherwise Electrical Contractor shall provide power connections to the equipment and Mechanical Contractor shall provide wiring required for start-stop, temperature control and safety interlock functions.

C. If mechanical contractor has proposed alternate equipment to that specified in the contract documents, and such alternate equipment requires modified electrical power connections, mechanical contractor shall coordinate these requirements with electrical contractor prior to ordering, purchasing, delivery or installation of any electrical conduits, conductors, circuit breakers and other electrical devices serving the alternate equipment.

D. Types of work, normally recognized as electrical but provided as mechanical include but are not necessarily limited to the following:
   1. Motors for mechanical equipment.
   2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, when specifically indicated to be furnished integrally with equipment.
   4. Electrical power connections for mechanical equipment that are not indicated on the electrical drawings.

E. Emergency Shutdown Switches: Mechanical Contractor shall coordinate with Electrical Contractor and shall verify that required shutdown switches for all equipment which requires emergency shutdown is provided. Types of equipment provided by mechanical, kitchen or foodservice equipment suppliers that may require emergency shutdown include but is not necessarily limited to the following:
   1. Boilers.

1.09 ELECTRIC MOTORS

A. Basic Motor Requirements
   1. Motors smaller than 1 HP: Single-phase.
   2. Motors 1 HP and Larger: Polyphase.

3. Frequency Rating: 60 Hz.
4. Voltage Rating: Determined by voltage of circuit to which motor is connected.
5. Service Factor: According to NEMA MG-1, unless otherwise indicated.
6. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
7. Enclosure: Open drip proof unless otherwise indicated.

1.10 FINAL COMPLETION

A. The Mechanical Contractor shall not call for a final completion check until all Mechanical Systems have been installed, adjusted, tested, and balanced and in full and complete satisfactory operation and the following certifications of inspection from equipment suppliers have been completed. Certifications of Inspection are required on the following equipment:
   1. Temperature Control Equipment.
   2. Variable Frequency Controllers.
   3. Hydronic Pumps.
   4. Boilers.

B. Certifications of Inspection shall consist of letters signed by Factory-Trained and -Authorized Service Personnel stating the following:
   1. They have inspected all of their equipment on the project.
   2. They approve the condition of the equipment and its installation.
   3. They have fully checked its operation and certify that it is operating properly.
   4. They have noted any problems, conditions or objections that could lead to future operating problems.

C. Documentation of the signed letters of Certification of Inspection shall be furnished in the Operations and Maintenance Manuals, included with the associated equipment.

1.11 GUARANTEE

A. The one year guarantee period shall not start until the project is fully completed and the Contractor has received the Final Payment and Certificate of Completion.

B. All equipment and all work shall be fully guaranteed, parts and labor, for one full year from the date of the Certificate of Completion. Repairs made during this period must be fully guaranteed for an additional one year period from the date of repairs.

C. The Mechanical Contractor has the full responsibility to guarantee all equipment and work and shall assume full responsibility to repair any equipment at his cost that the manufacturer refuses to guarantee.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 ELECTRICAL WORK PROVIDED BY MECHANICAL

A. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of the equipment manufacturer, this Section and Division 26.

3.02 PIPE HANGING AND SUPPORT

A. All piping systems shall be supported from building structural systems capable of supporting the applied load.

B. Piping shall not be supported from metal roof decking.

3.03 PAINTING AND FINISHING

A. Painting of exposed mechanical work is specified and performed under other divisions of these specifications, or as indicated on the drawings.

B. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

C. Paint inside of ductwork black, where it can be seen from occupied spaces through diffusers, grilles or louvers (under any lighting condition).

3.04 WORK IN EXISTING BUILDINGS

A. Work under this Contract includes additions and/or renovations to an existing building. It shall be the responsibility of each Bidder to fully inform himself of all conditions which affect the work contemplated by these specifications and accompanying drawings. The submission of proposal by any Bidder will be construed as an admission by him that he has examined and is fully familiar with the premises and all conditions thereon and adjacent thereto, and has included in this proposal a proper and adequate amount to cover rearrangement of existing work for the proper installation and operation of the new and existing equipment as shown on the drawings or as required by these specifications. Such work shall be neatly and properly done.

B. Maintain existing mechanical services to occupied areas and operational facilities unless otherwise indicated or when otherwise authorized in writing by Owner and Architect.

C. The operation of all existing equipment, fixtures and devices designated to remain shall be maintained. Provide temporary connections and devices as necessary to maintain the proper operation of the equipment designated to remain if required during construction.

3.05 REBATES

A. Contractor shall assist the Owner with filing of applicable forms to obtain rebates. This shall include but not be limited to determination of qualifying equipment and materials and furnishing invoices for equipment and materials as required to support the rebate application.

END OF SECTION

SECTION 23 0010
MECHANICAL SUBMITTALS

PART 1 GENERAL

1.01 GENERAL

A. Submittals shall include specially prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.

B. Submittals shall also include product data which includes standard printed information on materials, products and systems; not specially prepared for this project, but with the desi

C. gnation of selections from among available choices for this project clearly identified.

1.02 SUBMITTAL REQUIREMENTS

A. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect/Engineer's review with another.

B. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and providing space for Architect's/Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned by Architect/Engi

C. neer "Without Action".

D. Provide Contractor's certification on form, ready for execution, stating that information submitted complies with requirements of contract documents.

E. The Contractor shall be responsible for and bear any expense of alterations to the building or its appurtenances resulting from the substitution of equipment to that specified in the Contract Documents.

F. Review of submittals does not release the Contractor from further satisfactory operating responsibilities. Material and equipment shall be approved for final acceptance when construction is completed and all units and systems have been operated, tested, adjusted and balanced to the satisfaction of the Architect/Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before

G. installation of any such items of equipment. Any additional expense involved shall be a Contractor-borne expense.

H. Electronic Submittals: All submittals for shop drawings, O & M Manuals and Record Drawings shall be in electronic PDF format. Identify and incorporate information in each electronic submittal file as follows:
   1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
   2. Name file with submittal number or other unique identifier, including revision identifier.
      a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., Bryan MS-23 05 00). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., Bryan MS-23 05 00-A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and/or Construction Manager.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Architect, Engineer and Owner**,** containing the following information:
    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Names of subcontractor, manufacturer, and supplier.
    h. Category and type of submittal.
    i. Submittal purpose and description.
    j. Specification Section number and title.
    k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    l. Drawing number and detail references, as appropriate.
    m. Location(s) where product is to be installed, as appropriate.
    n. Related physical samples submitted directly.
    o. Indication of full or partial submittal.
    p. Transmittal number, numbered consecutively.
    q. Submittal and transmittal distribution record.
    r. Other necessary identification.
    s. Remarks.

1.03 SUBMITTAL LIST

A. Submittals shall be submitted for, but not limited to, the items listed in each section of the specifications. Submittals, in addition to those listed, may be required by the Architect/Engineer. The following submittal register is a summary list of submittals required for the project.

SUBMITTAL REGISTER	
SECTION	ITEM
23 0000	O&M Manuals
23 0000	Record Drawings
23 0000	Certification of Inspection
23 0500	Valves
23 0500	Meters and Gauges
23 0500	Supports and Anchors
23 0500	Mechanical Identification
23 0500	Vibration Control
23 0500	Joint Sealants
23 0593	Test & Balance Report
23 0700	HVAC Insulation Materials Schedule
23 0915	Variable Frequency Drives
23 0990	HVAC Instrumentation and Controls
23 0993	Sequence of Operation
23 20 00	Pumps
23 2113	Hydronic Piping & Fittings
23 2500	Hydronic System Cleaning & Treatment
23 6500	Cooling Tower and Accessories

END OF SECTION

SECTION 23 0915

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.02 WORK INCLUDED

A. Extent of variable frequency drives work is indicated by drawings and schedules and by requirements of this section.

B. The variable frequency drives for this Project shall be of the pulse width modulated type.

C. Provide the following electrical work as work of this section, in compliance with electrical specifications.
   1. Control and interlock wiring between operating controls, indicating devices, unit temperature control panels and variable frequency drive.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of variable frequency drives, of types and capacities required, where products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: A firm specializing and experienced in variable frequency drive installations for not less than five (5) years.

C. Codes and Standards:
   1. Electrical Standards: Provide electrical components of variable frequency drives which have been UL Listed and labeled, and comply with NEC Standards.
   2. NEMA Compliance: Comply with NEMA Standards pertaining to components and devices.
   3. ETL Compliance: Provide variable frequency drives with ETL approved label.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties, contactors and accessories; and installation and start-up instructions.

B. Coordination Data: Submit nameplate information for each motor to be operated by VFD.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.

D. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for variable frequency drives. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.

E. Operating Conditions: Submit manufacturer's printed information clearly stating ambient temperature requirement and carrier frequency at rated conditions.

F. Maintenance Data: Submit maintenance data and parts list for each variable frequency drive, control, and accessory; including "Trouble-Shooting" Maintenance Guide. Include this data and product data in Maintenance Manual.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle variable frequency drives carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store variable frequency drives in clean, dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading variable frequency drives and moving units to final location for installation.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide variable frequency drives from the following:
   1. Yaskawa

B. All VFD's shall be of the same manufacturer. The Contractor shall verify that the size of the equipment supplied by the selected manufacturer does not exceed the available mounting space.

C. The Contractor shall verify lead length between the VFD and associated motor. Output reactor or other device shall be provided as required to operate associated motor without damage to the motor windings.

2.02 GENERAL

A. Establish requirements for variable voltage variable frequency motor controls, for speed control of fans, blowers or pumps driven with AC motors.

B. Contractor shall coordinate exact locations of all motors controlled from a VFD and provide motors rated for VFD operation. In addition, motors shall be suitable for across-the-line starting.

2.03 VARIABLE FREQUENCY MOTOR CONTROL

A. Pulse Width Modulation VFD:
   1. The controller shall produce an adjustable AC voltage/frequency output. It should have an output voltage regulator to maintain correct output V/Hz. despite incoming voltage variations.
   2. The VFD shall be of the Pulse-Width Modulated type and shall consist of a full-wave diode bridge converter to convert incoming fixed voltage/frequency/ to a fixed DC voltage.
   3. The inverter output shall be generated by power transistors or IGBT's (isolated gate bipolar transistors).
   4. The logic control section shall be microprocessor based.

2.04 SPECIFICATION

A. Verify power input requirements with drawings.
   1. Nominal input voltage +/ - 10%
   2. Input frequency stability 48-62 HZ

B. Provide minimum 3% AC Input Line Reactor.

C. Output power; 3-phase, 1.5 to 60 Hz with variable voltage to give proper and efficient operation of variable torque load.

D. Displacement power factor - Minimum of 90% over the entire speed range.

E. VFD shall be rated for HP rating indicated on drawings. Additionally, amp rating shall not be less than National Electrical Code, Table 430-150 for corresponding HP size indicated. HP and current ratings noted above shall be minimum values after any/all derating factors such as frequency, elevation, ambient temperature, etc. have been applied. Ratings shall be based on 40°C ambient temperature and a carrier frequency of 4,500 to 8,000 KHz.

F. Minimum overload capacity of 110% for one (1) minute.

2.05 MINIMUM REQUIREMENTS FOR CONTROL OPERATION

A. Fused input door interlocked disconnect.

B. Isolated 115VAC control transformer.

C. Annunciated or digital display and time stamp of the following fault and limit functions for:
   1. Thermal overload relay trip.

2. Microprocessor self-check function.
3. Output overcurrent trip.
4. DC bus overvoltage trip.
5. Inverse time overload trip.
6. Heat sink overtemperature trip.
7. DC bus fuse open.
8. DC bus overvoltage (regen. limit).
9. Output ground fault.
10. Inverter ready light.
11. Inverter run light.
12. Inverter safety lockout light (red).
13. Power line on light.
14. Control voltage enabled light.

2.06 MINIMUM REQUIRED STANDARD FEATURES

A. Provide input disconnecting means, either a switch or circuit breaker. Disconnects shall be capable of being locked in the open position.

B. Provide VFD input fuses rated for protection of semiconductors.

C. Door Mounted Components:
   1. Inverter run indication.
   2. Digital speed (frequency or percent speed) and motor ammeter.
   3. Manual speed adjustment.
   4. Inverter / Off.
   5. Reset for fault and enable.
   6. Manual / Auto reference selector.

D. DC bus charged indicator.

E. Current limit circuit active to prevent nuisance tripping during acceleration or run conditions.

F. Regeneration limit circuit active to prevent nuisance OV tripping during deceleration.

G. Minimum and maximum speed set, separate and non-interactive.

H. Power loss restart selectable for Auto Restart in auto mode only.
   1. Automatic restart from undervoltage, power failure, or control fault or both.

I. Critical frequency lockout for up to two (2) points, available from 10% to 100% speed with at least a 6 Hz bandwidth.

J. Only non-filament type indicating lights may be used.

K. Control shall survive without component failure and annunciate output phase to phase and phase to ground faults.

L. Control shall have isolated instrument signal followers that are compatible with the temperature control system.

M. Loss of reference protection, VFD shall reset to predetermined minimum speed until such time as the control is commanded to stop or the analog reference returns to normal.

N. Control shall have available 15 selectable volts per hertz patterns.

O. Volts per hertz ratio shall be automatic, tracking motor load requirements to achieve most efficient operation within the parameters set by the volts per hertz pattern. Potentiometer adjustments not allowed.

P. VFD shall have adjustable automatic restart capabilities and be capable of starting into a spinning motor.

Q. Control must be capable of starting into a spinning motor and switching from inverter to bypass back to inverter without delay and without tripping off line of the inverter, also must be capable of stopping a motor rotating in the reverse direction and then accelerating that motor in the proper direction

R. All components must be supplied in an enclosure.

S. Manual Bypass Control. A bypass control shall be provided for the purpose of running the AC motor at full speed with line power while the VFD is being serviced. Bypass and drive shall be electrically interlocked. The VFD package shall be configured so that the VFD can be removed for service with the bypass control left in place.

T. The bypass control enclosure shall include the following:
   1. Door Interlock Disconnect
   2. Line Select Light
   3. Drive Off-line Selector
   4. Power On Light
   5. VFD Select Light
   6. Overload Relay
   7. 115 VAC Control Transformer

U. System shall have an adjustable setting to allow a power line dip ride through of four (4) cycles.

V. Up to four (4) programmable pre-set speeds.

W. Drive output reference signal:
   1. 0 to 10 vdc
   2. 4 to 20 ma

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which variable frequency drive systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF VARIABLE FREQUENCY DRIVE SYSTEMS

A. General: Install system and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable electrical specifications. Mount controllers at convenient locations and heights.

3.03 CLEANING

A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of variable frequency drives, including electrical connections. Report results in writing.
   1. Test and adjust controls and safeties.
   2. Replace damaged and malfunctioning controls and equipment.

3.05 COMMISSIONING

A. Startup Services: Engage a factory-authorized service representative to perform startup services and field report.

B. Operate motors and verify proper rotation and connections.

C. Operate controls and verify proper response to control inputs.

D. Submit a list of all adjustable and non-adjustable operating parameters along with actual settings and adjustment ranges.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.
   2. Review data in the maintenance manuals.
   3. Schedule training with Owner, through Engineer, with at least seven (7) days' advance notice.

END OF SECTION

SECTION 23 2113

HYDRONIC PIPING AND SPECIALTIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. This Section includes piping systems for Hot Water Piping.

B. Types of hydronic piping and specialties specified in this section include the following:
   1. Piping and Fittings
   2. Air Vents
   3. Pump Suction Diffusers
      1. Basket Strainers

1.02 SUBMITTALS

A. Product Data: From manufacturer's, for each hydronic specialty and special duty valve specified, include rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions.
   1. Furnish flow and pressure drop curves for calibrated plug valves, based on manufacturer's testing.

B. Shop Drawings: Detailing dimensions, weight loadings, required clearances, methods of assembly of components, and location and size of each field connection.

C. Maintenance Data: For hydronic specialties and special duty valves, for inclusion in operation and maintenance manual.

D. Quality Control Submittals:
   1. Welders' certificates certifying that welders comply with the quality requirements specified in Quality Assurance below.
   2. Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.
   3. Submit reports specified in Part 3 of this Section.
      a. Hydronic Piping System Testing Report.
      b. Hydronic Piping System Cleaning Report.

1.03 QUALITY ASSURANCE

A. Qualifications for Welding Processes and Operators: ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification."

B. Regulatory Requirements:
   1. ASME Compliance: Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.04 MAINTENANCE

A. Maintenance Stock: Furnish a sufficient quantity of chemical for initial system start-up and for preventive maintenance for one (1) year from Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one (1) of the following:
   1. Grooved Mechanical Joint Pipe, Fittings, and Couplings:
      a. Gruvlok; Anvil Industries.
      b. Tyco-Grinnell
      c. Victaulic Company of America
   2. Pressfit Mechanical Joint Pipe, Fittings and Couplings:

a. Pro Press System, Viega Company
b. Victaulic Company of America

3. Air Vents (manual and automatic):
   a. Hays Fluid Controls
   b. TACO, Inc.
   c. Bell & Gossett
   d. Pro Hydronic Specialties
4. Pump Suction Diffusers:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett ITT; Fluid Handling Div.
   d. Paco.
   e. Patterson Pump.
   f. Taco, Inc.
   g. Victaulic Company of America

2.02 PIPE AND TUBING MATERIALS OPTIONS (SELECTED OPTIONS SHALL COMPLY WITH ALL LOCAL CODES)

A. Material Options for Cooling Tower Piping:

1. Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe: ASTM F 441, Schedule 80, plain ends.
2. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 1785, Schedule 80, plain ends.
3. Steel Pipe, 2-1/2-inch to 12-inch NPS (DN65 to DN300): ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, plain ends with mechanical couplings (above ground only).

2.03 FITTINGS

A. Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 439 for Schedule 80 pipe.

B. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2467 for Schedule 80 pipe.

2.04 JOINING MATERIALS

A. Chlorinated Poly(Vinyl Chloride) (CPVC) Solvent Cement: ASTM F 493.

B. Poly(Vinyl Chloride) (PVC) Solvent Cement: ASTM D 2564.

2.05 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 175 PSIG working pressure, 250°F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8-inch discharge connection and 1/4-inch inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and non-ferrous internal parts; 150-PSIG working pressure, 250ºF operating temperature; with 1/4-inch NPS discharge connection and 1/2-inch NPS inlet connection.

C. Pump Suction Diffusers: Cast-iron body, with threaded connections for 2-inch and smaller, flanged connections for 2-1/2-inch and larger; 175 PSIG working pressure, 250°F maximum operating temperature; and complete with the following features:
   1. Inlet vanes with length 2-1/2 times pump suction diameter or greater.
   2. Cylinder strainer with 3/16-inch diameter openings with total free area equal to or greater than five (5) times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head.
   3. Disposable fine mesh strainer to fit over cylinder strainer.
   4. Permanent magnet, located in flow stream, removable for cleaning.

5. Adjustable foot support, designed to carry weight of suction piping.
6. Blowdown tapping in bottom; gage tapping in side.

D. Basket Strainers: High tensile cast-iron body (ASTM A 126, Class B), flanged end connections, bolted cover, perforated Type 304 stainless steel basket, bottom drain connection; 200 PSIG working pressure.

PART 3 EXECUTION

3.01 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Extreme care shall be exercised by the Contractor to prevent dirt and other foreign matter from entering pipe or components of system during construction. Pipe stored on Project shall have open ends capped and equipment shall have all openings fully protected. Before erection, each piece of pipe, fitting or valve shall be visually examined and all dirt removed.

C. Install piping at a uniform grade of 1-inch in 40-feet upward in the direction of flow.

D. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.

E. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.

F. Install unions in pipes 2-inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

G. Install flanges on valves, apparatus, and equipment having 2-1/2-inch and larger connections.

H. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment.

I. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2-inch and larger.

J. Anchor piping to ensure proper direction of expansion and contraction.

K. Support: The requirements of MSS-SP-69 "Pipe Hangers and Support - Selection and Application" shall, in general, govern the installation of hangers and supports, in accordance with the manufacturer's recommendations and with the following minimum spacings:

Nominal Pipe Size (Inches)	Max. Span Between Supports (Feet)
3/4	8
1	9
1-1/4	11
1-1/2	12
2	12
2 1/2	12
3	12
4	14
5	14
6	16
8	18
10	20
12	22
16	22

3.02 VALVE APPLICATIONS

A. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:
   1. Shut-off duty: Use ball and butterfly valves.
   2. Throttling duty: Use ball and butterfly valves.
   3. Install shut-off duty valves at each branch connection to supply and return mains, at supply and return connection to each piece of equipment, and elsewhere as indicated.
   4. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

B. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

C. Install check valves on each pump discharge and elsewhere as required to control flow direction.

D. Install pump discharge valves with stem in upward position; allow clearance above stem for check mechanism removal.

E. Install safety relief valves on hot water generators, and elsewhere as required by ASME Boiler and Pressure Vessel Code. Comply with ASME Boiler and Pressure Vessel Code Section VIII, Division 1 for installation requirements.
   1. On heating hot water systems in which no contaminants are present, pipe the discharge from the safety relief valve and boiler drains to floor drains. No valves shall be installed in the safety relief discharge piping.

F. Note that all valves required by this Section may not be shown on the drawings.

G. Hose Kit Valve and Assembly Piping: Connect hose kit valve supply and return piping to heat pump as indicated, with unions, hose valve kit assemblies and shutoff valves.

3.03 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting. For inaccessible vent locations, the vent piping shall be piped to a location where vent will be accessible.

B. Install combination separator/strainer in pump suction lines.

C. Install pump suction diffusers on pump suction inlet, adjust foot support to carry weight of suction piping. Install nipple and ball valve in blowdown connection.

D. Note that all hydronic specialties required by this Section may not be shown on the drawings.

3.04 FIELD QUALITY CONTROL

A. Testing Preparation: 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 system with clean water. Clean strainers.
   4. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.
   5. Install relief 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. Testing: Test hydronic piping as follows:
   1. Use ambient temperature clean water as testing medium.
   2. Use vents installed at the high points of system to release trapped air while filling system. Use drains installed at low points for complete removal of liquid.

3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low-pressure filling lines are disconnected.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Check to verify that stress due to pressure at bottom of vertical runs does
5. not exceed either 90% of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, "Building Services Piping."
6. 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 as appropriate, and repeat hydrostatic test until there are no leaks.
7. Prepare written report of testing and submit to Project Engineer and Owner's Representative for review. Written report shall be made available to phase 2 contractor for their final connections.

C. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens.

3.05 ADJUSTING AND CLEANING

A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

B. Close drains and refill systems for operation under normal closed loop conditions. HVAC Contractor shall add trisodium phosphate in an aqueous solution to system, prepared in a proportion of 1 lb/50 gallons of water in the system. After system is filled with this solution, the circulating pump should be started, trapped air vented, and the boiler set to supply approximately 100^{o}F loop temperature. Solution shall circulate for approximately three (3) hours.

C. System then shall be drained completely and refilled with fresh water. After system has been completely cleaned as specified herein, it shall be tested by litmus paper or other dependable methods and left on slightly alkaline side (PH 7.5). If system is still on acid side, cleaning by use of trisodium phosphate shall be repeated.

D. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

E. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

3.06 COMMISSIONING

A. Fill system and perform initial chemical treatment.

B. Perform these steps before operating the system:
1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

END OF SECTION

SECTION 23 6500
COOLING TOWERS AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Open-circuit, forced-draft, counterflow cooling towers.
   2. Open-circuit, induced-draft, cross-flow cooling towers.
   3. Condenser water treatment.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, furnished specialties, and accessories.
   1. Maximum flow rate.
   2. Minimum flow rate.
   3. Drift loss as percent of design flow rate.
   4. Volume of water in suspension for purposes of sizing a remote storage tank.
   5. Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.
   6. Performance curves for the following:
      a. Varying entering-water temperatures from design to minimum.
      b. Varying ambient wet-bulb temperatures from design to minimum.
      c. Varying water flow rates from design to minimum.
      d. Varying fan operation (off, minimum, and design speed).
   7. Fan airflow, brake horsepower, and drive losses.
   8. Motor amperage, efficiency, and power factor at 100%, 75%, 50%, and 25% of nameplate horsepower.
   9. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:
   1. Assembled unit dimensions.
   2. Weight and load distribution.
   3. Required clearances for maintenance and operation.
   4. Sizes and locations of piping and wiring connections.
   5. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of support structure.
   2. 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.
   3. Certificates: For certification required in "Quality Assurance" Article.
   4. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.
      a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:
1. Startup service reports.
2. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.
3. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by CTI.

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/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

F. FMG approval and listing in the latest edition of FMG's "Approval Guide."

1.05 COORDINATION

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

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:
1. Fan assembly including fan, drive, and motor.
2. All components of cooling tower.
3. Warranty Period: Five years from date of Substantial Completion.

1.07 SOURCE QUALITY CONTROL

A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

B. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

PART 2 PRODUCTS

2.01 OPEN- CIRCUIT, FORCED-DRAFT, COUNTERFLOW COOLING TOWERS (SPRING LAKE)

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Baltimore Aircoil Company.
2. Delta Cooling Towers, Inc.
3. Tower Tech, Inc.
4. Marley Cooling Technologies; an SPX Corporation.

B. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.

C. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

D. Casing and Frame:
   1. Casing and Frame Material: Galvanized steel, ASTM A 653/A 653M, G235 coating.
   2. Fasteners: Galvanized steel.
   3. Joints and Seams: Sealed watertight.
   4. Welded Connections: Continuous and watertight.

E. Collection Basin:
   1. Material: Galvanized steel, ASTM A 653/A 653M, G235 coating.
   2. Strainer: Removable stainless-steel strainer with openings smaller than nozzle orifices.
   3. Overflow and drain connections.
   4. Makeup water connection.

F. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

G. Electric Basin Heater:
   1. Stainless-Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.
   2. Heater Control Panel: Mounted on the side of each cooling tower cell.
   3. Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor cooling tower water level and de-energize the heater when the water reaches low-level set point.
   4. Control-circuit transformer with primary and secondary side fuses.
   5. Single-point, field-power connection to a fused disconnect switch and heater branch circuiting complying with NFPA 70.

H. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill throughout the flow range without the need for balancing valves and for connecting individual, removable, non-clogging spray nozzles.

I. Fill:
   1. Materials: PVC, with maximum flame-spread index of 5 according to ASTM E 84.
   2. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.

J. Discharge Hoods:
   1. Hood Configuration: Tapered; totally surrounding drift eliminators and constructed of same material as casing; and having factory-installed insulation and access doors.

K. Vibration Switch: For each fan drive.
   1. Vibration Detection: Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
   2. Switch shall, on sensing excessive vibration, shut down the fan.

L. Controls: Comply with requirements in Division 23 Section "Building Management and HVAC Controls Systems."

M. Personnel Access Components:
   1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.

2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
4. Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard, around top of cooling tower. Comply with 29 CFR 1910.23.
5. Internal Platforms: Aluminum, FRP, or galvanized-steel bar grating.
   a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.
   b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

2.02 OPEN- CIRCUIT, INDUCED-DRAFT, CROSSFLOW COOLING TOWERS (MINNE LUSA)

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one (1) of the following:
   1. Baltimore Aircoil Company.
   2. Marley Cooling Technologies; an SPX Corporation.
B. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.
C. Cooling tower designed to resist wind load of 30 lbf/sq. ft..
D. Casing and Frame:
   1. Casing and Frame Material: Galvanized steel, ASTM A 653/A 653M, G235 coating].
   2. Fasteners: Galvanized steel.
   3. Joints and Seams: Sealed watertight.
   4. Welded Connections: Continuous and watertight.
E. Collection Basin:
   1. Material: Galvanized steel, ASTM A 653/A 653M, G235 coating.
   2. Removable stainless-steel strainer with openings smaller than nozzle orifices.
   3. Overflow and drain connections.
   4. Makeup water connection.
   5. Outlet Connection: ASME B16.5, Class 150 flange.
   6. Equalizer connection for field-installed equalizer piping.
F. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.
G. Gravity Water Distribution Basin: Nonpressurized design with head of water level in basin adequate to overcome spray nozzle losses and designed to evenly distribute water over fill throughout the flow range indicated.
H. Fill:
   1. Materials: PVC, with maximum flame-spread index of 5 according to ASTM E 84.
   2. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.
I. Vibration Switch: For each fan drive.
   1. Vibration Detection: Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
   2. Switch shall, on sensing excessive vibration, shut down the fan.
J. Controls: Comply with requirements in Division 23 Section "Building Management and HVAC Control System."
K. Personnel Access Components:
   1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.

2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
4. Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard, around top of cooling tower. Comply with 29 CFR 1910.23.
5. Internal Platforms: Aluminum, FRP, or galvanized-steel bar grating.
    a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.
    b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

2.03 OPEN CIRCUIT INDUCED DRAFT COUNTERFLOW COOLING TOWER

A. ALTERNATE TOWER SELECTION: This tower is an approved alternate tower selection for both schools. Contractor is responsible for alterations to steel support, piping connections, and electrical connections for the use of this alternate selection.

B. General: Except as otherwise indicated, provide condenser water treatment system consisting of manufacturer's standard materials and components as indicated by published product information, and as recommended by manufacturer for application indicated.

C. Cooling tower

1. Shell shall be seamless, non-corrosive, hi-impact high density polyethylene (HDPE) of leak proof design. Conical transition for motor/fan assembly and 360 deg louvered air inlet panels around base of cooling tower integrated for optimum air distribution. The shell shall exceed 1/4" average thickness. The structural shell shall be capable of withstanding water temperatures up to 160 deg F on a continual basis.
2. Sump shall be integral with cooling tower shell, creating a one-piece seamless structure.
3. Cooling tower structural shell shall be guaranteed against corrosion for 20 years.
4. Removable PVC louver located above the integral cold sump for accessibility to automatic make-up valve and adjustable float.
5. PVC fittings shall be provided for inlet, outlet, overflow, drain and make up.
6. Outlet fitting for pump suction applications shall be provided with a vortex breaker.
7. Make up assembly shall be incorporated in the sump of the cooling tower. It shall be a mechanical valve assembly, adjustable height for varying operating condition.

D. Drift eliminator shall be non-corrosive polyethylene integral with rotating water distribution system

E. Water distribution: Fixed PVC distribution system incorporating a fixed arm assembly and lateral distribution arms. An access port shall be provided in cooling tower shell at lateral arm elevation for access to removable end caps for ease of maintenance.

F. Wet decking: Continuously wrapped spiral configuration of lightweight polyvinyl chloride PVC, bonded for maximum cooling efficiency.

G. Fan assembly
   1. Low sound fan option shall be included
   2. Fan propeller shall be adjustable pitch direct drive. Fan blades shall be constructed of fiberglass reinforced polypropylene with aluminum silicon alloy hub with stainless steel hardware; statically and dynamically balanced prior to shipping.
   3. Fan and motor shall be supported by heavy gauge rolled steel ring. The fan ring shall be coated with a premium Plastisol for corrosion protection.
   4. Motors shall be Direct Drive, Totally Enclosed, Energy Efficient, 1200 RPM, Inverter Rated, with Double Sealed Bearings, Corrosion Resistant Mill & Chemical Duty Paint and designed for cooling tower duty.
   5. Motor shall be provided with motor manufactures standard warranty.
   6. Fan guard shall be coated steel mesh, 1/2" open area to allow air to pass through with minimal pressure loss while protecting personnel from contacting the rotating fan propeller.

H. Ladder Assembly: Aluminum ladder to be supported at both top of tower and bottom of tower. Top support only is not acceptable.

I. Hardware: all fasteners are 304SS. Anchor and lifting lugs are aluminum.

J. Tower to include factory vibration switch.

2.04 CONDENSER WATER TREATMENT SYSTEM

A. General: Except as otherwise indicated, provide condenser water treatment system consisting of manufacturer's standard materials and components as indicated by published product information, and as recommended by manufacturer for application indicated.

B. Performance of Equipment: Provide system sized and equipped to treat raw water available at Project Site to maintain the following condenser water characteristics (tested values for condenser operation):
   1. Hardness: 400-500.
   2. Total Alkalinity: 200-300.
   3. Conductivity or TDS: 1300-1500.
   4. Sequestrant (Corrosion Scale Inhibitor): 15-20.
   5. pH: 8.0-8.5.

C. Conductivity Controlled Blowdown and Feed System:
   1. Maintains dissolved mineral concentration at a preset maximum limit by using a Total Dissolved Solids Controller to continuously monitor and measure conductivity of cooling tower recirculating water. When the preset maximum conductivity limit is exceeded, the TDS unit simultaneously activates the chemical feed system and opens the system blowdown valve. Make-up treatment chemicals are then added in direct proportion to the amount of chemical lost through blowdown. Feed and blowdown circuitry are deactivated when conductivity of the recirculating water drops slightly below the maximum setpoint.
   2. Equipment to be Provided:
      a. Total Dissolved Solids Controller: 0-5000 microohm meter, lockout timer, quick-disconnect temperature compensated electrode, NEMA 12X enclosure, and 115V power cord.
      b. Solenoid Operated Blowdown Valve: Normally closed, two-way, diaphragm, pilot operated.
      c. Chemical Feed Pump: Solenoid actuated diaphragm pump, and positive displacement, 100 to 1 turndown ratio.
      d. Corporation stop and nozzle assembly with injection check valve.
      e. Chemical Solution Drum: Polyethylene with foot valve suspended near bottom of drum.
      f. All other valves, piping, and accessories to make system complete.

D. Chemicals, Condenser Water Treatment: Furnish chemicals recommended by condenser water treatment system manufacturer for treating water to meet specified water quality.
   1. Ascertain from condenser water piping system Installer, what materials are used for condenser pump seals. Provide only chemicals that are compatible with these materials.
   2. Provide material safety data sheets on all chemicals. Data sheets shall be submitted to Owner.

E. Chemical Handling Equipment: Furnish to Owner one set of chemical resistant apron, gloves, and polyethylene eye shield for handling of chemicals.

F. Condenser Water Sample Test Kit: Furnish kit including carrying case and spare reagents, recommended by condenser water treatment system manufacturer for determining water hardness and water characteristics.

G. Manufacturers: Subject to compliance with requirements, provide condenser water treatment system of one (1) of the following:
   1. Betz Laboratories, Inc.
   2. Calgon Corporation.
   3. Dearborn Chemical, Chemed Corp.
   4. Drew Chemical Corp.
   5. Mitco Chemical Co.
   6. Mogul; Div. of The Dexter Corp.
   7. Nalco Chemical Co.
   8. US Water.

2.05 BIOCIDE CHEMICAL FEED SYSTEM (ALGEA CONTROL)

A. General: Except as otherwise indicated, provide biocide chemical feed system manufacturer's standard materials and components as indicated by published product information and as recommended by manufacturer for application indicated.

B. Manual Feed System (Bromicide Shot Feeder Assembly):
   1. Water from cooling tower recirculation piping is circulated through a flo-adjustable pot feeder. Water passes over bromine chloride tablets located within feeder. System consists of the following equipment and accessories.
      a. .5 to 5 GPM flowmeter.
      b. Pot feeder tank.
      c. Inlet, outlet, and drain ball valves.
      d. Miscellaneous couplings, unions, and PVC or FRP piping.
      e. Bromicide tablets (1 season of operation).

PART 3 EXECUTION

3.01 EXAMINATION

A. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting tower performance, maintenance, and operation.
   1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

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

3.02 INSTALLATION

A. Install cooling towers on 4’-0” support structure indicated.

B. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.03 INSTALLATION OF CONDENSER WATER TREATMENT SYSTEM

A. General: Install condenser water treatment system in accordance with manufacturer's written instructions.

B. Coordinate with other work as necessary to interface components of condenser water treatment system properly with condenser cooling water system.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted.
   1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

D. Install pressure gauges, valves, and controls furnished by manufacturer, in accordance with manufacturer's instructions.

3.04 CONNECTIONS

A. Install piping adjacent to cooling towers to allow service and maintenance.

B. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

C. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

D. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

E. Domestic Water Piping: Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

F. Supply and Return Piping: Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gauge, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a union, flange, or mechanical coupling.

G. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

3.05 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. Cooling towers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.
   1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
      a. Clean entire unit including basins.
      b. Verify that accessories are properly installed.
      c. Verify clearances for airflow and for cooling tower servicing.
      d. Check for vibration isolation and structural support.
      e. Lubricate bearings.
      f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
      g. Adjust belts to proper alignment and tension.

h. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
j. Check vibration switch setting. Verify operation.
k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
l. Verify operation of basin heater and control.
m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
n. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.07 ADJUSTING

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

END OF SECTION

SECTION 26 0500
GENERAL ELECTRICAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 RESPONSIBILITIES

A. The Bidding Requirements, Conditions of Contract, General Specifications and General Requirements, and this Division shall be binding on the Contractor and shall apply to all electrical work to be completed under this section.

B. The Contractor shall be responsible for the work from the date of his Contract until its acceptance by the Owner and must make good all damages sustained from whatever cause. He shall use proper care and diligence in bracing and securing all parts of the work and shall in all cases j

C. udge as to the amount of protection required.

1.03 ORDINANCES, LAWS AND CODES

A. All work shall conform to the rules and regulations of the National Electrical Code, Local Code, "Occupational Safety and Health Act" and the State Fire Marshall's Office. All certificates of approval shall be delivered to the Architect before final payment will be made.

B. Should any change in the drawings and/or specifications be required to conform to the abovementioned laws and ordinances, the Architect shall be notified by the Bidder prior to the Bid Date, that the necessary changes may be completed. After the Bid Date, all work necessary to meet the requirements shall be at Contractor's expense, with no additional cost to the Owner.

C. The Contractor shall pay all fees, permits or taxes for inspections, etc., in connection with the work under this Contract. Any costs, charges or connection fees which the Power Company assesses the Owner or Contractor in order to obtain permanent and temporary electrical service to the Project Facility will be paid by the Contractor as part of this Contract.

1.04 DATA AND MEASUREMENT

A. The data given herein and on the drawings is as exact as could be secured insofar as building construction and existing conditions are concerned. Extreme accuracy is not guaranteed. The drawings and specifications are intended for the assistance of the Contractor in achieving the end result. Exact locations, measurements, distance, levels, etc., will be governed by conditions at the Job Site.

B. The Contractor shall verify that the size of the equipment supplied by the selected manufacturers does not exceed

C. the available mounting space.

D. The Architect reserves the right to change location or size of conduits, outlets, luminaires or other pieces of equipment as may be necessary to avoid conflicts. No extra compensation will be allowed for such changes unless additional cost to the Contractor is caused.

E. The Bidder shall visit the Project Site that he or she may have knowledge of conditions at the Job Site and adapt his work to such conditions.

1.05 DRAWINGS AND SPECIFICATIONS

A. Anything mentioned in this specification and not shown on the drawings or vice versa shall be of like effect, as shown or mentioned in both. In any case of discrepancy or differences in the figures, drawings or specifications, the Bidder shall promptly report such discrepancies to the

Architect who shall make a decision in writing. Any adjustment by the Contractor without this decision shall be at the expense of the Contractor.

1.06 QUALITY OF WORKMANSHIP

A. The Contractor shall give his personal superintendence and direction to the work. He shall also keep a competent foreman or superintendent on the Project.

B. All equipment, controls and junction boxes shall be located for ready access, operation, repair or maintenance.

C. Any additional drawings necessary for the prosecution of the work will be furnished by the Architect as promptly as possible. The Contractor shall request any additional instructions needed and shall do no work without drawings and instructions.

D. Any discrepancies between the Mechanical, Electrical and Architectural Drawings shall be reported to the Architect prior to the Bid Date.

1.07 GUARANTEE

A. This Contractor shall guarantee all materials, workmanship and the successful operation of all apparatus furnished and installed by him for a period of one (1) year from the date of the final acceptance of the whole work, and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not to carelessness or improper operation. Guarantee period

B. for the replacement shall begin with the date of replacement.

C. The Owner shall notify the Contractor of any failure of any part or parts which occur during the guarantee period.

D. The Contractor shall also guarantee the systems and the apparatus to be working properly to meet all conditions as specified.

1.08 SHOP DRAWINGS

A. Shop Drawings shall be submitted in accordance with the requirements of Paragraph "Shop Drawings" of the General Conditions. The Contractor shall submit Shop Drawings of all fabricated work and equipment to be purchased. Data shall be sufficiently completed to permit evaluation and comparison with specified equipment and material. Each item shall be prepared as a separate submittal, not grouped or bound with other items.

B. All drawings shall bear the Contractor’s stamp of approval and must be dated.

C. See individual specification sections for required submittals.

D. A notation shall be made on each item submitted as to its specified use or description of specific location in the work.

E. None of the preceding items shall be purchased, delivered to the site or installed until the item has been properly submitted in writing and reviewed by the Architect.

F. Submittals shall be made even though the item is exactly as specified.

G. Should the Contractor fail to comply with any of the requirements as stated, the Architect reserves the right to select a full line of materials, appliances and equipment, which shall be final and binding upon the Contractor.

1.09 SUBMITTAL DATA

A. Review of submittal data is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: Dimensions, which shall be confirmed and correlated at the job site; fabrication processes and

techniques of construction; coordination of his work with that of all other trades and the satisfactory performanc

B. e of his work.

C. Contractor will be limited to one (1) review on a singular piece of equipment.

D. The listing of a manufacturer as "acceptable" does not imply automatic compliance with Contract Documents. It is the sole responsibility of the Contractor to ensure that any price quotations received and submittals made are for equipment/systems, which meet or exceed the specifications included herein.

1.10 EQUAL MANUFACTURERS/EQUIPMENT

A. Any requests for manufacturer/equipment to be considered as equal other than as specified herein shall be submitted to the Engineer not less than 10 days prior to Bid Date.

B. Requests for review shall be sufficiently complete to permit evaluation and comparison with specified equipment and material.

1.11 AUTOCAD DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, Farris Engineering (FE) will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an Officer of the requesting firm. FE does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals.

B. The drawing files will be "cleaned-up" by having the FE logo, Professional Engineer seal and all extraneous notes and details removed. FE must be compensated for this additional service by the requesting firm. A minimum fee of $400.00 for up to eight (8) sheets and $50.00 per sheet for each additional requested drawing will be invoiced to the requesting firm once the signed agreement is received.

PART 2 PRODUCTS

2.01 PROTECTION OF LUMINAIRES AND WARES

A. This Contractor shall apply the necessary protective coverage to luminaires and other equipment to prevent scratches and mars to such equipment as a result of falling objects or work of other trades.

2.02 STORAGE

A. This Contractor shall provide and be responsible for safe storage of his materials and such storage shall not interfere with the work of others or progress of the Project in any manner.

2.03 EQUIPMENT ENCLOSURES

A. Provide enclosures, which mate properly with the equipment to be enclosed and are NEMA rated to suit the atmospheric conditions of the equipment surroundings.

B. Equipment in corrosive atmosphere shall be rated NEMA 4X. All NEMA 4X equipment shall be fabricated from suitable non-metallic material or shall be stainless steel. Painted steel is not acceptable for NEMA 4X applications.

PART 3 EXECUTION

3.01 COORDINATION

A. Before installing any work, this Contractor shall coordinate the electrical work with all other Contractors on the Project, with the Electric Utility Company and the City Code enforcing department.

B. All electrical work shall be installed in proper sequence and so arranged with other trades that there will be no delay in the proper installation and completion of any part or parts of all piping systems and mechanical equipment.

C. This Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of equipment and conduit as indicated without major alteration. If alterations are required, a detailed drawing of the proposed departure due to actual field conditions or other c

D. auses shall be submitted to the Architect for approval.

E. Whenever interferences might occur, before installing any of the work in question, the Electrical Contractor shall consult with other Contractors and shall come to an agreement with them as to the exact location and level of his conduit bus duct, luminaires and/or parts of his installation.

F. Where recessed electrical devices (speakers, luminaires, etc.) are installed in fire-rated ceilings, Contractor shall provide an enclosure approved by authorities having jurisdiction to surround each device as required to maintain the fire integrity rating of the ceiling. Adequate clearance between device and enclosure shall be provided in accordance with device manufacturer's recommendations. Verify clearance requirements with device manufacturer prior to installation of luminaire.

G. Multiwire branch circuits as defined by the National Electrical Code (circuits with common neutral) shall not be used. Exception: Where an equipment manufacturer requires a multiwire branch branch circuit for only one utilization equipment and where all ungrounded conductors of that circuit are opened simultaneously by the branch circuit overcurrent device.

H. A cable raceway type wiring method, installed in exposed or concealed locations near metal-corrugated sheet roof decking, shall be installed and supported so the nearest outer surface of the cable raceway is not less than 6-inches from the nearest surface of the roof decking. Exception: Rigid metal conduit and intermed

I. iate metal conduit shall not be required to maintain this clearance.

J. All changes in the work of this Contractor, caused by his neglect to follow these instructions, shall be made at this Contractor's expense.

3.02 DITCHING, EXCAVATION AND BACKFILLING

A. Contractor shall do all excavation required to install conduits and equipment shown on drawings or required for proper operation. Excess excavation below the required level shall be backfilled with earth and thoroughly tamped.

3.03 CONNECTIONS FOR EQUIPMENT

A. Coordinate the hook up of the following equipment with the Contractor required to furnish and install them. See the appropriate sections in the General Construction Work specifications for further information.
   1. Mechanical Equipment
   2. Fire Alarm Equipment
   3. HVAC Controls Equipment
   4. Cabinetry Equipment
   5. Owner Furnished Equipment

B. If not included with equipment, all hand dryers shall have a disconnecting means. Provide 600v, 34 Amp rated quick disconnect for local disconnecting means within body of hand dryer, Molex #1726722002 (male connector) and #1726732002 (female connector).

C. Verify fuse and/or circuit breaker requirements for electrical connections to equipment and provide overcurrent devices accordingly.

D. The plans indicate the locations of system devices. The Contract shall include the wiring system required to interconnect the indicated devices to result in a complete, operating system. The interconnecting wiring shall be in conformity with the requirements of the manufacturer of the equipment as well as with other requirements set out herein. The basic wiring method to be employed is indicated herein. The Contractor's Shop Drawing submittal shall indicate the specific routing and type of wireway and t

E. he number and type of conductors to be installed.

3.04 WORK IN EXISTING BUILDING

A. Inasmuch as work under this Contract includes adding to in the existing building, it shall be the responsibility of each Bidder to fully inform himself of any and all conditions which influence or are influenced by work contemplated by these specifications and accompanying drawings. The submission of a proposal by any Bidder will be construed as an admission by him that he has examined and is fully familiar with the premises and all conditions thereon and adjacent thereto, and has included in this proposal

B. a proper and adequate amount to cover rearrangement of old work for the proper installation and operation of the new and existing equipment as shown on the drawings specified herein or as required. Such work shall be neatly and properly done.

C. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated or when authorized otherwise in writing by Owner or Architect. Provide temporary service during interruptions to existing facilities. When nece

D. ssary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate or abandon existing wiring as indicated.

E. The operation of all special systems within the building shall be maintained, including but not limited to fire alarm, telephone, intercom, communication, data, security, emergency call, etc. Provide temporary connections/equipment as necessary for required sequence of construction. Any necessary momentary outages shall be scheduled with the Owner prior to starting such work.

3.05 DEMOLITION AND REMOVAL OF EXISTING EQUIPMENT AND MATERIALS

A. Existing conduits that are made spare by demolition work shall be removed unless concealed in existing construction.

B. All existing unused wiring shall be removed.

C. All conduits and conductors shown to be reused shall be thoroughly tested and checked for insulation breakdown and continuity.

D. Electrical items must be removed where they interfere with or are not concealed by new construction such as new ceilings, walls, etc.

E. Existing luminaires, outlets, receptacles and other equipment and material shall be relocated, removed, reconnected or left in place as indicated on the drawings. Where an existing device is shown removed from an existing circuit, new wiring shall be provided as required to insure continuity of existing circuit. If existing devices or other electrical items, such as electrically operated equipment interfere with the location of a new partition, relocation of existing equipment, new equipment, etc., the existing items including electrical components of electrically operated equipment shall be disconnected and removed or satisfactorily relocated and reconnected even though not specifically indicated on the drawings. All material removed which is considered salvageable by the Owner and is not specifically designate

F. d to be reused on the drawings or not practical to be reused shall remain in the property of the Owner and shall be neatly stockpiled in a specially designated location.

3.06 CLEANING

A. This Contractor shall at all times keep the premises free of all waste or surplus materials, rubbish and debris which is caused by his employees or resulting from his work.

B. After all equipment and luminaires have been installed and building is ready for occupancy, the Electrical Contractor shall remove all stickers, rust stains, labels, temporary covers, plaster marks, paint spots, etc. All foreign matter shall be vacuumed out of all conduits, panels, motors, devices, switches, luminaires, etc.

C. Identification plates and trims on all equipment shall be free of paint and polished.

D. The Contractor shall leave the electrical portion of the work in a safe clean and very neat condition ready for operation.

3.07 REBATES

A. The Contractor shall assist the Owner with filing of applicable forms to obtain rebates. This shall include but not be limited to determination of qualifying materials and furnishing invoices for materials with corresponding quantities.

3.08 RECORD DRAWINGS

A. The Contractor shall maintain an up-to-date set of plans and specifications on the Job Site. He shall mark all Addendum Items and any field changes on this set and see that a copy of all changes is furnished to the Architect at the end of the Project.

B. The drawings shall also include as-built conditions such as equipment locations, routing of service entrance and major feeders, etc.

3.9 INSTRUCTION IN OPERATION BOOKS AND SPARE PARTS

A. After all tests and adjustments have been made, the Contractor shall furnish the necessary qualified personnel to place the special systems in continuous operation, during which time he shall provide complete Operating and Maintenance Instructions to the Owner's representative with an outline of instructions in written form. These personnel shall reserve adequate time to instruct an Owner's representative on proper operation (including all phases of the system

B. and each of its component parts).

C. Contractor shall furnish Owner with two (2) sets of all operating instructions, maintenance instruction and spare parts lists of all equipment furnished under this Contract. Lists shall include current unit prices and source of supply for each item of operable equipment.

3.10 FIRESTOPPING

A. Openings around electrical penetrations through fire-resistant rated walls, partitions, floors or ceilings shall be firestopped using listed materials to maintain the fire rating. Installation shall be done in accordance with manufacturer's recommendations. Materials shall be UL Listed and labeled and FM approved for fire ratings consistent with penetrated barriers.

1. Foamed-in-place type firestopping shall only be permitted in concealed-from-view locations. Sealant type firestopping shall be used in expos
2. ed-to-view locations.
3. Cable tray, conduit sleeves (2-inch and larger) and similar penetrations of fire-rated walls, floors or ceilings shall be sealed by a method that permits cables to be easily added or removed without damage to the firestopping materials. Products similar to Grace Construction Products Flamesafe Bags, Specified Technologies, Inc. EZ Path Fire Rated Pathway and Wiremold Flamestopper FS Series are acceptable when rated for the application. Coordinate requirements with product manufacturer and authority having
4. jurisdiction. Foamed in place or sealant type firestopping are not acceptable at these locations.

3.11 TESTS AND ADJUSTMENTS

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

B. During the progress and after completion of the work included under this specification, the Contractor shall make all required tests at his own expense in the prese

C. nce of the Architect as required hereinafter and by local ordinances, codes, laws and regulations. Such tests shall be in accordance with other sections of this division. The Architect shall be notified five (5) days in advance as to the time when such tests are to be performed that a representative of the Architect may be present.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.03 DEFINITIONS

A. VFC: Variable frequency controller.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2, Type XHHW-2.

2.02 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 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. Comply with NFPA 70.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper Stranded for all feeder conductors.

B. Branch Circuits: Copper. Stranded for all branch circuit conductors. All stranded wire connections to wiring devices shall be made with compression type wire terminations. Minimum wire size shall be #12 AWG. #14 AWG wiring shall be permitted for control wiring.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway

D. Feeders Concealed in Concrete, Below Slabs-on-Grade, in Wet / Damp Locations and Underground: Type XHHW-2, single conductors in raceway.

E. Feeders Serving Emergency Systems: In addition to requirements above feeders classified as emergency systems shall meet one of the requirements below. Emergency Systems shall be those feeders that are a part of the Life Safety Branch. Emergency systems feeders located in an enclosed ceiling space shall also conform to the conditions below. See fire protection plans and specs for areas protected by fully automatic protection system.

1. The cable or raceway is installed in spaces or areas that are fully protected by an approved automatic fire suppression system.
2. The cable or raceway is protected by a listed electrical circuit protective system with a minimum of 2-hour rating.
3. The cable or raceway is a listed fire resistive cable system.
4. The cable or raceway is protected by a listed fire rated assembly that has a minimum rating of 2 hours and contains only emergency circuits.
5. The cable or raceway is encased in a minimum of 2 inches of concrete.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

J. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."

G. Switch legs shall be color coded to distinguish them from Hot or Phase Conductors.

H. Switch legs occurring in the same box or enclosure shall be color coded separately.

3.04 CONNECTIONS

A. Tighten electrical 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-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables per Section 26 0553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly per Section 07 8413 "Penetration Firestopping."

END OF SECTION

SECTION 26 0533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Metal conduits, tubing, and fittings.
   2. Boxes, enclosures, and cabinets.

1.03 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers:
   1. Rigid Metallic Conduit: Allied Tube and Conduit Corporation or equivalent.
   2. Flexible Metallic Conduit: American Brass “Sealtite” or equivalent.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Fittings for EMT:
      a. Material: Steel.
      b. Type: Setscrew.
   2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:
   1. Raco, Steel City or equivalent.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:
   1. Material: Cast metal.
   2. Type: Fully adjustable.
   3. Shape: Rectangular.
   4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Fiberglass.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
      a. Mechanical rooms.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations and mechanical rooms.
   6. Damp or Wet Locations, including mechanical rooms: GRC.
   7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. Minimum Raceway Size: 3/4-inch (21-mm) trade size. 1/2-inch (21-mm) trade size for control wiring.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing

conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface raceways only where indicated on Drawings or where limited due to existing construction methods.

3.02 IDENTIFICATION OF BOXES

A. All junction box covers shall be labeled with the panel and circuit.

B. All concealed box covers shall be painted with enamel spray paint, using the following system:
1. Fire Alarm - Red
2. Emergency Power - Yellow
3. Security and Access Controls - Orange
4. HVAC Controls - Blue

3.03 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor. Where acceptable to authority having jurisdiction, rigid non-metallic conduits may be stubbed up no more than 6-inches above floor where concealed within walls.

J. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35 mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground or above ground raceway enters a building or structure. Include empty raceway with a removable seal.
   3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires**.** Use a maximum of 24 inches at equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

3.04 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.05 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Identification for raceways.
   2. Identification for conductors.

1.03 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with ANSI Z535.4 for safety signs and labels.

D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

E. Room numbers must be identified with OPS room numbers and names for labeling panel directories for electrical power, intercom, fire alarm, and electronic security.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes and standards. Use consistent designations throughout Project.

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

C. Coordinate installation of identifying devices with location of access panels and doors.

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

PART 2 PRODUCTS

2.01 BOXES AND RACEWAY IDENTIFICATION MATERIALS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label. Protective Overlay only required at exterior or wet locations. Provide at the following locations:
   1. Box covers labeled with panel and circuit number.

B. For emergency systems circuits that are part of the life safety transfer switch system provide label “EMERGENCY SYSTEM” on each box and enclosure. Label shall be as specified for J-box covers panel and circuit number. The “Emergency System” designation shall be permitted to be on the same label as the panel and circuit number. Where no boxes and enclosures are available on the emergency system the label “EMERGENCY SYSTEM” shall be printed on yellow background and located on raceways at intervals not exceeding 25 feet.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

PART 3 EXECUTION

3.01 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use color-coding conductor tape to identify the phase.
   1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
      a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
      b. Colors for 208/120-V Circuits:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
      c. Colors for 480/277-V Circuits:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
      d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

B. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

END OF SECTION