



NEW CASTLE COUNTY VO-TECH SCHOOL DISTRICT

PAUL M. HODGSON
VOCATIONAL TECHNICAL HIGH SCHOOL
2575 Glasgow Avenue, Newark, DE 19702

PROJECT MANUAL

BSA+A PROJECT #22.011

Contract No. NCC2401D

Volume 3
Divisions 21 through 22

**BID PACKAGE D – BUILDING ENVELOPE AND FIT OUT
ISSUE FOR BID – ADDENDUM #1**

December 28, 2023

ABHA | BSA+A

PROJECT MANUAL

NEW CASTLE COUNTY VO-TECH SCHOOL DISTRICT PAUL M. HODGSON VOCATIONAL-TECHNICAL HIGH SCHOOL

Contract No. NCC2401D

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**ISSUE FOR BID
December 28, 2023**

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SEALS PAGE

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The following previously issued Bid Package documentation is included by reference:

BPB Sitework and Utilities dated 25 May 23
BPB Addendum #1 dated 1 Aug 23
BPB Addendum #2 dated 7 Aug 23
BPB Addendum #3 dated 10 Aug 23
BPC Foundations and Structures 31 Aug 23
BPC Addendum #1 dated 29 Sept 23
BPC Addendum #2 dated 11 Oct 23
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COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1. GENERAL

1.1. SUMMARY

- A. All work under Division 21 is subject to the Division 01, General Conditions and Special Requirements for the entire contract.
- B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.
- C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Engineer.
- D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with Submittals specified below. The right is reserved to make reasonable changes in location of equipment, and piping up to the time of rough-in or fabrication.
- E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.
- F. Coordinate the work under Division 21 with the work of all other construction trades.
- G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

1.2. PERMITS AND FEES

- A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.
- B. Permits and fees shall comply with the Division 01, General Requirements of the specification.

1.3. EXAMINATION OF SITE

- A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractors failure to do so.
- B. Examine and verify specific conditions described in individual specifications sections.

- C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.4. CONTRACTOR QUALIFICATION

- A. Any Contractor or Subcontractor performing work under Division 21 shall be fully qualified and acceptable to the Architect and Owner. Submit the following evidence when requested:
 - 1. A list of not less than five comparable projects which the Contractor completed.
 - 2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.
 - 3. Local and/or State License, where required.
 - 4. Membership in trade or professional organizations where required.
- B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.
- C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.5. MATERIALS AND EQUIPMENT

- A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality.
- B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.
- C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.
- D. Substitution will not be permitted for specified items of material or equipment where noted.
- E. All items of equipment furnished shall have a service record of at least five (5) years.

1.6. FIRE SAFE MATERIALS

- A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA and ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

- A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.
- B. ASTM - American Society for Testing and Materials
- C. FM - Factory Mutual
- D. IBC - International Building Code
- E. IEEE - Institute of Electrical and Electronics Engineers
- F. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
- G. NEC - National Electrical Code
- H. NEMA - National Electrical Manufacturers Association
- I. NFPA - National Fire Protection Association
- J. UL - Underwriters' Laboratories
- K. State of Delaware Fire Protection Requirements.
- L. All equipment materials, piping and installation shall comply with the codes and standards listed in the enforceable edition of the Applicable National Fire Protection Association Pamphlets.
- M. Fire Protection Systems design, equipment and installation shall comply with the Delaware State Fire Prevention Regulations, latest edition including all Annexes and Addendums.

1.8. SUBMITTALS, REVIEW AND ACCEPTANCE

- A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect to be in best interest of Owner.
- B. After acceptance of Material and Equipment List, submit six (6) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with

Contract Documents. Edit submittal data specifically for application to this project.

- C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.
- D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.
- E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.
- F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.
- G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.
- H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.
- I. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.9. SHOP DRAWINGS

- A. Prepare and submit shop drawings for all mechanical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.
- B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.
- C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.
- D. Items and Systems

1. Accelerator (Dry Pipe Systems)
2. Access Doors/Panels including layout and location
3. Air Compressors (For Dry Pipe Systems)
4. Alarm Check Valves
5. Backflow Preventers
6. Blind Flange
7. Coordinated Drawings
8. Drip Pans
9. Exterior Equipment/Piping Supports
10. Fire Protection System including Hydraulic Calculations, Equipment and Devices
11. Fire Pump and Accessories
12. Fire Pump Controller and automatic transfer switch
13. Fire Stopping - Methods and Materials
14. Flowmeter and Primary Elements (Flow Fittings)
15. Gongs
16. Hose Valve Cabinets and Hose Valves
17. Identification System
18. Jockey Pump/controllers
19. Material and Equipment List
20. Operations and Maintenance Manuals
21. Paint Spray Booth Zone Valve Assemblies
22. Pipe Materials Including Itemized Schedule
23. Preliminary and Final Pipe Pressure Tests
24. Pressure Gauges
25. Pressure Maintenance Equipment for Dry Pipe Systems
26. Pressure Relief Valves

27. Pump Pressure Switches
 28. Pumps
 29. Sprinkler Heads
 30. Standpipes
 31. Strainers
 32. Test Certificates
 33. Valves
 34. Vibration Isolation Materials
 35. Weatherproof Assembly Components
 36. Wiring Diagrams, Flow Diagrams and Operating Instructions
 37. Zone Valve Assemblies and Wire Mesh Enclosures
- E. Contractor, additionally, shall submit for review any other shop drawings as required by the Architect. No item shall be delivered to the site, or installed, until the Contractor has received a submittal from the Engineer marked Reviewed or Comments Noted. After the proposed materials have been reviewed, no substitution will be permitted except where approved by the Architect.
- F. For any shop drawing requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

1.10. SUPERVISION AND COORDINATION

- A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.
- B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, equipment, and other work performed under Division 21.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for fire protection installations.
- D. Coordinate electrical work required under Division 21 with that under Division 26. Coordinate all work under Division 21 with work under all other Divisions.
- E. Supply services of an experienced (10 years minimum) and competent Project Manager to be in constant charge of work at site.
- F. Where a discrepancy exists within the specifications or drawings or between the

specifications and drawings, the more stringent (or costly) requirement shall apply until clarification can be obtained from the Engineer. Failure to clarify such discrepancies with the Engineer will not relieve the Contractor of the responsibility of conforming to the requirements of the Contract.

- G. Failure of contractor to obtain a full and complete set of contract documents (either before or after bidding) will not relieve the contractor of the responsibility of complying with the intent of the contract documents.
- H. Coordinate installation of large equipment requiring positioning before closing in building.

1.11. CUTTING AND PATCHING

- A. Accomplish all cutting and patching necessary for the installation of work under Division 21. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.
- B. Do not cut structural members without approval from the Architect or Structural Engineer.

1.12. PENETRATION OF WATERPROOF CONSTRUCTION

- A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.
- B. Where pipes penetrate roofs, flash pipe with Stoneman Stormtite, Pate or approved equal, roof flashing assemblies with skirt and caulked counter flashing sleeve.
- C. Furnish and install pitch pockets or weather tight curb assemblies where required.
- D. Furnish and install curbs, specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions. The Contractor shall be responsible for sleeve sizes and locations. All roof penetrations shall be installed in accordance with manufacturer's instructions, the National Roofing Contractors Association, SMACNA, and as required by other divisions of these specifications.

1.13. CONCRETE AND MASONRY WORK

- A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 21. Perform work in accordance with requirements of other applicable Divisions of these specifications.
- B. Concrete shall test not less than 3,000 psi compressive strength after 28 days.
- C. Grout shall be non-shrink, high strength mortar, free of iron or chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in

accordance with manufacturer's instructions and standard grouting practices.

1.14. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

- A. Unless otherwise noted on the drawings, where existing fire protection work is removed, pipes, valves, etc., shall be removed, including hangers, to a point below finished floors or behind finished walls and capped. Such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.
- B. Where work specified in Division 21 connects to existing equipment and piping, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and to leave completed work in a finished and workmanlike condition.
- C. Where the work specified under Division 21, or under other Divisions, requires relocation of existing equipment, piping, etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition.
- D. Where the relocation of existing equipment is required for access or the installation of new equipment, the contractor shall temporarily remove and/or relocate and re-install as required to leave the existing and new work in a finished and workman like condition.

1.15. EXCAVATION AND BACKFILLING

- A. General
 - 1. Perform all necessary excavation, or installation of work under Division 21, in whatever materials or conditions encountered, using suitable methods and equipment.
 - 2. Accurately establish required lines and grades and properly locate the work.
 - 3. Determine the locations of all existing utilities before commencing the work.
- B. Excavation: (Refer also to other portions of the specifications)
 - 1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
 - 2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.
 - 3. Keep excavations dry. Protect excavations from freezing.
- C. Backfilling: (Refer also to other portions of the specifications)
 - 1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.

2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

1.16. DRIVE GUARDS

- A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.
- B. When available, guards shall be factory fabricated and furnished with the equipment. Otherwise fabricate guards of heavy gauge steel, rigidly braced, removable, and finish to match equipment served. Provide openings for tachometers. Guards shall meet local, State and O.S.H.A. requirements.

1.17. VIBRATION ISOLATION

- A. Furnish and install vibration isolators, flexible connections, supports, anchors and/or foundations required to prevent transmission of vibration from equipment, or piping to building structure. See Division 23 Section, “Vibration Control for HVAC Plumbing and Fire Protection Equipment”.
- B. Install vibration isolation at dry pipe air compressors.

1.18. ALTERNATES

- A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

1.19. DEFINITIONS

- A. Approve - to permit use of material, equipment or methods conditional upon compliance with contract documents requirements.
- B. Furnish and install or provide means to supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.
- C. Contractor means the mechanical contractor and any of his subcontractors, vendors, suppliers, or fabricators.
- D. Piping includes pipe, all fittings, valves, hangers, insulation, identification, and other accessories relative to such piping.
- E. Concealed means hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction.

- F. Exposed means not installed underground or concealed as defined above.
- G. Invert Elevation means the elevation of the inside bottom of pipe.
- H. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.
- I. Review - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.
- J. Building Line: Exterior wall of building.

1.20. FUTURE ADDITIONS

- A. Where future additions are indicated, size, calculate, and install all piping to account for future additions. Furnish and install control valve with tamper switch in ceiling adjacent to future additions. Provide cap at the end of the piping. Arrange so that in the future the cap can be removed and control valve opened to serve future additions without draining system.

PART 2. ELECTRICAL REQUIREMENTS

2.1. GENERAL MOTOR AND ELECTRICAL REQUIREMENTS

- A. Furnish and install control and interlock wiring for the equipment furnished. In general, power wiring and motor starting equipment will be provided under Division 26. Carefully review the contract documents to coordinate the electrical work under Division 21 with the work under Division 26. Where the electrical requirements of the equipment furnished differ from the provisions made under Division 26, make the necessary allowances under Division 21. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 21.
- B. All electrical work performed under Division 21 shall conform to the applicable requirements of Division 26 and conforming to the National Electrical Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA and the IBC.
- C. Provide wiring diagrams with electrical characteristics and connection requirements.
- D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than five (5) horsepower.
- E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering. For extended outdoor storage, remove motors from equipment and store separately.
- F. All motors shall be furnished with visible nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor and efficiency.

- G. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- H. Brake horsepower load requirement at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors.
- I. All single phase motors shall be provided with thermal protection: Internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature ratings of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.
- J. Where equipment under this Division is specified with integral disconnecting means, the same shall be a single disconnecting means for disconnecting all ungrounded main power supply conductors that is capable of being locked in the open (“off”) position in accordance with the National Electrical Code and the local electrical inspector.

2.2. MOTORS AND CONTROLS

- A. Motors and controls shall conform to the latest requirements of IEEE, NEMA, NFPA-70 and shall be UL listed. Motor sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.
- B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG 1.
- C. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.
 - 1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplates.
 - 2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overloading, exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR2 of the driven equipment to operating speed.
 - 3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.
 - 4. Motors shall be designed for operation on 60 hertz power service. Unless otherwise specified or shown, motors less than ½ horsepower shall be single phase, and motors ½ horsepower and larger shall be 3 phase unless otherwise noted.

5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.
- D. Single phase motors, smaller than 1/20 horsepower shall be ball or sleeve bearing; drip-proof, totally enclosed or explosion proof, as specified; 120 volts; permanent-split capacitor or shaded pole type. These motors shall not be used for general power purposes, and shall only be provided as built-in components. When approved by the Engineer, deviations from the specifications will be permitted as follows:
1. Open motors may be installed as part of an assembly where enclosure within a cabinet provides protection against moisture.
 2. Motors used in conjunction with low voltage control systems may have a voltage rating less than 115 volts.
- E. Single phase motors, greater than 1/20 horsepower and less than ½ horsepower shall be ball bearing; drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115 or 120/208/240 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type with minimum efficiency of 70 percent and a minimum full load power of 77 percent.
- F. Except as otherwise specified in the various specification sections, 3 phase motors 60 horsepower and smaller shall be NEMA design B squirrel cage induction type meeting the requirements of this paragraph. Motors shall be drip-proof, totally enclosed or explosion proof, as specified or indicated. Insulation shall be Class B or F, at 40 degrees C ambient temperature. Drip-proof motors shall have a 1.15 service factor and totally enclosed and explosion proof motors shall have a service factor of 1.00 or higher. Motors specified for operation at 480, 240, and 208 volts shall be name-plated 460, 230, 200 volts, respectively. Efficiencies and percent power factor at full load for three phase motors shall be not less than the values listed below for premium efficiency motors:

MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
1HP and above to	85.5 percent	84 percent
1-½ HP	86.5 percent	85 percent
2HP	86.5 percent	85 percent
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent
7½ HP	91 percent	86 percent
10HP	91.7 percent	85 percent
15HP	93.0 percent	85 percent

20HP	93.0 percent	86 percent
25HP	93.6 percent	85 percent
50HP and above	94.5 percent	88 percent
60 HP	95.0 percent	90 percent
75HP	95.0 percent	90 percent
100 HP	95.4 percent	90 percent

- G. Three phase motors ½ HP or greater shall be the Duty Master XE by Reliance Electric Company, Super-E Premium Efficiency of Baldor Motor and Drives, E-plus Efficient Standard Duty Motor of the Electric Motor Division of Gould, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corp., the equivalent product of General Electric, or approved equal.
- H. Motor frames shall be NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast-iron or aluminum with steel inserts.

2.3. MOTOR INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors to support shaft regardless of shaft position.
- C. Check line voltage and phase and ensure agreement with nameplate. Check that proper thermal overloads have been installed prior to operating motors.

2.4. WIRING DIAGRAMS

- A. The Contractor is responsible for obtaining and submitting wiring diagrams for all major items of equipment.
- B. Wiring diagrams shall be provided with shop drawings for all equipment requiring electric power.

2.5. ENCLOSURES

- A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:
 - 1. Dry Interior Locations: NEMA 1.
 - 2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.
 - 3. Corrosive Locations, Including Laboratories, Chemical Storage Rooms and Similar Space = NEMA 4X.

PART 3. EXECUTION

3.1. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install fire protection equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.
- G. Do not install equipment or piping over electrical gear, electrical panels, motor controllers, and similar electrical equipment. Install equipment and piping to maintain clear space above and in front of all electrical components per the National Electric Code.

3.2. SUPPORTS, HANGERS AND FOUNDATIONS

- A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.
- B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For un-insulated copper piping provide copper hanger to prevent contact of dissimilar metals. All exterior hangers shall be stainless steel including hangers, rods, nuts, washers, bolts, etc.
- C. Concrete housekeeping pads and foundations shall be not less than 4 inches high and shall extend a minimum of 6 inches beyond equipment bases. Provide wire-mesh reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

3.3. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Record demonstration and training video recordings. Record each training module separately.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.

- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
- D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

3.4. PROVISIONS FOR ACCESS

- A. The contractor shall provide access panels and doors for all concealed equipment, valves, strainers, controls, control devices, and other devices requiring maintenance, service, adjustment, balancing or manual operation.
- B. Where access doors are necessary, furnish and install manufactured painted steel door assemblies consisting of hinged door, key locks, and frame designed for the particular wall or ceiling construction. Properly locate each door. Door sizes shall be a minimum of 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 20 inches x 30 inches for full body access where required. Review locations and sizes with Architect prior to fabrication. Provide U.L. approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, Mifab, or approved equal.
 - 1. Acoustical or Cement Plaster: Style B
 - 2. Hard Finish Plaster: Style K or L
 - 3. Masonry or Dry Wall: Style M
- C. Where access is by means of liftout ceiling tiles or panels, mark each ceiling grid using small color-coded and numbered tabs. Provide a chart or index for identification. Place markers within ceiling grid not on ceiling tiles.
- D. Access panels, doors, etc. described herein shall be furnished under the section of specifications providing the particular service and to be turned over to the pertinent trade for installation. Coordinate installation with installing contractor. All access doors shall be painted in baked enamel finish to match ceiling or wall finish.
- E. Submit shop drawings indicating the proposed location of all access panels/doors. Access doors in finished spaces shall be coordinated with air devices, lighting and sprinklers to provide a neat and symmetrical appearance.
- F. Where access doors are installed in wet locations (i.e. shower rooms, toilet rooms, kitchens, dishwasher rooms, can wash rooms, natatoriums, and similar spaces, etc.) provide aluminum access doors/frames.

3.5. PAINTING AND FINISHES

- A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.
- B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.
- C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.
- D. Protect all finishes and restore any finishes damaged as a result of work under Division 21 to their original condition.
- E. The preceding requirements apply to all work, whether exposed or concealed.
- F. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.
- G. All exposed piping, equipment, etc. shall be painted. Colors shall be as stated in this division or as selected by the Architect in Division 09 and conform to ANSI Standards.
- H. All exposed piping, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.
- I. Refer to Division 09 for additional painting requirements.

3.6. CLEANING OF SYSTEMS

- A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting equipment, and other accessory items. Blow out and flush piping until interior surfaces are free of foreign matter.
- B. Flush piping to remove cutting oil, excess pipe joint compound, solder slag and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating the name of service company used.
- C. Pay for labor and materials required to locate and remove obstructions from systems that are clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.
- D. Leave systems clean, and in complete running order.

3.7. COLOR SELECTION

- A. Color of finishes shall be as selected by the Architect.

- B. Submit color of factory-finished equipment for acceptance prior to ordering.

3.8. PROTECTION OF WORK

- A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.
- B. Cover temporary openings in piping and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver pipes and tubes with factory applied end caps.
- C. Cover or otherwise protect all finishes.
- D. Replace damaged materials, devices, finishes and equipment.
- E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.9. OPERATION OF EQUIPMENT

- A. Clean all systems and equipment prior to initial operation for testing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.
- B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.
- C. Submit factory start-up sheets or field start-ups sheets for all equipment.

3.10. IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

- A. Contractor shall submit for approval working fire protection drawings of each piping system installed in the building. Diagrams shall indicate the location and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under safety glass and hung in each Mechanical Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.
- B. All valves shall be plainly tagged. For any bypass valves, install sign indicating valve position as “Normally Open” or “Normally Closed” as required.
- C. All items of equipment, including motor starters, fire pump controllers, jockey pump controllers, and disconnects shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal). Equipment identification and room name or area served shall be on each label.

- D. Provide six (6) hard copies and one (1) electronic copy of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Operation and Maintenance Booklet as hereinafter specified.
- E. All piping installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and service. Refer to Division 21 Section, “Fire Suppression System Piping, Fittings, Valves, Etc”. Color code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.
- F. Submit list of wording, symbols, letter size, and color coding for fire protection identification. Submit samples of equipment identification cards, piping labels, and valve tags to Engineer for review prior to installation.
- G. Provide at least eight (8) hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner.
- H. Contractor shall demonstrate Sequences of Operation of all fire protection equipment in presence of Owner’s representative, and Fire Marshal.

3.11. WALL AND FLOOR PENETRATION

- A. All penetrations of partitions, ceilings, roofs and floors by piping or conduit under Division 21 shall be sleeved, sealed, and caulked airtight for sound and air transfer control.
- B. All penetration of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 07 Section, “Fire Protection, HVAC and Plumbing Protection Firestopping”.
- C. Where piping extends through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these specifications.
- D. Provide pipe escutcheons for sleeved pipes in finished areas.
- E. Piping sleeves:
 - 1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.
 - 2. Twenty-two (22) gauge galvanized steel elsewhere.
- F. Extend all floor sleeves through floor at least 2-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.
- G. Sleeves for penetrations in kitchen and food service areas shall finish .375 inches above floor or flush with wall surfaces and be neatly pointed up to fit snugly against floor or wall material.

3.12. RECORD DRAWINGS

- A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect one complete set of prints of the fire protection drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings.
- B. Contractor shall incorporate all sketches, addendums, value engineering, change orders, etc., into record drawings prior to delivering to Architect.

3.13. WARRANTY

- A. Contractor's attention is directed to warranty obligations contained in the GENERAL CONDITIONS.
- B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of equipment manufacturer's warranties shall be included in the operations and maintenance manuals.
- C. The contractor guarantees for a two (2) year period from the time of final acceptance by the Owner.
 - 1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.
 - 2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.
 - 3. That the contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The contractor shall also make good all damages caused to their work or materials in the process of complying with this section.
 - 4. That the entire work shall be water-tight and leak-proof.

3.14. LUBRICATION

- A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Operations and Maintenance Booklet.
- B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

3.15. OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall have prepared six (6) hardcopies and one (1) electronic copy of the

Operation and Maintenance Manuals and deliver these copies of the manuals to the Owner. The manuals shall be as specified herein. The manuals must be approved and will not be accepted as final until so stamped.

- B. The manuals shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: Operations and Maintenance Manuals – New Hodgson Vocational Technical High School – Fire Protection. No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out. Provide divider tabs and table of contents for organizing and separating information.
- C. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of Volume 1 (if applicable) of hard copies of the manual.
- D. Provide the following data in the booklet:
 - 1. As first entry, an approved letter indicating the starting/ending time of Contractor's warranty period.
 - 2. Maintenance operation and lubrication instructions on each piece of equipment furnished.
 - 3. Manufacturer's extended limited warranties on equipment.
 - 4. Chart form indicating frequency and type of routine maintenance for all fire protection equipment. The chart shall also indicate model number of equipment, location and service.
 - 5. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
 - 6. Provide supplier and subcontractor's names, address, and phone number.
 - 7. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.
 - 8. Provide and install in locations as directed by the Owner, valve charts including valve tag number, valve type, valve model number, valve manufacturer, style, service and location. Each valve chart shall be enclosed in a durable polymer based frame with a cover safety glass.
 - 9. Access panel charts with index illustrating the location and purpose of access panels.
 - 10. Approved Fire Suppression System Certificates.
 - 11. Start-up reports for equipment.
 - 12. NFPA Test Reports.

- E. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of volume 1 (if applicable) of hard copies of the manual.
- F. Submit Operations and Maintenance Manuals prior to anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Operations and Maintenance Manuals be reviewed and approved.

3.16. INSTALLATION AND COORDINATION DRAWINGS

- A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following:
 - 1. Complete Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with lights, electrical equipment, HVAC equipment and structural amenities.
- B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, and piping in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.
- C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

3.17. PIPING SYSTEMS TESTING

- A. The entire new fire protection piping systems shall be tested hydrostatically before insulation covering is applied and proven tight under the following gauge pressures for a duration of twenty-four (24) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Fire Suppression Piping (Refer to NFPA)	200 psi

- B. Testing and acceptance thereof shall be in accordance with local requirements and shall meet approval of authority having jurisdiction. Submit certificates and approved permits and insert one (1) copy in the Operations and Maintenance Manuals.

3.18. OUTAGES

- A. Provide a minimum of fourteen (14) days notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.
- B. Submit Outage Request form, attached at end of this Section, to Owner for approval.

NEW CASTLE COUNTY VOCATIONAL –
TECHNICAL SCHOOL DISTRICT

PAUL M. HODGSON VOCATIONAL
TECHNICAL HIGH SCHOOL

END OF SECTION

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE: _____

END OUTAGE -- TIME: _____ DATE: _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____

(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ NO ____ BY: _____ DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER: _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ NO: ____ NAME: _____

POINT OF CONTACT: _____ PHONE: _____

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DIVISION 21 SECTION 21 05 05
FIRE SUPPRESSION SYSTEM PIPING, FITTINGS & VALVES
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SECTION 21 05 05
FIRE SUPPRESSION SYSTEM PIPING, FITTINGS & VALVES

PART 1. GENERAL

1.1. SUMMARY

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

1.2. SYSTEM DESCRIPTION CONDITIONS

- A. Provide all labor and materials necessary to furnish and install all piping systems on this project as herein specified and/or shown on the drawings.
- B. All piping and insulation installed in ceiling plenums must be plenum rated and comply with NFPA and the authority having jurisdiction.
- C. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- E. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- F. Provide pipe hangers and supports in accordance with ASTM B31.9, MSS SP69 and NFPA-13 unless indicated otherwise.
- G. Use 3/4 inch (20 mm) ball valves with cap and chain for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
- H. For areas subject to freezing (exterior canopy, covered porch, exterior rack storage etc.), Contractor shall provide and install dry pipe heads, piping, control valves, tamper switches, test stations, dry pipe valve, air compressors, accelerators, and accessories, etc., required by NFPA-13 and the authority having jurisdiction.

1.3. QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- C. If the product is available domestically it shall be supplied as such.

1.4. DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under as hereinbefore specified.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

1.5. ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.6. EXTRA MATERIALS

- A. Provide one (1) repacking kit for each size valve.

1.7. ALTERNATES

- A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. PIPE MATERIALS

- A. All materials, unless otherwise specified, shall be new and of the best quality of their respective kinds, and shall conform to the requirements and ordinances of local, state and insurance authorities having jurisdiction.
 - 1. Fire Suppression System Piping (NFPA-13):
 - a. Piping Underground: Steel, schedule 40, ASTM A53, black pipe with ASME C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape, or listed ductile iron pipe.
 - b. Piping Above Grade (Inside): Steel, schedule 40, ASTM A53, black pipe. Piping 4 inches and smaller shall be ASTM A120, black steel pipe. Sizes 4-inches and above shall be standard weight, black, cast iron with screwed fittings, schedule 10 steel piping shall be acceptable when approved by the authority having jurisdiction.
 - c. Piping Above Grade (Outside): Galvanized Steel
 - d. Wet Pipe Fittings: Steel fittings shall be ASME B16.9, wrought steel, butt welded. Cast iron fittings shall be ASME 16.1, flanges and flanged fittings. Malleable iron fittings shall be ASME B16.3, threaded fittings. Mechanical grooved couplings shall be malleable iron housing clamps to

- engage and lock C shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe. Mechanical formed fittings shall be carbon steel housing with integral pipe stop and O-ring and O-ring uniformity compressed into permanent mechanical engagement onto pipe.
- e. Dry Pipe Fittings: UL listed for dry pipe service.
 - f. Victaulic, Grinnell, or approved equal, grooved end fittings and mechanical couplings shall be used for wet pipe and dry pipe systems 2” and larger. Couplings and fitting shall be UL listed and FM approved. Fittings shall be ASTM A536 ductile iron, ASTM A234 forged steel or ASTM A53 fabricated steel with factory grooved ends designed to accept Victaulic couplings.
 - g. Victaulic, Grinnell, or approved equal, mechanical couplings shall consist of two ASTM A536 ductile iron housings, pressure-responsive, synthetic rubber gasket and plated steel bolts and nuts.
 - i. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13. Tongue and recess rigid type couplings shall only be used if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer’s latest recommendation.
 - 1) 1-1/4” through 8”: “Installation Ready” stab-on rigid coupling, designed for direct ‘stab’ installation onto grooved end pipe without prior field disassembly and no loose part. Victaulic FireLock EZ Style 009H (1-1/4” – 4”) and Victaulic QuickVic Style 107H (2”-8”).
 - 2) 2” and Larger: Standard rigid coupling design. Victaulic Style 07 Zero-Flex.
 - ii. Flexible Type: use in seismic areas and where required by NFPA-13.
 - 1) 2” through 8”: “Installation Ready” stab-on flexible coupling, designed for direct ‘stab’ installation onto grooved end pipe without prior field disassembly and no loose parts. Victaulic QuickVic Style 177.
 - 2) 2” and Larger: Standard flexible coupling design. Victaulic Style 75 or 77.

Fire Suppression System Service	Temperature Range	Gasket Recommendation
Dry Systems	Ambient	Grade EPDM, Type A-FlushSeal, FireLock EZ, or QuickVic Design
Freezer Applications	-30°F to 0°F (-34°C to 17°C)	Grade L Silicone FlushSeal® Design
Water/Wet Systems	Ambient	Grade EPDM, Type A-C Shaped, FireLock EZ, or QuickVic Design

- h. Gate Valves: 2-1/2 inches & larger - listed 175 lb. OS&Y, flanged. 2 inches & smaller - UL/FM listed 175 lb., bronze, screwed. Furnish all sprinkler control valves with slow close manual operator and position indicator. Tamper switches furnish under Division 21.
 - i. Grooved End Gate Valves: 2-1/2 inches and Larger – UL listed/FM approved, 250 psi maximum pressure rating, OS&Y, ductile iron body, bronze mounted, grooved ends. Victaulic FireLock Series 771.
 - j. Grooved End Butterfly Valves: 2 inches & Larger: UL listed/FM approved, up to 365 psi maximum pressure rating, ductile iron body, nickel-plated ductile iron disc, Nitrile seat, weather-proof actuator with two pre-wired supervisory switches. Victaulic FireLock Series 765 or Series 705.
 - k. Globe Valves: 2 inches & smaller - 175 lb., bronze, screwed, UL/FM listed.
 - l. Check Valves: 2-1/2 inches & smaller - UL/FM listed 175 lb., flanged swing check. 2 inches & smaller - listed 175 lb., bronze swing check, screwed.
 - m. Grooved End Check Valves: 2 inches and Larger: UL listed/FM approved, up to 365 psi maximum pressure rating, ductile iron body, spring-loaded stainless steel or EPDM coated ductile iron disc, nickel-plated or welded-in nickel seat. Victaulic FireLock Series 717H or Series 717.
 - n. Finish: All exposed fire suppression piping shall be primed and painted with epoxy red paint. White letters shall indicate pipe and indicate direction of flow. Painting shall be provided under Division 09.
 - o. Special Requirements: All fire suppression piping, valves, fittings and joints shall comply with applicable National Fire Protection Pamphlets (NFPA) local codes, building codes, Fire Marshal, Owner's Insurance Underwriter, and the authority having jurisdiction.
- B. Steel pipe shall be similar and equal to National Allied Tube or Wheatland black or zinc-coated (galvanized) as hereinafter specified. Pipe shall be free from all defects which may affect the durability for the intended use. Each length of pipe shall be stamped with the manufacturer's name.
- C. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.
- D. Welding fittings for steel pipe shall meet the requirements of ASTM Standard A-23 and shall be standard catalog products. Fittings fabricated by metering and notching pipe will not be accepted.

2.2. PIPE HANGERS

- A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260 for pipe 3/4-inch and larger, and Figure 65 for pipe 2-inches and smaller, or approved equal. Adjustable pipe stanchion with U-bolt shall be Grinnell Company's Figure 191. Pipe roller supports shall be Grinnell's Figure 181 or Figure 271. Exterior pipe hangers shall be galvanized or stainless steel construction. For copper piping in direct contact with the hanger, hanger construction shall be copper coated to prevent

contact of dissimilar metals similar to Grinnell's Figure CT-65. Hanger spacing and rod sizes for steel and copper pipe shall not be less than the following:

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
3/4 & 1	6	5	3/8
1 - 1/2	6	8	3/8
2	8	8	3/8
2 - 1/2	10	9	1/2
3	12	10	1/2
4	14	12	5/8
5	14	12	5/8
6	16	14	3/4
8	18	16	7/8
10	20	18	7/8
12	20	18	7/8

- B. Anchors, guides, and roller supports shall be installed in accordance with the contract drawings and manufacturer's recommendations to provide pipe support and control pipe movement for all piping systems. Anchors and guides shall be securely attached to the pipe support structure. Submit shop drawing for proposed pipe support structure for guides and anchors for approval of the Structural Engineer. Pipe alignment guides shall be Fig. 255 Grinnell, or as approved equal. Guides shall be sized to accommodate the pipe with insulation. Guides shall be steel factory, fabricated, with bolted two section outer cylinder and base for alignment of piping and two section guiding spider for bolting to pipe.
- C. Hangers for pipe sizes 1/2 to 1 1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring, comply with NFPA-13.
- D. Hangers for pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis. Comply with NFPA-13.
- E. Hangers for cold pipe sizes 6 inches (150 mm) and over: adjustable steel yoke, cast iron roll, double hanger, comply with NFPA-13.

- F. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.
- G. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook, comply with NFPA-13.
- H. Wall support for pipe sizes 4 inches (100 mm) and over: Welded steel bracket and wrought steel clamp, comply with NFPA-13.
- I. Wall support for pipe sizes 6 inches (150 mm) and over: welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll, comply with NFPA-13.
- J. Vertical Support: Steel riser clamp, comply with NFPA-13.
- K. Floor support for pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support, comply with NFPA-13.
- L. Copper pipe support: Carbon steel ring, adjustable, copper plated, comply with NFPA-13.
- M. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded, comply with NFPA-13.
- N. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- O. Victaulic Style 009H, 107H, and 07, Grinnell, or approved equal, rigid couplings may be used with IPS steel piping systems, which meet the support and hanging requirements of NFPA-13. An adequate number of Victaulic Style 177, 75, and 77, Grinnell, or approved equal, flexible couplings shall also be used to compensate for thermal expansion/contraction of the pipe.
- P. For Pipe Hangers installed in corrosive environments such as chemical storage rooms...etc. the same shall be finished with an Electro-Galvanized finish such as Galv-Krom® or approved equal.

2.3. VALVES

- A. Provide parts list and assembly drawings (exploded view) for all valves in shop drawing submittals. Provide valves of the same type by the same manufacturer. All valves shall be provided with tamper switches and coordinated with Division 28.

2.4. PRESSURE GAUGES

- A. Unless otherwise indicated, pressure gauges shall be the bronze bourdon tube type, 4-1/2-inch dial, stem mounting, cast aluminum adjustable pointer, 1 percent accuracy over middle half of scale range, 1-1/2 percent over balance: Terice Model 600C; Weksler Instruments, Ernst Gage Co., Miljoco, or as approved equal.
- B. Gauges shall have pressure, vacuum, compound, or retard ranges as required, select ranges so that the normal readings are at the approximate midpoint and maximum system pressures do not exceed full scale.

- C. Furnish and install a gauge valve at each pressure gauge. Gauge valves shall be Crane Model No. 88, Needle Valve, Ernst Gage Co. FLG 200, Wexler Instrument Corp. Type BBV4, or approved equal, rated for pressure intended.
- D. Gauge connections for pressure gauges or control instruments shall be made using tee fittings, except that gauge connections up to 1-inch size in steel may be using threaded extra heavy pipe couplings welded directly to the main, provided that the main is at least 2-inch size for 2-inch connections, 3-inch size for 3/4-inch connections, and 4-inch size for 1-inch connections. Minimum gauge connection shall be 2-inch ips.
- E. Provide snubbers on all gauges. Snubbers shall be No. 872 by Trerice, RS1/RS6 by Wexler Instruments, Miljoco or as approved equal.

2.5. PIPING SPECIALTIES

- A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of all vertical in-line pumps and connections to dry pipe air compressors, all vibrating equipment, and elsewhere as shown. Refer to Division 23 Section, Vibration Control for HVAC, Plumbing and Fire Protection Equipment for specifications.
- B. Victaulic Style 177, 75, or 77, Grinnell, or approved equal, flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.

2.6. ESCUTCHEONS

- A. Provide chromium plated escutcheons properly fitted and secured with set screws on all exposed piping which passes through walls, floors or ceilings of finished spaces.
- B. All escutcheon plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface. Plastic escutcheon plates will not be accepted.

2.7. DIELECTRIC CONNECTIONS:

- A. Furnish and install electrically insulated dielectric waterway fittings, unions or flanges, as manufactured by EPCO Sales, Inc., or Victaulic Co. at the following locations:
 - 1. Where steel piping systems join copper piping.
 - 2. Avoid the installation of steel nipples, cast iron or steel valves and specialties, or other ferrous components in predominately copper piping systems. Where such installation is necessary, isolate the component with dielectric connections. Do not mix steel pipe and copper tube in the same run of pipe or in the same section of a piping system.

2.8. SLEEVES

- A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, roof structure members or other building parts. Sleeves shall be standard weight galvanized

iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.

- B. Sleeves through floors shall be flush with the floor except for sleeves passing through Equipment Rooms which shall extend $\frac{3}{4}$ -inch above the floor. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves. Each trade shall be responsible for drilling existing floors and walls for necessary sleeve holes. Drilling methods and tools shall be as hereinbefore specified.
- C. Sleeves through walls and floors shall be sealed with with a waterproof caulking compound.
- D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

2.9. WATER PROOF PIPE PENETRATION SEALS

- A. Provide and install waterproof pipe penetration seals at all pipes that enter the building below grade or through exterior wall.
- B. Link seals are to be Metraflex Metraseals, Model MS, Linkseal, or approved equal, black EPDM seal material, glass reinforced plastic pressure plates, zinc plated nuts and bolts, seals are to be resistant to sunlight and ozone, pressure rated to make a hydrostatic seal of up to 20 psig and up to 40 feet of head, temperature rated from –40 degrees F to 250 degrees F.

PART 3. EXECUTION

3.1. GENERAL PIPING INSTALLATION REQUIREMENTS

- A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment or devices and not to block access to doors, windows, manholes, or other access openings. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment, and installed so that there will be no interference with the installation of the equipment. All valves and specialties shall be placed to permit easy operation and access and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be installed so as to avoid air or liquid pockets throughout the work. Ends of pipe shall be reamed so as to remove all burrs.
- B. All piping shall be run to provide a minimum clearance of 2-inches between finished covering on such piping and all adjacent work. Group piping wherever practical at

common elevations.

- C. All valves and other fittings shall be readily accessible.
- D. Drain valves with hose connections shall be provided at low points for drainage of piping systems. Blow down valves shall be provided at the ends of all mains and branches so as to properly clean by blowing down the lines throughout in the direction of normal flow.
- E. Spring clamp plates (escutcheons) shall be provided where pipes are exposed in the building and run through walls, floors, or ceilings. Plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface.
- F. Install all valves with stem upright or horizontal, not inverted.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.
- H. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- I. All water containing pipes shall be routed clear of combustion air dampers and louvers to prevent freezing condition when dampers are open.
- J. Where zone valve assemblies are installed in stairwells, install primed and painted 18 gauge removable mesh screen. Color of paint shall be as selected by Architect.

3.2. PRESSURE GAUGE INSTALLATION REQUIREMENTS.

- A. Install pressure gages in piping tees with pressure gauge valve located on a pipe at most readable location.
- B. Adjust faces of pressure gauges to proper angle for best visibility.
- C. Clean windows of gauges and clean factory-finished surfaces. Replace cracked and broken window, and repair scratched and marred surfaces with manufacturer's touch up paint.

3.3. VALVE INSTALLATION REQUIREMENTS

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.

- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.
- G. Install valves as indicated, according to manufacturer's written instructions.
- H. Piping installation requirements are specified in other Division 21 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- I. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- J. Locate valves for easy access and provide separate support where necessary.
- K. Install valves in horizontal piping with stem at or above the center of the pipe.
- L. Install valves in a position to allow full stem movement.
- M. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

3.4. PIPE JOINTS INSTALLATION REQUIREMENTS

- A. Screwed Joints: All screwed joints shall be made with tapered threads properly cut. Screwed joints shall be made perfectly tight with a stiff mixture of graphite and oil, applied with a brush to the male threads on the fittings.
- B. Grooved Joints: Install in accordance with the manufacturer's (Victaulic, Grinnell, or approved equal) guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A Victaulic factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
- C. Soldered Joints and Copper Piping: Joints in copper piping shall conform to the following minimum standards.
 - 1. The pipes shall be cut to a length making certain that the ends are square, using a fine hacksaw blade or tube cutter. The ends of all pipes shall be reamed and all burrs removed.
 - 2. The outside end of the pipe and the cut end of the fitting shall be cleaned with steel

wool, sand cloth, or steel wire brush. All dark spots shall be removed.

3. The flux shall be applied evenly and sparingly to the outside end of the pipe and the inside of the outer end of the fitting until all surfaces to be jointed are completely covered. The piping and fitting shall be slipped together and reworked several times to insure an even distribution of the flux.
 4. The correct amount of solder per joint for each size pipe shall be used in accordance with the manufacturer's recommendations.
 5. Solder joints shall be made by using a direct flame from a torch.
 6. On pipe sizes larger than ¼-inch, the fittings and valves in the pipe shall be moved or tapped with a hammer when the solder starts to melt to insure an even distribution of the solder.
 7. The excess solder shall be removed while it is still in the plastic state leaving a fillet around the cup of the fitting.
 8. Solder joints shall be suitable for working pressure of 100 psig and for working temperature of not less than 250 degrees F. The type of solder and flux used will be submitted for approval. Type 95-5 shall be the minimum standard.
- D. Where copper piping joins steel piping, approved bronze adapters shall be used.
- E. Prohibited Connections: No direct weld, soldered, or brazed connections, without unions or flanges, shall be made to valves, strainers, apparatus, or related equipment. Right and left couplings, long threads, or caulking of pipe threads or gasket joints will not be permitted.

3.5. HANGERS AND SUPPORTS INSTALLATION REQUIREMENTS

- A. General: All hangers shall be of an approved type arranged to maintain the required grading and pitching of lines to prevent vibration and to provide for expansion and contraction. Saddles shall be Grinnells Figure 173/273 or approved equal. Provide approved spacers between saddles and pipe where flexible insulation is specified. Provide insulation protection shields for insulated piping without saddles. Shield shall be Grinnell Figure 167 or as approved equal. Comply with NFPA-13.
- B. Spacing: Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping.
- C. Pipes to be supported off every joist/beam in the perpendicular direction or at 6 feet on center in the parallel direction. Piping 6 inches or greater shall have their own individual hangers.
- D. Vertical Lines: Shall be supported at their bases, using either a suitable hanger placed in a horizontal line near the riser, or a base type fitting set on a pedestal, foundation or support. All vertical lines extending through more than one floor level shall be supported at each floor with a riser clamp. Riser clamp shall be Grinnell Co.'s Figure 261, or approved equal.

All vertical drops to pump suction elbows shall be supported by floor posts.

- E. Racks and Brackets: All horizontal piping on vertical walls shall be properly supported by suitable racks securely anchored into the wall construction. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction. Washer plates (Fib. 60, 60L) and other miscellaneous attachments, fasteners, etc., shall be Grinnell or as approved equal. All exterior hanger and bracket systems in their entirety shall be galvanized.
- F. Pipe Hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer.
- G. Select hangers and components for loads imposed. Secure rods with double nuts.
- H. Support of horizontal piping shall allow for vertical adjustment after installation of piping.
- I. Support overhead piping with clevis hangers.
- J. Do not support all parallel piping from the same joist. Stagger all supports in accordance with the structural engineer's recommendations.
- K. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- L. Construct concrete anchors of poured in place concrete of dimensions indicated and include embedded fasteners.
- M. Refer to structural documents for appropriate connection/attachment materials to building.
- N. Fire protection pipes shall be supported independently of other building trade supports per NFPA-13.

3.6. PIPING IDENTIFICATION INSTALLATION REQUIREMENTS

- A. All piping shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color code and system identification shall comply with ANSI Standards and piping identification system shall comply with ASME A13.1-81., scheme for the identification of piping systems and NFPA pamphlets, latest edition.
- B. Markings shall be plain block letters, stenciled on pipes, and shall be located near each branch connection, near each valve, and at least every 10 feet on straight runs of pipe. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such manner as to be easily legible from the floor. Pipe identification schedule shall be as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)
½ to 1 ¼	8	½

1-½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
Over 10	32	3 ½

3.7. VALVE IDENTIFICATION REQUIREMENTS

- A. All valves shall be tagged with a numbered tag.
- B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.
- C. Provide a minimum of six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.
- D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in the main fire protection riser room. Additional copies shall be provided in each copy of the O&M manuals.

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DIVISION 21 SECTION 21 10 00
WATER BASED FIRE SUPPRESSION SYSTEM – FIRE PUMP
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SECTION 21 10 00
WATER BASED FIRE SUPPRESSION SYSTEM – FIRE PUMP

PART 1. GENERAL

1.1. REFERENCE

- A. The conditions of the Contract and General Requirements apply to the work specified in this section. All work under this section shall also be subject to the requirements of Division 21 Section, Common Work Results for Fire Protection Systems and Division 01 General Requirements.
- B. Submit complete shop drawings of all equipment utilized with the fire pump in accordance with Division 21 Section, Common Work Results for Fire Protection. Submittals shall include but not be limited to the following fire pump system and accessories:
 - 1. Alarm Check Valves
 - 2. Alarm Gong
 - 3. Automatic Air Release
 - 4. Automatic Air Release Valves
 - 5. Automatic Fire Pump Controller with integral transfer switch
 - 6. Automatic Jockey Pump Controller
 - 7. Backflow Preventers
 - 8. Ball Drip Valves
 - 9. Blind Flange with Escutcheon
 - 10. Circulation Relief Valve
 - 11. Dry Pipe Air Compressor and Accessories
 - 12. Dry Pipe Valve
 - 13. Eccentric Reducers
 - 14. Fire Department Connection
 - 15. Fire Pump and Associated Trim
 - 16. Flow Meters
 - 17. Flow Switches
 - 18. Hose Header Valves and Accessories

19. Hose Valve Cabinets
 20. Inspector's Test Station
 21. Jockey Pump and Associated Trim
 22. Paint Spray Booth Sprinkler Heads, Tamper Switches, Flow Switches, and Piping
 23. Pressure Sensing Devices, Valves
 24. Pressure Switches
 25. Pressure/Vacuum Gauges
 26. Relief Valves
 27. Standpipe Valves
 28. Tamper Switches
 29. Valves and Piping
- C. Provide fire pumps and associated equipment complete and ready for operation. Equipment materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA-13, NFPA-70, NFPA-14, and NFPA-72E. Devices and equipment for fire protection service shall be U.L listed or FM approved.
- D. All of the fire pump equipment and devices shall be included within the project Operations and Maintenance Manuals.
- E. Refer to Division 21 Section, Fire Protection Pipes, Fittings, and Valves.
- F. Fire Protection Systems design, equipment and installation shall comply with the Delaware State Fire Prevention Regulations, latest edition including all Annexes and Addendums.
- G. Extend fire protection system to serve the dust collection fire extinguishing system and paint mixing and paint spray booths. Furnish and install shut-off valves, tamper switches and flow switches.

1.2. DESCRIPTION

- A. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section and as shown on the drawings. The work shall be performed by a licensed sprinkler contractor only. All equipment, piping, devices, and valves shall be sized based on hydraulic calculations. Include a 10 psig safety factor with hydraulic calculations.
- B. Layout sprinkler system complete and size all fire protection piping in accordance with requirements of the National Fire Protection Association and the State Fire Marshal. System shall be designed for occupancy as required by applicable codes. Conceal fire

protection piping in finished spaces unless indicated otherwise. System drains and inspector's test shall not be located in finished spaces.

- C. Sprinkler equipment and work shall conform to requirements of National Fire Protection Association Standard No. 13, No.14, No. 20, No. 24, and No. 101. In addition, all work shall conform to requirements of all codes and regulations of authorities having jurisdiction over this work, including, but not limited to, State Fire Marshal, County Fire Marshal, Life Safety Codes and International Code, and Insurance Underwriter.
- D. Preliminary Shop Drawing: Prior to preparing detailed working drawings for submission to State Fire Marshal, submit preliminary sprinkler system layout to the Architect for review and approval. Show all finished ceilings, light fixtures, air diffusers and other ceiling mounted devices. Coordinate sprinkler head types and locations with ceiling types. All sprinkler heads in acoustic tile ceilings shall be centered in the tile.
- E. The fire protection contractor shall prepare dimensioned and detailed working drawings, specifications, and hydraulic calculations and submit same to the State Fire Marshal and/or County Fire Marshal for review and approval. Prior to submission to the Fire Marshal, the Fire Protection Contractor shall have all fire protection drawings, submittals, calculations reviewed and approved by a registered Fire Protection Engineer or a level III Nicet Technician. One set of these approved documents shall be provided to the Engineer for record purposes. All costs related to changes required to obtain the Fire Marshal's or Insurance Underwriters' approval shall be the responsibility of the contractor.
- F. Manufactured equipment and materials shall be submitted to the Engineer for review and approval, in accordance with the requirements of Division 21 Section, Common Work Results for Fire Protection.
- G. Hydraulic calculations should be based on an available water supply as follows:

Static Pressure =	36 psig
Residual Pressure =	33 psig
Flow =	952 GPM
Existing Pipe Material	For Hydraulic Calculations Assume Roughness Coefficient C factor = 100 for all Exterior Piping.

- H. Hydraulic calculations shall include a 10 psig safety factor to account for pipe aging and deterioration of water supply.
- I. The fire pump size (flow and pressure) shall be hydraulically determined per the requirements of NFPA-13.
- J. The fire pump room shall be fully sprinklered in accordance with NFPA-13 and NFPA-20. Provide sprinkler heads with guards, inspectors test station, drains and piping to completely protect pump room.

- K. For areas subject to freezing (exterior canopy, covered porch, exterior rack storage, etc.), Contractor shall provide and install dry pipe heads, piping, control valves, tamper switches, test stations, dry pipe valve, air compressors, and accessories, etc., required by NFPA-13 and the authority having jurisdiction.
- L. All stage/platforms shall be fully sprinklered/protected per the requirements of N.F.P.A.-13, N.F.P.A.-101, and the International Building Code. Provide and install Hose Valves on both sides of stages/platforms in addition to sprinkler protection. Hose connections shall be 1 ½ inch with sufficient 1 ½ inch hose to provide fire protection for the stage/platform area. The hose connections shall be equipped with approved adjustable fog nozzles and be mounted in a cabinet. For small loops, antifreeze may be utilized if allowed by the authority having jurisdiction. Install piping, control valves, tamper switches, test stations, backflow preventers, expansion tanks, fill cup, drain valve, etc. as required by NFPA-13 and the authority having jurisdiction.
- M. Where combustible construction/materials are located above ceilings, provide above ceiling fire protection in accordance with N.F.P.A.-13.

1.3. DELIVERY, STORAGE AND PROTECTION

- A. Refer to Division 01 Section, General Requirements: Transport, handle, store, and protect products.
- B. Accept fire pumps and components on site in factory packing. Inspect for damage. Comply with manufacturer's rigging and installation instructions for all pumps, drives, and equipment.
- C. Protect fire pumps and components from physical damage including effects of weather, water, and construction debris.
- D. Provide temporary inlet and outlet caps, and maintain in place until installation.

1.4. EXTRA MATERIALS

- A. Provide one set of seals for each pump type and model supplied.
- B. Provide extra sprinklers under provisions of NFPA-13. Provide suitable wrenches for each sprinkler type and metal storage cabinet.
- C. Provide two (2) sets of spare cellophane bags for each paint spray booth sprinkler head.

1.5. PERMITS FROM THE AUTHORITY HAVING JURISDICTION AND FEES

- A. Pay all permits, fees, and charges required for this work.

1.6. HYDRANT FLOW TESTS

- A. The Fire Protection Contractor shall perform a hydrant flow test.

- B. The hydrant flow test shall be performed by the Fire Protection Contractor in the vicinity of each building at no additional cost to the Owner. Hydrant flow test shall be completed not more than 12 months prior to submission of the working plans.
- C. Where practical, tests shall be performed between 9:00 a.m. and 5:00 p.m. on a normal working day during summer. If conducting the test is impractical during these hours, then a local Fire Department representative shall be present to observe the test during off peak hours and to acknowledge the correctness of results.
- D. The tests shall be submitted for review prior to submitting any hydraulic calculations. The test data shall contain the following:
 - 1. Date of the test
 - 2. Who performed the test and who was present.
 - 3. Site plan indicating locations and diameters of water mains and locations of the hydrants tests.
 - 4. Grade elevation of the hydrant tests
 - 5. Static pressure in psig
 - 6. Flow in GPM
 - 7. Residual pressure in psig
 - 8. Hydrant butt size in inches
 - 9. Hydrant coefficient

1.7. ALTERNATES

- A. Refer to Division 01 Section, Alternates - Alternates for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. SPECIALTIES

- A. All sprinkler heads shall be U.L. listed and shall be of the same manufacturer throughout the building.
- B. Piping shall be in accordance with Division 21 Section, Fire Suppression System Piping, Fittings, Valves, etc. All exposed fire protection piping in unfinished areas shall be painted with red epoxy paint. White letters shall identify piping and indicate direction of flow. Exposed fire protection piping within finished areas shall be painted in color as determined by the Architect/Engineer.
- C. Shut-off valves shall be UL approved O.S. and Y. double disc gate valves or UL/FM approved grooved end butterfly valves.

- D. Check valves shall be swing check type or spring-loaded type UL approved for the application.
- E. Fire department connection shall be Potter-Roemer 5750 Series, Elkhart, American Fire Hose, Guardian, American Fire House & Cabinet, Elkhart Brass Mfg Co, Fire Protection Products, or approved equal, with individual drop clapper valves, plugs, and chains on each connection. Exposed parts shall be polished chrome plated. Threads shall match local Fire Department specifications. Where required by local Fire Department, provide Storz type Siamese connection. Escutcheon shall be lettered or AUTO SPRINKLER - STANDPIPE, as required. Locate as shown on drawings and connect to main fire line through check valve with ball drip. Discharge ball drip drain line as indicated on contract drawings. Type of fire department connection shall be determined by local fire department.
- F. Coordinate the fire protection systems with the fire alarm system specified under Division 26. Provide alarm initiating devices with proper contact arrangement. All electrical wiring shall be furnished and installed under Division 26.
- G. Flow control valve, alarm switches and valve supervision shall be furnished and installed under this Division. All wiring shall be accomplished by the electrical contractor, under Division 26. Provide any additional flow control valves, alarm switches, tamper switches and flow switches required by NFPA-13, but not indicated on contract drawings. Coordinate with the alarm system and electrical subcontractor.
- H. Pipe and fittings shall meet the requirements of NFPA 13, NFPA-20, and NFPA-24.
- I. Wet pipe alarm check valve shall be Victaulic UMC, Victaulic FireLock Series 751, Reliable Automatic Sprinkler Co., Tyco Fire Products, or approved equal. Valve shall be UL listed and FM approved for sprinkler systems with 300 psig maximum working pressure. Provide complete valve trim package including all necessary valves, gauges, fittings, nipples and alarm test. Valve internal components shall be replaceable without removing the valve from the installed position. Valve shall be installed in the vertical position only.
- J. Floor zone valve assemblies shall be Victaulic series UMC universal manifold check assembly or approved equal. Assemblies shall be suitable for pressures up to 300 psig. Furnish with control valves (butterfly or ball type) and proper right/left hand arrangement units shall include integrated check valve; universal test drain with adjustable relief valve, quick drain hose, vane type flow switch, pressure gauges, plugged ports and ductile iron construction. Assembly shall be U.L. listed and Fire Marshal approved.
- K. Retard Chamber shall be Victaulic Series 752. Retard Chamber shall be UL listed and FM approved. Chamber shall prevent false alarms with ordinary city water pressure surges.
- L. Water motor alarm shall be Victaulic Series 760, Globe Fire Sprinkler Corp., Tyco Fire Products, Viking Corp., or approved equal. Alarm shall be UL listed and FM approved. Alarm shall be hydraulically driven and tested 100 percent at low flow, 5 psig. Gong assembly and motor housing shall be finished with corrosion resistant, red enamel. Furnish unit with nylon bearings and inlet strainer. At contractor's option furnish and install electric gong. Install all power and control wiring under this Division of specifications.

- M. Stage/platform standpipe angle valves shall be Potter-Roemer 2500 series 1 ½ inch angle valve, brass body, brass mounting, inside screw rising stem, red handle, cap and chain. Provide unit with 50' hose length, 1 ½ inch valve size, and 1 ½ inch diameter polyflex hose. Provide each unit with fog nozzle as required. Valve cabinet shall be Potter-Roemer series fully recessed fire hose cabinet, 20 gauge white glossy polyester coated steel box, 20 gauge tubular steel door with 18 gauge frame. Door and frame finished with white prime polyester coating, provide with break glass steel door, cam catch, identify decal, recessed or surface mounted unit.
- N. Dry Pipe Valve and Air Compressor: UL 260; differential type; 175-psig (1200-kPa) working pressure; with cast-iron flanged inlet and outlet, bronze seat with O-ring seals, and single-hinge pin and latch design. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment. Minimum required air pressure is 13 psi with Series 776 low pressure actuator with pneumatic activation. Valve internal components shall be replaceable without removing the valve from the installed position and shall be externally resettable. Victaulic FireLock NXT Series 768.
1. Option: Grooved-end connections for use with keyed couplings.
 2. Air-Pressure Maintenance Devices: Automatic device to maintain correct air pressure in piping. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) maximum inlet pressure.
 3. Air Compressor: Fractional horsepower, 120-V ac, 60 Hz, single phase.
 4. Air Maintenance/Compressor Assembly: Consisting of a riser-mounted compressor, Series 757P air maintenance device and flexible hoses for installation. Assembly shall be designed to ensure the valve system can achieve operational air pressure within 30 minutes of discharge in accordance with NFPA 13 requirements. Where an accelerator is required, a tank-mounted compressor with a regulated air maintenance device should be used. Victaulic Series 7C7.

2.2. SPRINKLER HEADS

- A. Suspended Ceiling:
1. Manufacturer: Victaulic, Viking, Grinnell, Reliable, or approved equal.
 2. Sprinkler heads installed in suspended ceilings and drywall ceilings including bulkheads, shall be Victaulic Model V38 concealed response sprinkler or approved equal. Cover plate shall be finished with a polyester baked enamel finish. Color selection of cover plates shall be by the Architect. Submit color chart to Architect for color selection. Provide cover assembly with each head. Frangible glass bulb shall be temperature rated for specific area hazard.
- B. Exposed Area Type:
1. Manufacturers: Victaulic, Viking, Grinnell, Reliable, Gem or approved equal.

2. Sprinkler heads in unfinished or exposed areas without ceilings shall be Victaulic Model V27, or approved equal. These sprinklers shall be standard, ½ inch upright, pendant or conventional where required. Provide guards where hereinafter indicated. Sprinklers shall be brass with frangible glass bulb temperature rated for specific area hazard. Provide standard brass, screw on flat escutcheon plate.
- C. Sidewall type:
1. Manufacturers: Viking, Grinnell, Reliable, Gem, or approved equal.
 2. Sidewall sprinklers shall be quick response concealed horizontal sidewall type with matching cover plate. Sprinkler and escutcheon plate finish shall be custom color as selected by Architect. Fusible link shall be temperature rated for specific area hazard.
- D. Dry Sprinklers:
1. Manufacturers: Victaulic, Viking, Grinnell, Reliable, Gem or approved equal.
 2. Sprinkler heads for areas subject to freezing (walk-in boxes), small loading docks, and similar spaces shall be Victaulic Model V36 dry sprinkler or approved equal. Dry sprinkler shall be standard or expose pendant type with matching escutcheon plate. Sprinkler and escutcheon plate shall be chrome plated. Frangible glass bulb shall be temperature rated for specific area hazard. Length of heads shall be as required to suit field conditions. Provide adjustable surface mounted escutcheon plate with each head. Provide flush ceiling plate.
- E. Paint Spray Booth Sprinklers/Fire Protection:
1. Manufacturers: Reliable, Victaulic, Viking, Grinnell, Tyco, or approved equal.
 2. Sprinkler heads in the paint spray booth shall be dry-sprinklers with a minimum 286°F actuation temperature or as required by the paint spray booth manufacturer. Reliable Model F3QR80 dry, quick response heads or approved equal shall be provided. Furnish with white polyester finish with painted stainless steel escutcheons.
 3. All sprinkler penetrations shall be along the center lines of the filter rack supports. No fire protection pipe installation shall be allowed along floor inside paint spray booth cabin.
 4. Fire protection pipe penetrations of the paint spray booth envelope shall be sealed with Dow Corning 999 silicone building and glazing sealant or equivalent product meeting Federal Specification TT-S-001543A Class A for silicone building sealant and/or TT-S-00230C Class A for one component building sealant. Sealant shall be applied to the interior and exterior at pipe/sprinkler head penetrations.
 5. Paint spray booth sprinklers shall be provided with a zone valve assembly including alarm check valve, shut-off valve, tamper switch, test assembly and drain assembly.

6. Furnish and install cellophane bags per NFPA-13 at all paint spray booth sprinkler heads. Cellophane bags shall have a thickness of .003 inches or less.
- F. The temperature rating of the sprinklers shall be as required by N.F.P.A.-13 and or the authority having jurisdiction.
- G. All sprinkler heads installed in lay-in ceiling tiles shall be located in the center of the tile to provide a symmetrical, aesthetic and neat appearance. All sprinkler heads installed in bulkheads, recesses, and soffits shall be centered to provide a symmetrical, aesthetic and neat appearance.
- H. Provide extended escutcheons in rooms with surface mounted lighting fixtures.
- I. Additional heads shall be furnished as required by NFPA-13. The heads shall be in a cabinet designed to hold the heads and include one sprinkler head wrench for each type of sprinkler. Cabinet shall be mounted where indicated in the field.
- J. Head guards shall be provided in mechanical spaces, penthouses, janitors' closets, electrical rooms, fire pump rooms, auxiliary gymnasiums, gymnasiums, storage areas, elevator shafts, and elevator machine rooms. Finish for head guards in finished spaces shall be selected by the Architect.
- K. Sprinkler escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler, by the sprinkler manufacturer.
- L. Provide high temperature sprinkler heads for use adjacent to kilns, skylights, autoclaves, heaters, lights, or other high temperature areas.
- M. All sprinklers, piping, and pipe hangers installed in corrosive areas (locker rooms, chemical room...etc.) shall be provided with a protective coating.

2.3. FLEXIBLE SPRINKLER DROPS

- A. Stainless Steel Sprinkler Fittings
 1. Manufacturer: Victaulic VicFlex® or Grinnel.
 2. In lieu of rigid pipe offsets for concealed locations only, or return bend for sprinkler drops, the Victaulic VicFlex® stainless steel, multiple-use, sprinkler fitting system may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided or unbraided (corrugated) type 304 stainless steel flexible tube, a zinc-plated steel 1" NPT male threaded nipple for connection to branch-line piping, and a zinc-plated steel reducer with 1/2" or 3/4" NPT female thread for connection to the sprinkler head. Union joints shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate bracket. The braided drop system is FM approved for sprinkler services to 200 psi and can be installed without the use of tools, and the unbraided system is UL listed for sprinkler services to 175 psi.

2.4. SIGNS

- A. Provide 9 inch x 7 inch signs suspended from control valves which indicate the purpose of the valve and its normal position, Central Type A or approved equal.
- B. All control, drain, and test connection valves shall be provided with signs indicating purpose.
- C. Signs shall be fabricated of an approved material, painted red with white lettering.
- D. Sign shall have typed labels. Hand written labels shall not be acceptable.

2.5. DRAINS

- A. The sprinkler systems shall be arranged to be completely drainable. Means of drainage shall be provided with adequate protection from freezing.
- B. Drain valve may be combined with sprinkler alarm test valve and sight glass, G/J Innovations Sure-Test, Reliable Automatic Sprinkler Co., Tyco Fire Products, Victaulic, or approved equal. Valve shall be UL listed with positive off handle for off, test or drain, integral sight glass, orifice size equal to smallest sprinkler orifice and full 1 inch drain.

2.6. ALARM DEVICES

- A. Approved water flow switches shall be installed to activate the fire alarm, and annunciate sprinkler flow at a minimum on each floor, each system riser, [elevator shaft] where indicated on the contract drawings and where required by NFPA or the authority having jurisdiction. Conductors shall be provided under the electric division to provide fire alarm, and annunciation. Activation of the sprinkler system by one sprinkler or equivalent test shall cause the fire alarm system to activate, and the appropriate lamp(s) to activate on the annunciator. An approved test shall be provided for each water flow switch.
- B. All valves controlling water supply for sprinklers shall be electrically supervised in accordance with requirements of NFPA 13 and 72A, and provided under this Division. Provide separate valve chart for all fire protection valve indicating valve type, normal position, size, location and type of supervision insert in O&M manual and mount additional copies in fire pump room and mechanical rooms.
- C. Valve tamper switches shall be Model OSY2 as manufactured by System Sensor or Model OSYSU-A2 as manufactured by Potter Electric Signal Company or approved equal. The valve tamper switches shall monitor the open position of all OS&Y gate valves. Each tamper switches shall contain two sets of single pole double throw, Form C contacts. All valve tamper switches shall have tamper resistant covers that upon removal of the cover will cause the switches to operate. Tamper switches shall be suitable for 125/250 VAC @ 15 AMPS. All tamper switches shall be U.L. listed and F.M. approved.
- D. Pressure type flow switches shall be Model EPS 10 as manufactured by System Sensor or Model PS10-2 as manufactured by Potter Electric Signal Company, Tyco Fire Products, United Electric Controls, Viking Corp., or approved equal. Each pressure type flow switch shall contain two sets of single pole double throw switch contacts. All pressure type flow switches shall have tamper resistant covers that upon removal of the cover will cause the

switches to operate. Pressure type flow switches shall be suitable for 125/250 VAC @ 10 AMPS. All pressure type flow switches shall be U.L. listed and F.M. approved.

- E. Vane Type waterflow switch with retard shall be WFD Series as manufactured by System Sensor or Model VSR-F as manufactured by Potter Electric Signal Company, ADT Security Services, McDonnell & Miller, Viking Corp., Watts, or approved equal. The VAC type waterflow switches shall contain two single pole, double throw form C, snap return switches. All Vane type waterflow switches shall have tamper resistant covers that upon removal of the cover will cause the switches to operate. Vane type waterflow switches shall be suitable for 125/250 "AC" 10 AMPS. All vane type waterflow switches shall be U.L. listed and F.M. approved.

2.7. GAUGES

- A. A listed 3 ½ inch dial spring pressure gauge shall be connected to the top of each standpipe. Gauges shall be located in a suitable place to prevent freezing. Each gauge shall be controlled by a valve having arrangement for draining.
- B. Listed pressure gauges with connections not smaller than ¼ inch shall be installed at the system main drain, at each main drain associated with a floor control valve, and above and below each alarm check-valve.
- C. All pressure gauges shall be listed and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal and shall be located where they will not be subject to freezing.
- D. (Discharge Gauge on Fire Pump) A pressure gauge having a dial not less than 3 ½ inches in diameter shall be connected near the discharge casing with a ¼ inch gauge valve. The dial shall indicate pressure to at least twice the rated working pressure of the pump but not less than 200 psi. The face of the dial shall read in pounds per square inch with the manufacturers standard graduations. ITT A-C Pump or approved equal.
- E. (Suction Gauge on Fire Pump) A compound pressure and vacuum gauge having a dial not less than 3 ½ inches in diameter shall be connected to the suction pipe near the pump with a ¼ inch gauge valve. The face of the dial shall read in inches of mercury for the suction range. The compound gauge shall have a pressure range two times the rated maximum suction pressure of the pump, but not less than 100 psi. Compound gauges shall be ITT A-C Pump or approved equal.

2.8. DOUBLE DETECTOR CHECK VALVE BACKFLOW PREVENTER (FIRE PROTECTION SYSTEM)

- A. The sprinkler system backflow preventer shall be provided under this Division and coordinated with Plumbing Contractor. Backflow preventer shall be sized for sprinkler demand to limit pressure drop to 5 psig.
- B. Backflow preventers for Fire Protection Systems shall be ASSE/AWWA-1015 approved, double detector check-valve backflow preventer assemblies at sprinkler system water service connections. Units shall be specifically listed for Fire Protection use. Units shall be double detector check valve as manufactured by Watts 709 DCDA, Ames, Conbraco, Wilkens, or approved equal with OS&Y Gate valves, U.L. listed, F.M. approved, NSF-61

approved. Units shall be suitable for minimum 175 psi working pressure. Backflow preventers shall be factory tested at two (2) times the working pressure encountered or as required by N.F.P.A. Backflow preventer shall be capable of withstanding test pressures per N.F.P.A.

- C. Backflow preventer shall be factory finished with epoxy coated paint or shall be 304 stainless steel.
- D. Pipe any discharge openings full size, through air gap fittings, to nearest floor drain. Maintain clearances for servicing as required by Plumbing Code and authority having jurisdiction. Discharge piping shall be Type L copper pipe.
- E. Provide and install tamper switches on all backflow preventers OS&Y gate valves. Backflow preventer shall be installed between 12 inches and 60 inches above finished floor. Provide 18 inch clearance around backflow preventer for service and maintenance.
- F. Unit shall include auxiliary piping with approval backflow preventer and water meter. Meter shall indicate flow in gallons per minute.

2.9. VERTICAL IN-LINE ELECTRIC FIRE PUMP

- A. Furnish and install where indicated on the drawings ITT A-C, Peerless, Allis Chalmers, Aurora or approved equal, electric driven, vertical in-line, close coupled fire pump. The complete pumping unit shall be listed by Underwriters Laboratories, Inc. The entire pumping unit shall meet all requirements of National Fire Protection Association Pamphlet No. 20.
- B. The fire pump shall be designed to deliver the design flow with a total boost as determined by hydraulic calculations per NFPA-13 and NFPA-20. The Fire Pump Suction Piping shall be sized for minimum resistance to flow. Suction piping from street to fire pump shall be sized to prevent suction pressure at pump from dropping below 10 psig, when tested at 150 percent of nominal capacity. Pump suction piping size shall be as indicated on contract drawings or as required by NFPA-20, whichever is the larger of the two requirements.
- C. Type: UL 448 and UL 778 vertical, single stage, close coupled, direct connected, radially split casing, for 250 psi (1,720 kPa) maximum working pressure.
- D. Casing: Cast or ductile iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- E. Impeller: Bronze, fully enclosed, balanced and keyed to shaft.
- F. Shaft: Alloy steel with replaceable bronze shaft sleeve.
- G. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 230 degrees F (110 degrees C) maximum continuous operating temperature.
- H. Electrical characteristics shall be as indicated on contract drawings. Motor horsepower shall not exceed scheduled capacity. Motors shall be U.L. listed.

2.10. FIRE PUMP CONTROLLER

- A. Furnish and install for each fire pump, a Joslyn Clark or approved equal fire pump controller. Fire pump controller shall be service entrance rated, Wye-Delta Type, Closed Transition as manufactured by Joslyn Clark or approved equal.
- B. The fire pump controller shall be listed by Underwriters Laboratories and approved by Factory Mutual. The entire fire pump controller and accessories shall meet all requirements of National Fire Protection Association Pamphlet No. 20.
- C. The Wye Delta type reduced voltage starting method shall minimize inrush current. The starters shall be closed transition type in which the motor circuit is closed during the transition from start to run. Under a normal automatic start mode, the start contactors shall close connecting the motor to line in a wye connection. After approximately a 3 second time delay, the start contactors shall open and the run contactors shall close reconnecting the motor in a delta connection. During the transition, a contactor connects a resistor bank to keep the motor partially energized.
- D. The starting line current shall be reduced to 33.3 percent of across-the-line starting inrush and starting torque shall be approximately 33.3 percent of normal starting torque.
- E. The following standard equipment and performance features shall be provided with the fire pump controller:
 - 1. Disconnect Switch. Externally operable, quick break type.
 - 2. Circuit breaker; size to NFPA-20, minimum 65,000 amperes interrupting capacity.
 - 3. Neutral terminal lug(s).
 - 4. Grounding/bonding terminal lug(s).
 - 5. Automatic start responsive to a change in water pressure.
 - 6. Automatic stop with running period timer.
 - 7. Terminal board jumper provided for manual stop operation.
 - 8. Emergency start, by simply lifting the mechanical start handle.
 - 9. Locked rotor protection for drive motor protection.
 - 10. Voltage surge protection.
 - 11. Motor starter: Energized automatically through pressure switch or manually by external operable handle.
 - 12. Pressure Switch.
 - 13. Pilot lamp: Indicate circuit breaker closed and power available.

14. Test Accessories: Ammeter test link and voltmeter test studs.
 15. Alarm Relay: Energizes alarm to indicate circuit breaker open or power failure.
 16. Switch Relay: For remote start.
 17. Manual Selection Station: On enclosure marked "Automatic" and "Non-Automatic".
 18. Pressure recorder that shall operate for at least 7 days without resetting or rewinding.
 19. Integral service entrance rated automatic transfer switch.
 20. Stainless steel pressure transducer.
- F. The fire pump controller shall be constructed of heavy gauge formed steel, Type 2 enclosure with top dry hood and baked enamel red finish. The fire pump controller shall be mounted on leg supports and 4 inch high housekeeping pad.
- G. The following contactors for remote alarm shall be provided within the fire pump controller:
1. Pump running
 2. Loss of line power in any phase
 3. Phase reversal
 4. Generator power provided
- H. The fire pump controller shall be capable of and designed for operation at scheduled horsepower, voltage, and phase. The exact size of the fire pump controller shall be coordinated with the size of the fire pump. The fire pump controller shall be service entrance rated.

2.11. JOCKEY PUMP (PRESSURE MAINTENANCE PUMP)

- A. Furnish and install where indicated on the drawings one ITT-A-C, horizontal close coupled, regenerative turbine jockey pump. Jockey pump shall be capable of flowing a minimum flow of 5 GPM at a total dynamic head as determined by N.F.P.A.-20.
- B. The entire jockey pump shall meet all requirements of National Fire Protection Association Pamphlet No. 20. Provide relief valve for jockey pump where required by N.F.P.A.-20.
- C. Jockey pump shall be all bronze fitted with 303 stainless steel shaft and BUNA N "C" rings.
- D. Electrical characteristics shall be as indicated on the contract drawings. Motor horsepower shall not exceed scheduled capacity.

- E. Mount jockey pump on 4 inch high, concrete housekeeping pad.
- F. Control of automatic jockey pump controller with full voltage starter and minimum run timer to start pump on pressure drop in system and stay in operation for minimum period of time. Fire pump shall start automatically on further pressure drop or on jockey pump failure.

2.12. JOCKEY PUMP CONTROLLER

- A. Furnish and install, where indicated on the drawings, a Joslyn Clark Type JS & JC jockey pump controller. Jockey pump controller shall be across the line, full voltage, and of the automatic type. The jockey pump controller shall be U.L. listed and in full compliance with all requirements of National Fire Protection Association, Pamphlet No. 20.
- B. The jockey pump controller shall be furnished complete with service entrance rated, fusible disconnect, control transformer, and pressure switch.
- C. The following standard Equipment and Performance features shall be provided with the jockey pump controller:
 - 1. Automatic start responsive to water pressure, with integral pressure sensing switch.
 - 2. Independent "high" and "low" adjustment points on pressure switch.
 - 3. HOA (Hand-Off-Auto) selection switch.
 - 4. Magnetic motor starter with thermal overload relay to provide 3-line overload protection.
 - 5. Fusible disconnect, switch combination with power fuser.
 - 6. External operator, equipped for pad locking in "OFF", which also locks the door closed.
 - 7. External pressure switch connector.
 - 8. NEMA 2 Enclosure.
 - 9. Running period timer.
 - 10. Full voltage starter.
 - 11. Pilot Lamps/Lights
- D. The jockey pump controller shall be capable of and designed for jockey pump scheduled horsepower, voltage, and phase. The exact size of the jockey pump controller shall be coordinated with the size of the jockey pump.

2.13. AUTOMATIC BALL DRIP VALVES

- A. Provide and install automatic ball drip valves at both the Fire Department connection and the hose header test connection. Discharge ball drip valves to closest floor drain or building exterior as required with suitable air gap. Automatic ball drip valves shall be ITT-AC Pump, Reliable Automatic Sprinkler Co., Tyco Fire Products, or approved equal.

2.14. HOSE HEADER MANIFOLD VALVES

- A. Provide and install approved hose header manifold with size and quantity of National Standard male hose threads as required by NFPA-20, with cap and chain. Unit shall be complete with 2 ½ inch valves in quantity as required by NFPA-20. Locate unit with center line at 3 feet above grade in the horizontal position. Connect to fire pump system through a normally closed, listed, OS&Y gate valve. Provide and install escutcheon at test header manifold lettered with "Fire Pump Test Header". Provide automatic ball drip and discharge to closest floor drain. Hose header manifold and valves shall be ITT A-C Pump or approved equal.

2.15. MAIN RELIEF VALVE

- A. Provide and install a main relief, UL 1478 as indicated on contract drawings. Discharge main relief valve outside of pump house. Provide concrete splash block at main relief valve discharge. Main relief valves shall be sized, set, and installed per N.F.P.A.-20. Main relief valve shall be ITT A-C Pump, Watts, Cla-val or approved equal.

2.16. AUTOMATIC AIR RELEASE VALVE

- A. Provide and install a ¾ inch automatic air release valve as shown on the contract drawings and in accordance with N.F.P.A.-20. Automatic Air Release valves shall be ITT A-C Pump or approved equal.

2.17. CIRCULATION RELIEF VALVE

- A. Provide and install a ¾ inch circulation relief valve as shown on the contract drawings and in accordance with N.F.P.A.-20. Discharge circulation relief valve into closest floor drain with suitable air gap. Circulation relief valve shall be ITT A-C Pump or approved equal.
- B. Where a flow meter test loop is installed, furnish and install an additional circulation relief valve.

2.18. VALVES

- A. Provide and install control valves as indicated on contract drawings and as required by N.F.P.A.-13, and N.F.P.A.-14. Gate valves shall be listed O.S. & Y. type. All control valves shall be supervised open except test outlet control valve which shall be supervised closed. Supervision shall be as required by N.F.P.A.-13 and N.F.P.A.-14. Victaulic Series 705 and 765 grooved end butterfly valves shall be supervised in the open position and Victaulic Series 707 and 766 shall be supervised closed, for fire pump metering test lines for NFPA 20, as well as pressure reducing valve by-pass lines per NFPA-14.

- B. Eccentric suction reducer and OS&Y gate valve on suction side of pump.
- C. Concentric increaser and check valve in pump discharge and OS&Y gate valve on system side of check valve.

2.19. FIRE PUMP BYPASS

- A. Where required by NFPA-20 and/or the authority having jurisdiction provide and install a fire pump bypass fitted with OS&Y gate or butterfly valves and check valves.

2.20. FLOW METERING SYSTEM

- A. Where required by NFPA-20 and/or the authority having jurisdiction provide and install a flow metering system for closed loop testing in addition to test header piping.
- B. Fire Pump Test Meters: Grooved end calibrated Venturi meter manufactured of carbon steel zinc electroplate body, brass needle valve conforming to ASTM B124 with attached GPM meter. Minimum straight pipe installation of five diameters upstream and two diameters downstream. Victaulic Series 735.

2.21. STANDPIPE HOSE VALVES

- A. Standpipe angle valve shall be Potter Roemer 4020 series, Class I, 2½ inch angle valve, brass body, brass mounting, inside screw rising stem, red handle, cap and chain, pressure regulating up to 100 psig inlet pressure. Match threads to local fire department.

2.22. STANDPIPE VALVE CABINETS

- A. Valve cabinets shall be fully recessed or surface mounted as indicated, Potter Roemer, 20 gauge steel cabinet, white polyester finish with continuous hinge, steel door with lockable handle, and glass door. Standpipe valve cabinets shall be rated for installation in stairwell, fire rated wall. Valve cabinet locks shall match requirements of local Fire Department keys. Keys shall be located in exterior lock box. Coordinate with local Fire Department.
- B. Pressure regulating fire department valve cabinet shall be the 1810 series as manufactured by Potter-Roemer, Larsens or approved equal.
- C. Coordinate surface or recessed mounting with Contract Drawings.

2.23. BLIND FLANGE FOR FORWARD FLOW TESTING OF BACKFLOW PREVENTER

- A. A blind flange with normally closed control valve shall be provided for use in forward flow testing of backflow preventer. Blind flange shall be sized to flow entire system demand in accordance with NFPA-13 and NFPA-25, latest edition. Control valve shall be monitored with tamper switch.
- B. Identify and label blind flange Backflow Preventer Test Connection to differentiate fitting on exterior wall from Fire Department connection.
- C. Install ball drip in test pipe to allow drainage and prevent freezing.

PART 3. EXECUTION

3.1. GENERAL INSTALLATION REQUIREMENTS

- A. Install equipment in accordance with manufacturers' instructions.
- B. Where required, install buried shut-off valves in valve box. Provide post indicator.
- C. Provide approved double detector check valve assembly at sprinkler system water source connection.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent fire department connections to allow full swing of fire department wrench handle.
- E. Locate outside alarm gong on building wall.
- F. Place pipe runs to minimize obstruction to other work.
- G. Place piping in concealed spaces above finished ceilings.
- H. Center sprinklers in two directions in ceiling tile and provided piping offsets as required.
- I. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- J. Flush entire piping system of foreign matter.
- K. Install guards on sprinklers where specified.
- L. Hydrostatically test entire system.
- M. Require test be witnessed by Fire Marshal/authority having jurisdiction/ Owner's insurance underwriter and Architect/Engineer.
- N. Refer to plumbing floor plans for approximate locations of sprinkler zones control valve assemblies and routing of fire protection mains.
- O. Locate inspectors test stations for sprinkler zones per NFPA-13. Provide and install drain piping from all approved terminations. Provide splash blocks for terminations outside. Splash block locations shall be approved by the Architect.
- P. The fire protection contractor shall hydraulically prove the most remote area per NFPA-13.
- Q. Coordinate locations of sprinkler heads with lights, diffusers, ceiling types, etc.
- R. Hydrostatically test system at 200 PSI for 4 hours, per NFPA-13.
- S. Provide and install class III standpipe hose valves on each side of stage/platform per NFPA-13, NFPA-101, NFPA-14 and the International Building Code provide indicating

control valve for each hose valve.

- T. Provide dry pipe sprinklers at all loading docks, canopies, paint spray booths, walk-in freezers, etc., as required by NFPA-13.
- U. Provide sprinklers above and below specialty ceilings with clouds and perforations.
- V. Refer to Architectural Drawings for exact location and extent of all fire rated walls and smoke barriers.
- W. Sprinkler shall be provided at top and bottom of the elevator shaft as per NFPA-13, latest edition.
- X. The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.
- Y. A separate control valve with tamper switch shall be installed for the top and bottom of the elevator shaft and elevator machine room.
- Z. Grooved joint piping systems shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealings.

3.2. INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

3.3. FIRE PUMP INSTALLATION REQUIREMENTS

- A. Install in accordance with NFPA-20.
- B. Provide access space around pumps for service, no less than minimum as recommended by manufacturer.
- C. Install piping in accordance with Division 21 Section, Fire Suppression System Piping, Fittings, Valves, etc. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports under elbows on pump suction and discharge.
- D. Provide drains from bases and seals, piped to and discharging in floor drains.
- E. Mount fire pump on vibration isolators and 4 inch high concrete housekeeping pad. Grout pump base with non-shrink grout.
- F. Provide for connection to electrical service. Refer to Division 26.

- G. Lubricate pumps before start-up.
- H. Check, align, and certify fire pumps and pressure maintenance pumps by qualified millwright prior to start-up.
- I. Perform flow test on entire system in accordance with NFPA-20.
- J. Require test to be witnessed by Fire Marshal, authority having jurisdiction, Owner's insurance underwriter, Architect/Engineer.
- K. Demonstrate automatic operation of system including verification of pressure switch set points.
- L. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- M. Set pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 - 1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between pump base and concrete base for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.
- N. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
- O. Perform field tests for each fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump performs as indicated. Verify operation of fire pump when emergency power is "on".
- P. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:
 - a. Lubricate oil-lubrication-type bearings.
 - b. Remove grease-lubrication-type bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.

- d. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
- 3. Starting procedure for pumps is as follows:
 - a. Prime pump by opening suction valve and closing drains, and prepare pump for operation.
 - b. Open sealing-liquid supply valves if pump is so fitted.
 - c. Start motor.
 - d. Open discharge valve slowly.
 - e. Observe leakage from stuffing boxes and adjust sealing-liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately, but let packing run in before reducing leakage through stuffing boxes.
 - f. Check general mechanical operation of pump and motor.
- 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- 5. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.
- Q. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps, drivers, controllers, and pressure-maintenance pumps. Refer to Division 01 Section, Closeout Procedures and Demonstration and Training.

3.4. STANDPIPE AND HOSE VALVE INSTALLATION REQUIREMENTS

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA-14.
- C. Locate and secure cabinets plumb and level. Establish top of cabinet surface 66 inches above finished floor.
- D. Locate hose station valve in cabinet at 60 inches above floor. Locate hose connection valve below hose station valve and not closer than 4 inches from side or bottom of cabinet.
- E. Where static pressure exceeds 100 psi but is less than 100 psi at any hose station, provide pressure orifice disc in discharge of hose station valve to prevent pressure on hose exceeding 90 psi.
- F. Where static pressure exceeds 100 psi at any hose station, provide pressure reducing valve to prevent pressure on hose exceeding 90 psi.
- G. Where required by Code or Fire Marshal, provide two way fire department outlet connection on roof.

- H. Flush entire system of foreign matter.
- I. Install control valves on each standpipe riser and pressure gauges at the top of each standpipe.

3.5. LAYOUT

- A. Coordinate layout and installation of fire protection system with all other buildings structural, mechanical and electrical work. Locate sprinkler heads symmetrically with respect to ceiling tiles, lighting fixtures, registers, grilles, diffusers, etc. Provide piping offsets as required to maintain symmetry. Note that a preliminary sprinkler layout is to be submitted for review. Contractor is cautioned that sprinkler mains must be located to prevent conflict with other work and in any case, sprinkler contractor shall be responsible for coordination of his work with work of other trades.
- B. Unless otherwise indicated, the entire building including pump room shall be protected throughout with a wet pipe sprinkler system. Where required by NFPA-13 and/or the authority having jurisdiction, install sprinkler heads above and below ceilings.

3.6. WET PIPE SPRINKLER SYSTEM

- A. System components shall, but not be limited to include flow control valves, electrical connection to central fire alarm system, fire department connection, check valves, main piping, branch piping, inspector's test, drains, sprinkler heads, hose valves and cabinet, ball drip valves, signs, fire pump, jockey pumps, controllers, etc. and all other incidental appurtenances as required.
- B. Entire fire pump room shall be fully sprinklered.

3.7. DRY PIPE SYSTEM

- A. All non-heated areas or any location where water will freeze shall be protected throughout with a dry pipe sprinkler system.
- B. System components shall include, but not be limited to flow control valves, electrical connection to central fire alarm system, dry pipe alarm valve, dry pipe air compressor, check valves, main piping, branch piping, inspectors test drains, dry pipe sprinkler heads, signs, relief valve, air maintenance device, automatic drain, accelerator, sensing line, pressure switch, flexible hose, etc., and all other incidental appurtenances as required.

3.8. VALVE INSTALLATION

- A. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
- B. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
- C. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain-line connection.

- D. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - 1. Air-Pressure Maintenance Devices for Dry-Pipe Systems: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
 - 2. Install air compressor and compressed-air supply piping.
- E. Do not install any control valves other than an OS&Y gate valve within 50 feet of the fire pump suction.
- F. Install supervised control valve on test header piping and interlock with fire alarm system.

3.9. CONNECTIONS

- A. Connect water supplies to standpipes and sprinklers. Include backflow preventers.
- B. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- C. Connect piping to specialty valves, specialties, fire department connections, and accessories.
- D. Connect alarm devices to fire alarm.
- E. Connect compressed-air supply to dry-pipe sprinkler piping.
- F. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire alarm system devices, including low-pressure alarm.
 - 4. Test automatic transfer switch, all remote alarms, and interface with emergency generator.
- G. Test automatic transfer switch, all remote alarms, and interface with emergency generator.

3.10. COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that air compressors and their accessories are installed and operate correctly.
- C. Verify that specified tests of piping are complete.

- D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- F. Verify that potable-water supplies have correct types of backflow preventers.
- G. Drain dry-pipe sprinkler piping.
- H. Pressurize and check dry-pipe sprinkler piping air-pressure maintenance devices and air compressors.
- I. Verify that fire department connections have threads compatible with local fire department equipment
- J. Fill wet-pipe sprinkler piping with water.
- K. Energize circuits to electrical equipment and devices.
- L. Start and run air compressors.
- M. Adjust operating controls and pressure settings.
- N. Coordinate with fire alarm tests. Operate as required.

3.11. DRAINS

- A. The sprinkler system shall be arranged to be completely drainable. Means of drainage shall be provided with adequate protection from freezing.

3.12. TESTS

- A. The sprinkler systems installation shall be hydrostatically tested, inspected, and approved, in accordance with NFPA Standard No. 13, NFPA Standard No. 14, NFPA Standard No. 20 and N.F.P.A. Standard No. 25. Test certificate shall be forwarded to the Office of the State Fire Marshal and the Architect as proof of compliance.
- B. Tests shall be performed in accordance with the requirements of the Office of the State Fire Marshal and shall prove the systems to be adequate and satisfactory in every respect. All tests shall be performed in the presence of the State Fire Marshal or his representative.
- C. Any deficiencies revealed by these tests shall be corrected and the systems shall be retested until acceptable results are obtained.
- D. Fire Protection Contractor shall provide all equipment and water necessary for testing the fire pump, and associated equipment.

3.13. AS-BUILT DRAWINGS & PROJECT CLOSEOUT

- A. Provide separate as-built drawings of all fire protection systems meeting requirements of

Division 21 Section, Common Work Results for Fire Protection Systems herein before specified.

- B. At the completion of the work, provide a sealed plan of the building indicating the locations of all control valves, low point drains, flow switches, and Inspectors Test Stations. The plan shall be neatly drawn and color coded to indicate the portion of the building protected by each system, framed under glass and permanently mounted on the wall adjacent to the system header.
- C. Include manufacturers' literature, cleaning procedures, replacement parts, lists, and repair data for pumps, drivers, controllers, and equipment.
- D. Include manufacturers' instructions, start-up data, troubleshooting, checklists for pumps, drivers, controllers and equipment.
- E. Include a list of recommended spare parts and lubricants.

3.14. WARRANTY

- A. The Contractor's attention is directed to the warranty obligations contained in the Article of the General Conditions of the specifications entitled "Warranty".

3.15. OWNER TRAINING

- A. Upon completion of the project, furnish a complete copy of NFPA-25 and NFPA-20 to Owner. Provide correspondence indicating that the pamphlets have been turned over to the Owner.
 - 1. Contractor shall provide at least eight (8) hours of training to the Owner on the proper inspection, testing, and maintenance of the installed fire protection system.
 - 2. Schedule training with the Owner through the Architect and/or Engineer with at least seven (7) days prior notice.
 - 3. A Victaulic factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

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DIVISION 22 SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING
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**SECTION 220500
COMMON WORK RESULTS FOR PLUMBING**

PART 1. GENERAL

1.1. SUMMARY

- A. All work under Division 22 is subject to the Division 01, General Requirements, the General Conditions and Supplementary Conditions.
- B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all plumbing work.
- C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.
- D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with Submittals specified below. The right is reserved to make reasonable changes in location of equipment, piping, up to the time of rough-in or fabrication.
- E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.
- F. Coordinate the work under Division 22 with the work of all other construction trades.
- G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

1.2. PERMITS AND FEES

- A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.
- B. Permits and fees shall comply with the Division 01, General Requirements of the specification.

1.3. EXAMINATION OF SITE

- A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for contractors failure to do so.
- B. Examine and verify specific conditions described in individual specifications sections.

- C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.4. CONTRACTOR QUALIFICATION

- A. Any Contractor or Subcontractor performing work under Division 22 shall be fully qualified and acceptable to the Architect and Owner. Submit the following evidence when requested:
 - 1. A list of not less than five comparable projects which the Contractor completed.
 - 2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.
 - 3. Local and/or State License, where required.
 - 4. Membership in trade or professional organizations where required.
- B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.
- C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.5. MATERIALS AND EQUIPMENT

- A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality.
- B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.
- C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.
- D. Substitution will not be permitted for specified items of material or equipment where noted.
- E. All items of equipment furnished shall have a service record of at least five (5) years.

1.6. FIRE SAFE MATERIALS

- A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA and ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

- A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.
- B. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
- C. ASME - American Society of Mechanical Engineers
- D. ASPE - American Society of Plumbing Engineers
- E. ASTM - American Society for Testing and Materials
- F. AWWA - American Water Works Association
- G. ASME CSD-1 - American Society of Mechanical Engineers Controls and Safety Devices for Automatically Fired Boilers
- H. CAGI - Compressed Air and Gas Institute
- I. CS - Commercial Standard
- J. CSD - Control and Safety Devices
- K. DNREC - Delaware Department of Natural Resources and Environmental Control
- L. FM - Factory Mutual
- M. IBC - International Building Code
- N. IEEE - Institute of Electrical and Electronics Engineers
- O. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
- P. NEC - National Electrical Code
- Q. NEMA - National Electrical Manufacturers Association
- R. NSF - National Sanitation Foundation
- S. UL - Underwriters' Laboratories

- T. All plumbing equipment and materials shall comply with the codes and standards listed in the latest edition of ASHRAE HVAC Applications Handbook, Chapter entitled Codes and Standards.

1.8. SUBMITTALS, REVIEW AND ACCEPTANCE

- A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect to be in best interest of Owner.
- B. After acceptance of Material and Equipment List, submit six (6) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.
- C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.
- D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.
- E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.
- F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.
- G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.
- H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.
- I. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.9. SHOP DRAWINGS

- A. Prepare and submit shop drawings for all plumbing equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.
- B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.
- C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.
- D. Items and Systems
 - 1. Access Doors/Panels including layout and location
 - 2. Air Compressors
 - 3. Automatic Temperature Control System and Equipment as it relates to plumbing system
 - 4. Sink Plaster Traps
 - 5. Backflow Preventers
 - 6. Backwater Valves
 - 7. Bubblers
 - 8. Compressed Air Filters
 - 9. Compressed Air Regulators
 - 10. Compressed Air Drain Traps
 - 11. Compressed Air Solenoid Valves and Valve Boxes
 - 12. Compressed Air Quick Disconnects
 - 13. Compressed Air Hose Reels
 - 14. Coordinated Drawings
 - 15. Condensate Neutralizers
 - 16. Dental Equipment and Piping
 - 17. Direct Buried Piping

18. Domestic Booster Pumps
19. Domestic Water Expansion Tanks
20. Domestic Water Solenoid Valves
21. Drain Valves
22. Drip Pans
23. Elevator Sump Pumps
24. Emergency Fixtures & Thermostatic Mixing Valves
25. Equipment Rails
26. Exterior Equipment/Piping Supports
27. Exterior Pipe Roller Support
28. Fire Stopping - Methods and Materials
29. Floor and Roof Drains
30. Gas Fired Domestic Water Heaters
31. Gas Flexible Hoses
32. Gas Pressure Regulating Valves
33. Gas Quick Disconnect Valves
34. Gas Solenoid Valves and Valve Boxes
35. High/low Mixing Valves
36. Hose Bibbs and Wall Hydrants
37. Identification System
38. In-Line Circulators
39. Interceptors
40. Makeup Water Meters
41. Material and Equipment List
42. Nitrogen Piping Systems
43. Operations and Maintenance Manuals

44. Pipe Enclosures
45. Pipe Guides and Anchors.
46. Pipe Materials Including Itemized Schedule
47. Plumbing Fixtures & Trim
48. Preliminary Testing and Balancing Report
49. Pre-Pressurized Hydro-Pneumatic Tanks
50. Pressure/Temperature Relief Valves
51. Pressure Regulating Valves
52. Pumps
53. Refrigerated Air Dryers (for compressed air systems)
54. Roof Curbs
55. Roof Drains
56. Roof Hydrants
57. Screenshots of ATC System Graphics
58. Section Valves - Lab Utilities
59. Shock Absorbers
60. Solenoid Valves
61. Strainers
62. Test Certificates
63. Thermal Insulation Materials Include Table Summary
64. Thermometers and Gauges
65. Thermostatic Mixing Valves
66. Trap Priming Station/Valves/Mini Primer
67. Underground Pre-Fabricated Piping Systems
68. Vacuum Breakers
69. Valves

- 70. Variable Frequency Drive Motor Bearing Protective Rings
 - 71. Variable Speed Drives
 - 72. Vibration Isolation Materials
 - 73. Water Meters
 - 74. Weatherproof Assembly Components
 - 75. Water Filters
 - 76. Wiring Diagrams, Flow Diagrams and Operating Instructions
- E. Contractor, additionally, shall submit for review any other shop drawings as required by the Architect. No item shall be delivered to the site, or installed, until the Contractor has received a submittal from the Engineer marked Reviewed or Comments Noted. After the proposed materials have been reviewed, no substitution will be permitted except where approved by the Architect.

1.10. SUPERVISION AND COORDINATION

- A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.
- B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, equipment, and other work performed under Division 22.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- D. Coordinate electrical work required under Division 22 with that under Division 26. Coordinate all work under Division 22 with work under all other Divisions.
- E. Supply services of an experienced (10 years minimum) and competent Project Manager to be in constant charge of work at site.
- F. Where a discrepancy exists within the specifications or drawings or between the specifications and drawings, the more stringent (or costly) requirement shall apply until clarification can be obtained from the Engineer. Failure to clarify such discrepancies with the Engineer will not relieve the Contractor of the responsibility of conforming to the requirements of the Contract.
- G. Failure of contractor to obtain a full and complete set of contract documents (either before or after bidding) will not relieve the contractor of the responsibility of complying with the intent of the contract documents.
- H. Coordinate installation of large equipment requiring positioning before closing in building.

1.11. CUTTING AND PATCHING

- A. Accomplish all cutting and patching necessary for the installation of work under Division 22. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and work-manlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.
- B. Do not cut structural members without approval from the Architect or Engineer.

1.12. PENETRATION OF WATERPROOF CONSTRUCTION

- A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.
- B. Where plumbing vents or other pipes penetrate roofs, flash pipe with Stoneman Stormtite, Pate or approved equal, roof flashing assemblies with skirt and caulked counter flashing sleeve.
- C. Furnish and install pitch pockets or weather tight curb assemblies where required.
- D. Furnish and install roof drains, curbs, and vent assemblies specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions. The Contractor shall be responsible for sleeve sizes and locations. All roof penetrations shall be installed in accordance with manufacturer's instructions, the National Roofing Contractors Association, SMACNA, and as required by other divisions of these specifications.

1.13. CONCRETE AND MASONRY WORK

- A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 22. Perform work in accordance with requirements of other applicable Divisions of these specifications.
- B. Concrete shall test not less than 3,000 psi compressive strength after 28 days.
- C. Grout shall be non-shrink, high strength mortar, free of iron chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in accordance with manufacturer's instructions and standard grouting practices.

1.14. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

- A. Unless otherwise noted on the drawings, where existing plumbing work is removed all pipes, valves, etc., shall be removed, including hangers, to a point below finished floors or behind finished walls and capped. Such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.
- B. Where work specified in Division 22 connects to existing equipment, piping, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and

to leave completed work in a finished and workmanlike condition.

- C. Where the work specified under Division 22, or under other Divisions, requires relocation of existing equipment, piping, etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition. Where existing insulation is disturbed, replace insulation where removed or damaged equal to existing, in type, thickness, density, finish and thermal resistance (R-value) value.
- D. Where the relocation of existing equipment is required for access or the installation of new equipment, the contractor shall temporarily remove and/or relocate and re-install as required to leave the existing and new work in a finished and workman like condition.

1.15. EXCAVATION AND BACKFILLING

A. GENERAL

- 1. Perform all necessary excavation, or installation of work under Division 22, in whatever materials or conditions encountered, using suitable methods and equipment.
- 2. Accurately establish required lines and grades and properly locate the work.
- 3. Determine the locations of all existing utilities before commencing the work.

B. Excavation: (Refer also to other portions of the specifications)

- 1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
- 2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.
- 3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling: (Refer also to other portions of the specifications)

- 1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
- 2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
- 3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
- 4. Do not backfill against frozen material. Do not use frozen material for backfill.

1.16. DRIVE GUARDS

- A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.
- B. When available, guards shall be factory fabricated and furnished with the equipment. Otherwise fabricate guards of heavy gauge steel, rigidly braced, removable, and finish to match equipment served. Provide openings for tachometers. Guards shall meet local, State and O.S.H.A. requirements.

1.17. VIBRATION ISOLATION

- A. Furnish and install vibration isolators, flexible connections, supports, anchors and/or foundations required to prevent transmission of vibration from equipment, or piping to building structure. See Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection.

1.18. ALTERNATES

- A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

1.19. DEFINITIONS

- A. Approve - to permit use of material, equipment or methods conditional upon compliance with contract documents requirements.
- B. Furnish and install or provide means to supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.
- C. Contractor means the mechanical contractor and any of his subcontractors, vendors, suppliers, or fabricators.
- D. Piping includes pipe, all fittings, valves, hangers, insulation, identification, and other accessories relative to such piping.
- E. Concealed means hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction.
- F. Exposed means not installed underground or concealed as defined above.
- G. Invert Elevation means the elevation of the inside bottom of pipe.
- H. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.
- I. Review - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.
- J. ECM: Electronically Commutating Motor.

- K. Building Line: Exterior wall of building.

1.20. MINIMUM EFFICIENCY REQUIREMENTS

- A. All plumbing equipment shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.
- B. All piping and equipment insulation shall comply with ASHRAE Standard 90.1, latest edition.
- C. All service water/heating equipment shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.
- D. All plumbing devices, controls, accessories, and components shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.
- E. Department of Energy (DOE) compliance: Pump manufacturers shall comply with US Department of Energy (DOE) energy conservation standard for “clean water pumps” 1-200 horse power, less than 459 feet of head and greater than 25 gpm. These pumps shall be evaluated using the Pump Energy Index (PEI) of equal to or lesser than 1.0. The PEI number shall appear on the pump name plate and available for the record at <http://er.pumps.org>.
- F. Where Energy Star certification exists for equipment utilized on this project, the equipment must be Energy Star certified. Provide Energy Star certification with submittals.

1.21. FUTURE ADDITIONS

- A. Where future additions are indicated, install all piping to account for future additions. Furnish and install shut-off valve in ceiling adjacent to future additions. Provide cap at the end of the piping. Arrange so that in the future the cap can be removed and shut-off valve opened to serve future addition without draining system. Install bypass with balance valve and shut-off valve on domestic recirc system. Balance to future flow rate and then shut the bypass balance valve.

1.22. SYSTEM INTEGRATION

- A. For all plumbing equipment specified to be provided with packaged controls and interfaced with the automatic temperature control system, provide system integration between the equipment manufacturer and the automatic temperature control subcontractor.
- B. Plumbing equipment submittals requiring system integration as defined above must identify all required system integration points.
- C. Plumbing equipment manufacturers must coordinate with ATC subcontractor regarding system integration prior to submitting on the equipment.
- D. A system integration meeting must be arranged by the Mechanical Contractor and include, but not be limited to the systems integrator for the plumbing equipment manufacturer and the ATC Subcontractor. This portion of systems integration must occur prior to plumbing

equipment being delivered to the project.

- E. Once the plumbing equipment is on site, a second systems integration meeting must be arranged by the Mechanical Contractor to coordinate the packaged controls with the ATC system. The plumbing equipment manufacturer's representative familiar with system integration and the ATC subcontractor familiar with programming must be present.
- F. A final system integrations meeting shall occur once all equipment is in place and ready for operation. The Mechanical Contractor, the plumbing equipment systems' integrator, and the ATC Subcontractor shall meet on site to jointly program, schedule, verify points, interlock devices, and fully set up all systems integration components.
- G. All systems integration coordination, programming, and graphics must be completed prior to requesting commissioning and/or inspections by the Engineer of Record.

1.23. LEAD FREE REQUIREMENTS

- A. All plumbing fixtures, equipment, and devices that contact potable water must be lead free per the State requirements. Potable water systems shall also comply with NSF 61 – Annex G and NSF-372.

1.24. COORDINATION WITH NEW CASTLE COUNTY VOCATIONAL TECHNICAL SCHOOL DISTRICT I.T. DEPARTMENT

- A. All equipment that interfaces with the internet shall be coordinated with the New Castle County Vocational Technical School District I.T. Department to verify that the same is suitable for use on the New Castle County Vocational Technical School District IT infrastructure. Coordinate with the New Castle County Vocational Technical School District I.T. Department regarding the allowable frequency bands to avoid interference with the New Castle County Vocational Technical School District I.T. infrastructure.

1.25. EXTRA MATERIALS

- A. Provide one set of seals for each type and model of pump provided on the project.

PART 2. ELECTRICAL REQUIREMENTS

2.1. GENERAL MOTOR AND ELECTRICAL REQUIREMENTS

- A. Furnish and install control and interlock wiring for the equipment furnished. In general, power wiring and motor starting equipment will be provided under Division 26. Carefully review the contract documents to coordinate the electrical work under Division 22 with the work under Division 26. Where the electrical requirements of the equipment furnished differ from the provisions made under Division 26, make the necessary allowances under Division 22. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 22.
- B. All electrical work performed under Division 22 shall conform to the applicable requirements of Division 26 and conforming to the National Electrical Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA & International Building Code.

- C. Provide wiring diagrams with electrical characteristics and connection requirements.
- D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than five (5) horsepower.
- E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering. For extended outdoor storage, remove motors from equipment and store separately.
- F. All motors shall be furnished with visible nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor and efficiency.
- G. Motors located in exterior locations, wet air streams and outdoors shall be totally enclosed weatherproof epoxy-treated type.
- H. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- I. Brake horsepower load requirement at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors.
- J. All single phase motors shall be provided with thermal protection: Internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature ratings of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.
- K. Where a motor disconnect is indicated downstream of a variable frequency drive (VFD) provide interlock wiring from the auxiliary contacts on the disconnect to the VFD to de-energize when the disconnect is turned "off".
- L. Where equipment under this Division is specified with integral disconnecting means, the same shall be a single disconnecting means for disconnecting all ungrounded main power supply conductors that is capable of being locked in the open ("off") position in accordance with the National Electrical Code and the local electrical inspector.

2.2. MOTORS AND CONTROLS

- A. Motors and controls shall conform to the latest requirements of IEEE, NEMA, NFPA-70 and shall be UL listed. Motor sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.
- B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG 1.
- C. Motors used with variable-frequency controllers shall have ratings, characteristics, and features coordinated with and approved by the variable frequency controller (drive)

manufacturer. As a minimum the following shall apply to variable frequency controlled motors:

1. Motors shall be manufactured to withstand peak voltages of 1600 volts with .1 microsecond rise time per NEMA MG-1.
2. Critical vibration frequencies of motor shall not be within operating range of variable frequency controller output.
3. Temperature rise: Match rating for Class B insulation.
4. Insulation: Class F.
5. Thermal Protection: Conform to MG1 requirements for thermally protected motors.

D. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.

1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplates.
2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overloading, exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR2 of the driven equipment to operating speed.
3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.
4. Motors shall be designed for operation on 60 hertz power service. Unless otherwise specified or shown, motors less than ½ horsepower shall be single phase, and motors ½ horsepower and larger shall be 3 phase unless otherwise noted.
5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.

E. Single phase motors, smaller than 1/20 horsepower shall be ball or sleeve bearing; drip-proof, totally enclosed or explosion proof, as specified; 120 volts; permanent-split capacitor or shaded pole type. These motors shall not be used for general power purposes, and shall only be provided as built-in components of plumbing equipment. When approved by the Engineer, deviations from the specifications will be permitted as follows:

1. Open motors may be installed as part of an assembly where enclosure within a cabinet provides protection against moisture.

2. Motors used in conjunction with low voltage control systems may have a voltage rating less than 115 volts.
- F. Single phase motors, greater than 1/20 horsepower and less than ½ horsepower shall be ball bearing; drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115 or 120/208/240 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type with minimum efficiency of 70 percent and a minimum full load power of 77 percent.
- G. Except as otherwise specified in the various specification sections, 3 phase motors 60 horsepower and smaller shall be NEMA design B squirrel cage induction type meeting the requirements of this paragraph. Motors shall be drip-proof, totally enclosed or explosion proof, as specified or indicated. Insulation shall be Class B or F, at 40 degrees C ambient temperature. Drip-proof motors shall have a 1.15 service factor and totally enclosed and explosion proof motors shall have a service factor of 1.00 or higher. Motors specified for operation at 480, 240, and 208 volts shall be nameplated 460, 230, 200 volts, respectively. Efficiencies and percent power factor at full load for three phase motors shall be not less than the values listed below for premium efficiency motors:

MOTOR NAMEPLATE	MINIMUM EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
1HP and above to	85.5 percent	84 percent
1-½ HP	86.5 percent	85 percent
2HP	86.5 percent	85 percent
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent
7½ HP	91 percent	86 percent
10HP	91.7 percent	85 percent
15HP	93.0 percent	85 percent
20HP	93.0 percent	86 percent
25HP	93.6 percent	85 percent
50HP	94.5 percent	88 percent

- H. Three phase motors ½ HP or greater shall be the Duty Master XE by Reliance Electric Company, Super-E Premium Efficiency of Baldor Motor and Drives, E-plus Efficient Standard Duty Motor of the Electric Motor Division of Gould, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corp., the equivalent product of General Electric, or approved equal.
- I. For motors serving equipment being controlled by a variable speed drive, motor shall be

premium efficiency inverter duty rated.

- J. Motor frames shall be NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast-iron or aluminum with steel inserts.
- K. Control of each motor shall be manual or automatic as specified for each in the various mechanical sections. In general, and unless otherwise specified for a particular item in the various mechanical sections of the specifications, motor starters and controls shall be specified and provided under the various electrical sections of these specifications.

2.3. MOTOR INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors to support shaft regardless of shaft position.
- C. Check line voltage and phase and ensure agreement with nameplate. Check that proper thermal overloads have been installed prior to operating motors.

2.4. WIRING DIAGRAMS

- A. The Contractor is responsible for obtaining and submitting wiring diagrams for all major items of equipment.
- B. Wiring diagrams shall be provided with shop drawings for all equipment requiring electric power.
- C. Provide wiring diagrams for all major plumbing items of equipment to electrical contractor and ATC subcontractor for coordination.

2.5. VARIABLE FREQUENCY DRIVE MOTOR BEARING PROTECTIVE RINGS:

- A. For all motors driven by a variable frequency PWM drive include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents. Grounding rings shall be manufactured by AEGIS SGR or approved equal.
- B. Furnish units with one year warranty.
- C. Size and select Bearing Protective Rings per the manufacturer requirements based on the motor size, shaft diameter, and shaft shoulder length. For motors with slingers furnish and install NEMA /IEC kit as required.
- D. Furnish and apply Colloidal silver shaft coating to all shafts with Bearing Protective Rings to improve shaft voltage discharge capability.

2.6. ENCLOSURES

- A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:

1. Dry Interior Locations: NEMA 1.
2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.
3. Corrosive Locations, Including Indoor Laboratories, Chemical Storage Rooms and Similar Space = NEMA 4X.

PART 3. EXECUTION

3.1. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the work are shown only in diagrammatic form. Refer conflicts to the Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.
- G. Do not install equipment or piping over electrical gear, electrical panels, motor controllers, and similar electrical equipment. Install equipment and piping to maintain clear space above and in front of all electrical components per the National Electric Code.

3.2. SUPPORTS, HANGERS AND FOUNDATIONS

- A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.
- B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For un-insulated copper piping provide copper hanger to prevent contact of dissimilar metals. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.
- C. Concrete housekeeping pads and foundations shall be not less than 4 inches high and shall extend a minimum of 6 inches beyond equipment bases. Provide wire-mesh reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

3.3. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Record demonstration and training video recordings. Record each training module separately.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
- D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

3.4. PROVISIONS FOR ACCESS

- A. The contractor shall provide access panels and doors for all concealed equipment, valves, strainers, dampers, filters, controls, control devices, cleanouts, traps, and other devices requiring maintenance, service, adjustment, balancing or manual operation.
- B. Where access doors are necessary, furnish and install manufactured painted steel door assemblies consisting of hinged door, key locks, and frame designed for the particular wall or ceiling construction. Properly locate each door. Door sizes shall be a minimum of 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 20 inches x 30 inches for full body access where required. Review locations and sizes with Architect prior to fabrication. Provide U.L. approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, Mifab, Acudor Products, Babcock-Davis, Nystrom, or approved equal.
 - 1. Acoustical or Cement Plaster: Style B
 - 2. Hard Finish Plaster: Style K or L
 - 3. Masonry or Dry Wall: Style M
- C. Where access is by means of liftout ceiling tiles or panels, mark each ceiling grid using small color-coded and numbered tabs. Provide a chart or index for identification. Place markers within ceiling grid not on ceiling tiles.
- D. Access panels, doors, etc. described herein shall be furnished under the section of specifications providing the particular service and to be turned over to the pertinent trade for installation. Coordinate installation with installing contractor. All access doors shall be painted in baked enamel finish to match ceiling or wall finish.
- E. Submit shop drawings indicating the proposed location of all access panels/doors. Access

doors in finished spaces shall be coordinated with air devices, lighting and sprinklers to provide a neat and symmetrical appearance.

- F. Where access doors are installed in wet locations (i.e. shower rooms, toilet rooms, kitchen rooms, kitchens, dishwasher rooms, can wash rooms, and similar spaces, etc.) provide aluminum access doors/frame.

3.5. PAINTING AND FINISHES

- A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.
- B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.
- C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.
- D. Protect all finishes and restore any finishes damaged as a result of work under Division 22 to their original condition.
- E. The preceding requirements apply to all work, whether exposed or concealed.
- F. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.
- G. All exposed piping, equipment, etc. shall be painted. Colors shall be as stated in this division or as selected by the Architect and conform to ANSI Standards.
- H. All exterior roof mounted equipment, piping and vents shall be painted to match roof in color as selected by Architect.
- I. All exposed piping, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.
- J. All exposed piping, equipment, etc., in Mechanical Rooms, Penthouses, Fire Pump Rooms, Mezzanines, Crawlspace, and Storage where PVC jacketed shall not require painting. Label and identify and color code as specified.

3.6. CLEANING OF SYSTEMS

- A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Blow out and flush piping until interior surfaces are free of foreign matter.
- B. Flush piping in re-circulating water systems to remove cutting oil, excess pipe joint compound, solder slag and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components.

After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating name of Service Company used.

- C. Maintain strainers and dirt pockets in clean condition.
- D. Pay for labor and materials required to locate and remove obstructions from systems that are clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.
- E. Leave systems clean, and in complete running order.

3.7. COLOR SELECTION

- A. Color of finishes shall be as selected by the Architect.
- B. Submit color of factory-finished equipment for acceptance prior to ordering.

3.8. PROTECTION OF WORK

- A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.
- B. Cover temporary openings in piping and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver pipes and tubes with factory applied end caps.
- C. Cover or otherwise protect all finishes.
- D. Replace damaged materials, devices, finishes and equipment.
- E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.9. OPERATION OF EQUIPMENT

- A. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.
- B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.
- C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing and balancing work. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.
- D. Do not use plumbing systems for temporary services or temporary conditioning during

construction. Refer to Division 01 section "Temporary Facilities and Controls" for temporary plumbing during construction.

- E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.10. IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

- A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate the location and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under safety glass and hung in each Mechanical Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.
- B. All valves shall be plainly tagged. For any bypass valves, install sign indicating valve position as "Normally Open" or "Normally Closed" as required.
- C. All items of equipment, including motor starters and disconnects shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal). Equipment identification and room name or area served shall be on each panel.
- D. Provide six (6) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Operations and Maintenance Manuals as hereinafter specified.
- E. All lines piping installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and service. Refer to Division 22 Section, Plumbing Piping, Fittings, Valves, Etc. Color code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.
- F. Submit list of wording, symbols, letter size, and color coding for plumbing identification. Submit samples of equipment identification cards, piping labels, labels, and valve tags to Engineer for review prior to installation.
- G. Provide at least 24 hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner. Additional instruction time for the automatic temperature control (ATC) system is specified in Division 23 Section, Instrumentation and Controls of HVAC and Plumbing Systems.
- H. Contractor shall demonstrate Sequences of Operation of all plumbing equipment in presence of Owner's representative, Engineer, and ATC subcontractor.

3.11. WALL AND FLOOR PENETRATION

- A. All penetrations of partitions, ceilings, roofs and floors by piping or conduit under Division 22 shall be sleeved, sealed, and caulked airtight for sound and air transfer control.

Penetrations of mechanical room partitions, ceilings, and floors shall be as specified in Division 07 Section, “Fire Protection, HVAC and Plumbing Penetration Firestopping”.

- B. All penetration of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 07 Section, “Fire Protection, HVAC and Plumbing Penetration Firestopping”.
- C. Where piping extends through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these specifications.
- D. Provide pipe escutcheons for sleeved pipes in finished areas.
- E. Piping sleeves:
 - 1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.
 - 2. Twenty-two (22) gauge galvanized steel elsewhere.
- F. Extend all floor sleeves through floor at least 2-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.
- G. Sleeves for penetrations in wet labs, kitchen, and food service areas shall finish .375 inches above floor or flush with wall surfaces and be neatly pointed up to fit snugly against floor or wall material.

3.12. RECORD DRAWINGS

- A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect one complete set of prints of the mechanical contract drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings.
- B. Contractor shall incorporate all sketches, addendums, value engineering, change orders, etc., into record drawings prior to delivering to Architect.

3.13. WARRANTY

- A. Contractor's attention is directed to warranty obligations contained in the General Conditions and Supplementary Conditions.
- B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of equipment manufacturer's warranties shall be included in the operations and maintenance manuals.
- C. The contractor guarantees for a two year period from the time of final acceptance by the Owner.

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.
2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.
3. That the contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The contractor shall also make good all damages caused to their work or materials in the process of complying with this section.
4. That the entire work shall be water-tight and leak-proof.

3.14. LUBRICATION

- A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Operations and Maintenance Manuals.
- B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

3.15. OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractor shall have prepared six (6) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals and deliver these copies of the manuals to the Owner. The manuals shall be as specified herein. The manuals must be approved and will not be accepted as final until so stamped.
- B. The manuals shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: Operations and Maintenance Manual New Hodgson Vocational Technical High School – Plumbing Systems. No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out. Provide divider tabs and table of contents for organizing and separating information.
- C. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of Volume 1 (if applicable) of hard copies of the manual.
- D. Provide the following data in the booklet:
 1. As first entry, an approved letter indicating the starting/ending time of Contractor's warranty period.
 2. Catalog data on each piece of plumbing equipment furnished.

3. Maintenance operation and lubrication instructions on each piece of plumbing equipment furnished.
 4. Complete catalog data on each piece of plumbing equipment furnished including approved shop drawing.
 5. Manufacturer's extended limited warranties on equipment.
 6. Chart form indicating frequency and type of routine maintenance for all plumbing equipment. The chart shall also indicate model number of equipment, location and service.
 7. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
 8. Provide supplier and subcontractor's names, address, and phone number.
 9. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.
 10. Provide and install in locations as directed by the Owner, valve charts including valve tag number, valve type, valve model number, valve manufacturer, style, service and location. Each valve chart shall be enclosed in a durable polymer based frame with a cover safety glass. .
 11. Copy of the approved balancing report for plumbing equipment/system.
 12. Access panel charts with index illustrating the location and purpose of access panels.
 13. Approved Health and Plumbing and Electrical Certificates.
 14. Start-up reports for equipment.
 15. Insert color graphic with embedded parameters for ATC system into Record and Information Booklet.
- E. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of volume 1 (if applicable) of hard copies of the manual.
- F. Submit Operations and Maintenance Manuals prior to the anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Operations and Maintenance Manuals are reviewed and approved.

3.16. INSTALLATION AND COORDINATION DRAWINGS

- A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following:

1. Complete Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with lights, electrical equipment, HVAC equipment and structural amenities.
- B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, and piping in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.
- C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

3.17. PIPING SYSTEMS TESTING

- A. The entire new plumbing piping systems shall be tested hydrostatically before insulation covering is applied and proven tight under the following gauge pressures for a duration of twenty-four (24) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Domestic Water & Coil Drain Piping	100 psig
Sanitary & Storm Water Piping	As specified below
Shop Compressed Air Piping	175 psig
Laboratory Compressed Air Piping	150 psig
Dental Piping	Refer to Division 22 Section Dental Piping Devices
Nitrogen Piping (Automotive Shop)	100 psig
Chemical Treatment Piping	50 psig
Emergency Fixtures, Tempered Water	100 psig

- B. All gas piping shall be pressure tested in accordance with NFPA-54, and NFPA-58. Gas piping systems shall be proven tight under the following gauge pressures for a duration of four (4) hours:

SYSTEM	TEST PRESSURE
Gas Piping	100 psig

- C. All storm, waste, vent and water piping shall be tested by the Contractor and approved by the Engineer before acceptance. All storm, soil, and waste piping, located underground, shall be tested before backfilling. The costs of all equipment required for tests are to be included in the contract price.
- D. The entire new drainage system and venting system shall have all necessary openings

plugged and filled with water to the level of the highest stack above or at the roof. The system shall hold this water for thirty (30) minutes without showing a drop greater than 1inch. Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except a vertical stack 10 feet above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. The pressure shall be maintained for thirty (30) minutes. All testing shall be in accordance with the local Plumbing Code and witnessed by the Plumbing Inspector or authority having jurisdiction.

- E. Upon completion of roughing-in and before setting equipment and fixtures, the entire new water piping system shall be tested at a hydrostatic pressure of not less than one hundred (100) pounds per square inch gauge and proven tight at this pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system.
- F. Testing and acceptance thereof shall be in accordance with local requirements and shall meet approval of authority having jurisdiction. Submit certificates and approved permits and insert one (1) copy in the Operations and Maintenance Manuals.

3.18. EQUIPMENT BY OTHERS

- A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.
- B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections. Failure to do so will not relieve this contractor of any responsibility for improper equipment operation.

3.19. OUTAGES

- A. Provide a minimum of fourteen (14) days' notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.
- B. Submit Outage Request form, attached at end of this Section, to Owner for approval.

END OF SECTION

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE: _____

END OUTAGE -- TIME: _____ DATE: _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____

(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ NO ____ BY: _____ DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER : _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ NO: ____ NAME: _____

DIVISION 22 SECTION 22 05 05
PLUMBING PIPING, FITTINGS & VALVES
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END OF SECTION30

SECTION 22 05 05
PLUMBING PIPING, FITTINGS AND VALVES

PART 1. GENERAL

1.1. SUMMARY

- A. The conditions of the contract and other general requirements apply to the work specified in this section. All work under this section shall also be subject to the requirements of Division 22 Section, Common Work Results for Plumbing and Division 01, General Requirements.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SYSTEM DESCRIPTION CONDITIONS

- A. Provide all labor and materials necessary to furnish and install all piping systems on this project as herein specified and/or shown on the drawings. Final connections to equipment furnished in other sections of the specifications shall be included under this section.
- B. All piping and insulation installed in ceiling plenums must be plenum rated and comply with NFPA and International Building Code (IBC).
- C. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- E. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- F. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.
- G. Use spring loaded "silent" check valves on discharge of all pumps.
- H. Use 3/4 inch (20 mm) ball valves with cap and chain for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
- I. At all runout piping serving equipment, use swing joints with elbows to prevent excessive movement of piping due to expansion.

1.3. QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.

- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulation. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.
- C. Welders Certification: In accordance with ASME Section 9.
- D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- E. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.
- F. Maintain one copy of each document on site.

1.4. DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under as hereinbefore specified.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

1.5. ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.6. EXTRA MATERIALS

- A. Provide one (1) repacking kit for each size valve.

1.7. ALTERNATES

- A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

1.8. LEAD FREE REQUIREMENTS

- A. All plumbing fixtures, equipment, and devices that contact potable water must be lead free per the State requirements.

1.9. PLASTIC PIPE PENETRATIONS

- A. Install UL listed collars, sealing methods, and firestopping at all plastic pipe penetrations of smoke walls and fire rated walls per NFPA.

PART 2. PRODUCTS

2.1. PIPE MATERIALS

- A. All materials, unless otherwise specified, shall be new and of the best quality of their respective kinds, and shall conform to the requirements and ordinances of local, state and insurance authorities having jurisdiction.
1. Sanitary Underground - Within Building to 5 Feet Outside of Foundation Wall:
 - a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
 2. Sanitary and Vents Above Floor Inside Building:
 - a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
 3. Indirect Waste Piping:
 - a. Pipe & Fittings: Hard drawn Type L copper tubing with cast brass drainage fittings. ASTM B88-78 and ANSI B16.1877. All exposed indirect waste piping shall be chrome plated or primed and painted with silver paint.
 4. Storm Water Below Grade or Under Building to Point 5 Feet from Building Line:
 - a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
 5. Storm Water Above Floor Inside Building:
 - a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
 6. Domestic Cold Water Outside of Building Below Ground or Under Building to Point 5 Feet from Building Line:
 - a. Pipe: 2-1/2 inches & smaller, soft temper type K. ASTM B88 - No joints below grade except as approved by the Engineer.
3 inches & larger, ductile iron pipe for water, ANSI 21.50 & 21.51 with double thickness cement mortar lining, ANSI 21.4.
 - b. Fittings & Joints: wrought copper solder joint fittings, ANSI B16.22. Joints for copper piping shall be ASTM B32, SOLDER, grade 95TA. Cast iron pressure fittings, ANSI 21.10, Class 250. Mechanical specification for mechanical joint for cast iron pressure pipe & fittings

ANSI A21.11. Joints for ductile iron pipe shall be AWWA C111, rubber gasket with 3/4 inch diameter rods.

7. Domestic Hot, Cold, and Recirculating Water, Emergency Fixture Tempered Water, Piping Inside Buildings, Above Grade:
- a. Pipe or Tubing: 2 inches & smaller, all water lines soft temper Type K copper tubing below ground, hard temper Type L copper tubing above ground, ASTM B88, or Type 304/304L, Schedule 10S, stainless steel to ASTM A312.
2-1/2 inches & larger, hot dipped galvanized steel A120, ASTM A53, Grade B, Schedule 40 steel, or hard copper tube, Type L with copper-tube dimensioned grooved ends; copper ground - end fittings; copper tubing, keyed couplings; and grooved joints. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)
Provide dielectric fittings between steel and copper. Victaulic Style 47 or approved equal.
 - b. Fittings & Joints: Copper tubing fittings and joints shall be solder type wrought copper - 95-5 silver solder or braze (lead and antimony based solders are prohibited). Galvanized steel pipe fittings and joints shall be ANSI B16.12 hot dipped galvanized threaded ends and 125 lb. galvanized cast iron fittings or 150 lb. galvanized malleable iron.
 - i. Stainless steel fittings shall be Vic-Press or approved equal for Schedule 10S pipe. Fittings shall be precision, cold drawn, stainless steel with EPDM O-ring seals. (Seals shall be UL classified in accordance with ANSI/NSF61 for Potable Water service.) Fittings rated for working pressures to 500-psi.
 - ii. Grooved joint couplings shall consist of two ductile iron housing segments cast with offsetting angle pattern bolt pads, FlushSeal elastomer gasket, and ASTM A449 electroplated steel bolts and nuts. (Gasket shall be UL classified in accordance with ANSI/NSF61 for Potable Water service, and shall meet the lead content requirements of NSF-372.) Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 807N or approved equal. Couplings shall be coated blue enamel.
 - iii. Installation-Ready™ fittings for grooved end copper tubing shall be manufactured to copper-tube dimensions. Fittings shall be ductile iron conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, complete with PVDF (Poly Vinylidene Fluoride) and Grade “EHP” EPDM-HP (Grade ‘T’ Nitrile) gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be rated to 300 psi (2065 kPa) with Type K or L Copper Tubing.
 - 1) UL classified in accordance with NSF-61 for potable water service. The system shall meet the low-lead requirements of NSF-372.
 - iv. For copper/stainless steel/CPVC pipe the gasket shall be potable water grade P compound with a red and blue stripe color code for operating temperatures from 0°F to 180°F.
 - 1) Reference shall always be made to the latest published

Victaulic selection guide for gaskets for proper gasket selection for the intended purpose.

- c. Gate Valves: 2-1/2 inches & larger - OS&Y, IBBM flanged, 125 lb. standard solid wedge.
 - i. 2 inches & smaller - bronze solder end, bronze body, solid wedge, rising stem, 200 lb. w.o.g. non-shock. However, use brass valves only on all copper pipe.
- d. Butterfly Valves: Cast brass body to UNS C87850, elastomer pressure responsive seat, aluminum-bronze disc with stainless steel stem. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Copper-tube dimensioned grooved ends, suitable for working pressures to 300-psig CWP Victaulic Style 608N or approved equal.
- e. Ball Valves: Shut-off valves 2-inches and smaller shall be ball valves. Ball valves shall be 150 lbs, brass or bronze body, standard port, 2 piece body, TFE seats with bronze trim. Ball valves shall be threaded end or solder end, or Vic-Press end as required to accommodate piping. Ball valves shall be as manufactured by Victaulic, Conbraco, Crane, Apollo, Nibco, Watts or engineer approved equal.
- f. Unions: 2-1/2 inches & larger - 150 lb. brass companion flanges.
 - i. 2 inches & smaller - wrought copper, ground joint solder ends; threaded hexagonal stainless steel union with Vic-Press ends, Victaulic P589 or approved equal.
- g. Check Valves: 2-1/2 inches & larger - IBBM, 125 lb. std. flanged bronze swing check, with metal disc; 2-inches and smaller - 125 lb. std. screwed or solder ends.
- h. Globe Valves: 2 inches and smaller, bronze body, bronze trim, rising stem, hand wheel, inside screw, renewable composition disc, solder ends, 150 lb, with back seating capacity.
 - i. 2 inches & larger: IBBM, 150 lb, bronze trim, rising stem, handwheel OS&Y, plug type disc, flanged ends, renewable seat and disc.
 - ii. Globe valves shall be Conbraco, Crane, Nibco, Milwaukee, Watts or approved equal.
- i. Combination Shut-off/Balancing Valves:
 - i. Victaulic/TA Hydronics, Taco Circuit Setter, Bell & Gossett Circuit Setter Plus, Flowset Accuset, Gerand, or engineer approved equal, ½ inch-3 inches 300 psi rated globe type or ball valve with DZR brass Ametal (copper-alloy) or bronze body/brass ball construction with glass and carbon filled TFE seats, in-line flow meter and balancing and shut-off valve with built in ball valve for flow adjustment. Valve shall have memory stop, calibrated nameplate, Schrader valve connections and preformed molded insulation. Valves shall be leaktight at full rated working pressure. Balance valve size shall be selected based on manufacturer's acceptable flow range and design flow rate. Pressure drop through combination shut off balance valves shall not exceed 5 feet of head at design flow rate. Where required for flow rates below 0.6 GPM, provide "reduced flow" combination shut-off balance valves sized so that the flow rate is within the

manufacturer's recommended flow range.

- j. Extended Valve Stems: Provide and install round collar type extended valve stems on all valves installed in insulated piping. Valve stem and collar shall be selected to suit insulation thickness and maintain valve handles outside of insulation.
- k. (Alternate): At contractor's option, Viega ProPress pressure seal mechanical fittings may be utilized.
 - i. Viega ProPress, Mueller Streamline PRS or approved equal, Pressure Seal Fittings: Bronze, or copper shall conform to ASME B16.51, ICC LC 1002, IAPMO PS 117, NSF 61, and NSF 61-G or NSF 372. Pressure Seal fittings ½-inch thru 4-inch for use with ASTM B88 copper tube type L and ½-inch up to 1-1/4-inch annealed copper tube. Pressure Seal fittings shall have an EPDM sealing element grip ring, PBT separator ring, EPDM sealing element and Smart Connect (SC) or Sure PS Leak Detection.

8. Gas Piping:

- a. Pipe: Inside Building Above Ground: Schedule 40 uncoated black steel pipe, ASTM A53 or A120.
- b. Outside Building, Below Ground: Copper type L tubing, ASTM B88 Below Ground.
- c. Outside building above grade/roof: Schedule 40 black steel pipe, ASTM A53 or A120.
- d. Fittings & Joints: 150 lb. screwed malleable iron ASTM B16.3 with joints sealed with litharge and glycerin. Piping 2 ½ inches and larger and any concealed piping within walls must be welded, ASTM A24 forged steel welded type joints shall be threaded or welded to ANSI B31.1 or ASME Sec. 1.
- e. Plug Valves: 2- ½ inches & larger ASME B16.38 and MSS SP-78 cast iron lubricated plug valves with 125 psig pressure rating, 3 turn type. Gas valves are prohibited above ceilings.
- f. Cocks: 2 inches & smaller - bronze, Crane 270. AGA certified bronze body, plug type with bronze plug, ball type with chrome plated brass ball, for 5 psig or less gas. Include AGA stamp, flat or square head or lever handle, and threaded ends conforming to ASME B1.20.1
- g. Ball Valves: Full flow, double seal, ball type with bronze body, Buna-N seals and O-ring packing, chrome plated brass ball and designed for working pressures up to 175 psig. Valves shall be 3 turn type. MSS SP-78, class 175 WOG.
- h. Gas Vents: Install vent piping for gas pressure regulators and gas trains, extend outside building to a non-hazardous location away from any potential source of ignition, and vent to atmosphere. Pipe material shall be identical to gas piping here-in before specified. Terminate vents with turned down, reducing elbow fittings with corrosion-resistant insect screen in large end.
- i. Finish: All gas piping downstream of regulator, installed exposed in a kitchen, or piping installed on a roof shall be primed and finished with two coats of rust resistant paint with pewter gray finish. Paint shall be two part epoxy-exterior paint as manufactured by Pittsburgh Paint, Themeco, or

approved equal. Painting shall be provided under another Section of these Specifications.

9. Shop Compressed Air:
 - a. Pipe: Standard weight steel pipe, Schedule 40, black, ASTM A53 or A120; or Schedule 10S stainless steel, ASTM A312, with plain ends.
 - b. Fittings & Joints: 250 lb ASME B16.3 malleable iron fittings or ASTM A234, forged steel welding type. Joints shall be threaded or welded to ANSI B31.1 or ASME Section 1 requirements.
 - c. Stainless steel fittings shall be Vic-Press or approved equal for Schedule 10S pipe. Fittings shall be precision, cold drawn, stainless steel with HNBR O-ring seals. Fittings rated for working pressure to 500-psi.
 - d. Ball Valve: Victaulic Series P569, Worcester ball valve Type X-411T, approved equal.
10. Dental Compressed Air and Vacuum Piping: Refer to Division 22 Sections 226113 Compressed Air Piping for Dental Systems and 226213 Vacuum Piping for Dental Systems.
11. Elevator Sump Pump Discharge Piping:
 - a. Piping: Schedule 40 A53 grade A galvanized steel pipe with cast iron plain galvanized pressure fittings.
 - b. Fittings and Joints: Galvanized ductile iron grooved end fittings or malleable iron fittings conforming to ANSI B16.3 Class 150 threaded. 3 inch and larger shall be flanged cast iron.
 - c. Basis of Design: Victaulic Series 318 Sump Ejector
 - d. Shut-off Valves: 150 psig working pressure, 150 degree F maximum operating temperature, full port design 2 piece body design.
12. Gas Fired Condensing Water Heating Condensate Piping
 - a. Piping shall be PVC pipe, ASTM D1785 schedule 40 with ASTM D2466 socket fittings for schedule 40. Join PVC pipe/fittings utilizing solvent cement ASTM D2564 with ASTM F 656 primer.
 - b. Provide backwater valve (ball float type) at connections of condensate piping to stormwater piping and air gap fitting. Backwater valve shall be Model Z1099 as manufactured by Zurn or approved equal. Backwater valve shall have drain coated cast iron body, plastic ball float, bronze backwater bushing and replaceable neoprene seat.
13. Nitrogen Piping (Auto Shop)
 - a. Hard Copper Tube: ASTM B819, Type K or L, seamless, drawn-temper, medical gas tube that has been factory cleaned, purged, and sealed for oxygen service. Include standard color marking "Nitrogen" in green for Type K tube and blue for Type L tube.
 - b. Fittings: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and bagged as specified in "Preparation" Article in Part 3.

- i. Copper Pressure Fittings, ASME B16.22, wrought-copper solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 - ii. Cast-Copper-Alloy Flanges: ASME B16.24, Class 300.
 - iii. Copper Unions: ASME B16.22 or MSS SP-123.
 - c. Joining Materials
 - i. Refer to Division 22 Section, “Common Work Results for Plumbing” and Division 22 Section “Plumbing Piping, Fittings, and Valves” for joining materials not in this Section.
 - ii. Brazing Filler Metals: AWS A5.8, BCuP series alloys. Flux is prohibited unless used with bronze fittings.
 - iii. Threaded-Joint Tape: PTFE
 - iv. Gasket Material: ASME B16.21, nonmetallic, flat asbestos free, and suitable for oxygen service.
 - d. Gas Valves (Nitrogen)
 - i. Valves, General: Factory cleaned for nitrogen service and bagged.
 - ii. Copper-Alloy Ball Valves: MSS SP-110, 3-piece-body, full-port ball valve rated for 300-psig 2070-kPa minimum working pressure; with chrome-plated brass ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and locking type handle designed for quarter turn between opened and closed positions.
 - 1) Manufacturers:
 - Amico
 - Allied Healthcare Products, Inc.; Chemetron Div.
 - Allied Healthcare Products, Inc.: Oxequip Health Industries.
 - Beacon Medical Products
 - EMSE Corporation
 - Hill-Rom.
 - Milwaukee Valve Company
 - NIBCO, Inc.
 - Squire-Cogswell/Aeros Instruments.
 - e. Brazed Joints: Use silver or copper-phosphorus-composition filler metal and comply with CDA’s “Copper Tube Handbook,” Section VII, “Brazed Joints”; or AWS D10.13, “Recommended Practices for the Brazing of Copper Pipe and Tubing for Medical Gas Systems.”
- B. Steel pipe shall be similar and equal to National Tube Company, Grinnell, Republic, or Bethlehem black or zinc-coated (galvanized) as hereinafter specified. Pipe shall be free from all defects which may affect the durability for the intended use. Each length of pipe shall be stamped with the manufacturer's name.
- C. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.

- D. Welding fittings for steel pipe shall meet the requirements of ASTM Standard A-23 and shall be standard catalog products. Fittings fabricated by metering and notching pipe will not be accepted.

2.2. PIPE HANGERS, ROLLER SUPPORTS, ANCHORS, GUIDES, AND SADDLES

- A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260, Carpenter and Patterson, or approved equal for pipe $\frac{3}{4}$ -inch and larger, and Figure 65 for pipe 2-inches and smaller, or approved equal. Adjustable pipe stanchion with U-bolt shall be Grinnell Company's Figure 191. Pipe roller supports shall be Grinnell's Figure 181 or Figure 271. Exterior pipe hangers shall be galvanized or stainless steel construction. For copper piping in direct contact with the hanger, hanger construction shall be copper coated to prevent contact of dissimilar metals similar to Grinnell's Figure CT-65. Hanger spacing and rod sizes for steel and copper pipe shall not be less than the following:

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
$\frac{3}{4}$ & 1	6	5	$\frac{3}{8}$
1 - $\frac{1}{2}$	6	8	$\frac{3}{8}$
2	8	8	$\frac{3}{8}$
2 – $\frac{1}{2}$	10	9	$\frac{1}{2}$
3	12	10	$\frac{1}{2}$
4	14	12	$\frac{5}{8}$

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
5	14	12	5/8
6	16	14	3/4
8	18	16	7/8
10	20	18	7/8
12	20	18	7/8

B. Install hangers for storm water and soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. PS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
6. NPS 15 (DN 375): 48 inches (1200 mm) with 1-inch (25-mm) rod.
7. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

C. Install supports for vertical soil piping every 4 feet (1200 mm).

- D. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters.
- E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 ½ and NPS 2 (DN and DN 50): 48 inches (1200 mm) with 3/8 inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches (1200 mm) with ½ inch (13 mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8 inch (16 mm) rod.
 - 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4 inch (19 mm) rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8 inch (22 mm) rod
- F. Install supports for vertical PVC piping every 48 inches (1200 mm).
- G. Spacing of hangers for polypropylene pipe (where specified) shall be as follows:
 - 1. 2-inches & smaller - every 2 feet
 - 2. Larger than 2-inches - every 3 feet
 - 3. Plastic piping shall not be installed in ceiling plenums per NFPA.
- H. Anchors, guides, and roller supports shall be installed in accordance with the contract drawings and manufacturer's recommendations to provide pipe support and control pipe movement for all piping systems. Anchors and guides shall be securely attached to the pipe support structure. Submit shop drawing for proposed pipe support structure for guides and anchors for approval of the Structural Engineer. Pipe alignment guides shall be Fig. 255 Grinnell, or as approved equal. Guides shall be sized to accommodate the pipe with insulation. Guides shall be steel factory, fabricated, with bolted two section outer cylinder and base for alignment of piping and two section guiding spider for bolting to pipe.
- I. Hangers for pipe sizes ½ to 1 ½ inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
- J. Hangers for cold pipe sizes 2 inches (50 mm) and over: Carbon steel, adjustable, clevis.
- K. Hangers for cold pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
- L. Hangers for cold pipe sizes 6 inches (150 mm) and over: adjustable steel yoke, cast iron roll, double hanger.
- M. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.
- N. Multiple or Trapeze hangers for hot pipe sizes 6 inches (150 mm) and over: Steel channels

with welded spacers and hanger rod, cast iron roll.

- O. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook
- P. Wall support for pipe sizes 4 inches (100 mm) and over: Welded steel bracket and wrought steel clamp.
- Q. Wall support for hot pipe sizes 6 inches (150 mm) and over: welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- R. Vertical Support: Steel riser clamp.
- S. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- T. Floor support for hot pipe sizes to 4 inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- U. Floor support for hot pipe sizes 6 inches (150 mm) and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- V. Copper pipe support: Carbon steel ring, adjustable, copper plated.
- W. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- X. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- Y. For Pipe Hangers installed in corrosive environments such as, chemical storage rooms...etc. the same shall (including hardware) shall be finished with on Electro-Galvanized Finish such as Galv-Krom® or approved equal.

2.3. VALVES

- A. Provide parts list and assembly drawings (exploded view) for all valves in shop drawing submittals. Provide valves of the same type by the same manufacturer.
- B. Check valves in base mounted pump discharges shall be of the vertical type and shall be Miller "non-slam" check valves or approved equal suitable for service intended. Check valves in circulator discharges shall be horizontal type.
- C. Provide at each base mounted pump a suction diffuser of size and type shown on drawings. Units shall consist of a cast iron angle type body with inlet vanes, magnetic insert, and blowdown connection tapped gauge post, 125 psi ANSI flange and a combination stainless steel diffuser strainer with 3/16-inch diameter opening for pump protection. Unit shall be equipped with a disposable fine mesh start up strainer which shall be removable after 30 days. Flow direction shall be from inside the strainer to outside for ease of service and cleaning. The body shall fit the pump and connecting pipe size. The unit shall be provided with an adjustable support foot to relieve piping strains from the pump suction. Suction diffuser shall be Taco "SD" Series Catalog 300-4.1, Bell and Gossett Model FLG,

Armstrong, or approved equal.

- D. Multi-purpose valve (non-slam check valve, throttling valve, shut-off valves and calibrated balancing valve) shall be provided at discharge side of each constant speed pump. The valve shall be of heavy-duty cast iron construction with standard ANSI flanged connections and rated for a maximum working pressure of 175 psig at 240°F. The valve shall be fitted with a stainless steel stem or stem sleeve and brass seat with "O" ring seal. Valve shall be Taco "Plus One" Number 300-4.2, Bell and Gossett 3DS Triple Duty Valve, Armstrong, or as approved equal, and shall have check and plug valve features plus a memory stop with pointer and scale. Provide additional shut-off valve to allow servicing of check valve if a multipurpose valve is utilized in lieu of separate check, shut-off, and balance valve. Provide additional shut-off valve downstream of multi-purpose valve to allow servicing of multi-purpose check valve feature. Provide pre-manufactured, removable insulation covers for all multipurpose valves.
- E. For variable speed pumps do not utilize multipurpose valves. For variable speed pumps install separate shut-off valve and check valve.

2.4. STRAINERS

- A. Strainers shall be of the basket or "Y" type and shall be heavy and durable, constructed of best grade gray iron with the bottoms drilled and plugged. Bodies shall have arrows clearly cast on the sides to show flow direction. Strainers shall be equipped with easily removable covers and brass sediment baskets made of brass not less than #22 gauge in thickness. Total area of basket perforations shall be not less than four times the cross section of the entering pipe. Flow shall be into basket, and then out through the perforations. Strainers shall be suitable for water or the intended fluid. Strainers 2 inches and smaller shall have threaded or solder ends, 2 inches and larger shall have flanged ends.
- B. Strainer screens shall be stainless steel with perforations and shall be 1/16-inch for pipe sizes 5 inches and less, 1/8-inch (40 percent open area) perforations for pipe sizes 6-inch and greater.
- C. Provide valved and capped (with chain) blowdowns in each strainer. Blowdown valves shall be Appolo 78-100/200 series or as approved equal.
- D. Strainers shall be manufactured by Watts, Mueller, Armstrong, Yarway, Spirax/Sarco or as approved equal.

2.5. UNIONS, FLANGES, AND COUPLINGS

- A. Unions in steel pipe 2-inches and smaller shall be malleable iron with brass inserted seats designed for a working pressure of 150 psig.
- B. Unions in copper pipe 2-inches and smaller shall be sweat fittings with bronze seats designed for a working pressure of 125 psig.
- C. Flanges for steel pipe over 2 inches shall be 150 psig, forged steel, and slip on type. Gaskets shall be 1/16 inch thick pre-formed neoprene.
- D. Flanges for copper pipe over 2 inches shall be bronze. Gaskets shall be 1/16 inch thick

preformed neoprene.

2.6. MANUAL AIR VENTS

- A. Manual air vents shall be similar to the hereinafter specified gauge valves. Provide 1/4-inch size on 3/4-inch pipe and smaller, 1/2 -inch size on 1-inch pipe and larger. Install at all high points of piping. Valves shall be Crane No. 88, Honeywell or as approved equal, with threaded ends, bronze body, bronze or brass bonnet and bronze stem.

2.7. THERMOMETERS

- A. Unless otherwise indicated, thermometers shall be ASTM E1, in a glass type, organic filled, 9-inch scale size, corrosion-resistant metal case, with "any-angle" mounting with positive locking device. Trerice Industrial Thermometers, Weksler Instruments, Ernst Gage Co., Miljoco, or approved equal. Insertion stem length shall suite the pipe size and configuration. Thermometer wells shall be brass with brass union hubs in copper and in ferrous piping. Where piping is insulated or otherwise covered, use wells with lagging extension. Where wells are installed in pipe tees at turns, increase pipe size so that well does not restrict flow. Accuracy shall be 2 percent.
- B. Unless otherwise indicated, thermometer ranges shall be as follows:
 - 1. Tepid water, Tempered water, Domestic cold water: 0 degrees F to 100 degrees F, 1 degrees F Division.
 - 2. Domestic hot and hot water recirculating: 30 degrees F to 180 degrees F, 2 degrees F Division.
 - 3. Tempered Water: 30 degrees F to 100 degrees F, 2 degrees F Division.
- C. Provide heat conducting compound in wells.

2.8. PRESSURE GAUGES

- A. Unless otherwise indicated, pressure gauges shall be the bronze bourdon tube type, 4-1/2-inch dial, stem mounting, cast aluminum adjustable pointer, 1 percent accuracy over middle half of scale range, 1-1/2 percent over balance: Trerice Model 600C; Weksler Instruments, Ernst Gage Co., Miljoco, or as approved equal.
- B. Gauges shall have pressure, vacuum, compound, or retard ranges as required, select ranges so that the normal readings are at the approximate midpoint and maximum system pressures do not exceed full scale.
- C. Furnish and install a gauge valve at each pressure gauge. Gauge valves shall be Crane Model No. 88, Needle Valve, Ernst Gage Co. FLG 200, Wexler Instrument Corp. Type BBV4, or approved equal, rated for pressure intended.
- D. Gauge connections for pressure gauges, thermometers, or control instruments shall be made using tee fittings, except that gauge connections up to 1-inch size in steel may be using threaded extra heavy pipe couplings welded directly to the main, provided that the main is at least 2-inch size for 2-inch connections, 3-inch size for 3/4-inch connections,

and 4-inch size for 1-inch connections. Minimum gauge connection shall be 2-inch ips.

- E. Provide snubbers on all gauges. Snubbers shall be No. 872 by Trerice, RS1/RS6 by Wexler Instruments, Miljoco or as approved equal.

2.9. PIPING SPECIALTIES

- A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of all base mounted and vertical in-line pumps, connections to air compressors, connections to vacuum pumps, connections to booster pumps, all vibrating equipment and elsewhere as shown. Refer to Division 23 Section, Vibration Control for HVAC, Plumbing and Fire Protection Equipment for specifications.
- B. Pressure relief valves shall be provided in the number and sizes required to relieve 110 percent of the full input to the systems. Valves shall be rated; and installed in accordance with ASME, and CSD-1 including all amendments. Pipe discharge full size to floor drain, (with union) and support discharge pipe to prevent exerting any strain on relief valve body, piping to be Type-L copper. Water safety relief valves shall be Watts Series 740, Conbraco, Series 154A, Bell and Gossett, or approved equal. Provide pressure gauge adjacent to all safety relief valves.
- C. Gas relief valve piping shall be sized and installed in accordance with the latest edition of ASME Boiler & Pressure Vessel Code, CSD-1 including amendments. Pipe material shall be as specified for gas piping. Gas relief valve piping material shall be the same as hereinbefore specified for gas piping. Install stainless steel mesh screen and turndown on all gas relief valve/vent piping terminations.

2.10. ESCUTCHEONS

- A. Provide chromium plated escutcheons properly fitted and secured with set screws on all exposed piping which passes through walls, floors or ceilings of finished spaces.
- B. All escutcheon plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface. Plastic escutcheon plates will not be accepted.

2.11. DIELECTRIC CONNECTIONS (BRASS FITTINGS)

- A. Furnish and install brass fittings, unions, waterway fittings, or flanges, at the following locations:
 - 1. Where steel piping systems join copper piping.
 - 2. Where copper tube connects to domestic water storage tanks, water heaters, heat exchangers, expansion tanks, and other steel vessels.
 - 3. Avoid the installation of steel nipples, cast iron or steel valves and specialties, or other ferrous components in predominately copper piping systems. Where such installation is necessary, isolate the component with brass fitting connections. Do not mix steel pipe and copper tube in the same run of pipe or in the same section of a piping system.

2.12. SLEEVES

- A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, roof structure members or other building parts. Sleeves shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.
- B. Sleeves through floors shall be flush with the floor except for sleeves passing through Equipment Rooms which shall extend ¾-inch above the floor. Refer to Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment for mechanical equipment room penetrations additional requirements. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves. Each trade shall be responsible for drilling existing floors and walls for necessary sleeve holes. Drilling methods and tools shall be as hereinbefore specified.
- C. Sleeves through walls and floors shall be sealed with a waterproof caulking compound.
- D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

2.13. PRESSURE REDUCING VALVES

- A. Provide pressure reducing valves as indicated, of size and capacity selected by the installer to maintain operating pressure on the system. Body shall be cast-iron or bronze construction, renewable stainless steel seat, non-corrosive disc, water tight cage assembly, adjustable pressure ranges and inlet strainer Watts Regulator Model 223-S, Armstrong, Bell and Gossett or as approved equal. Maximum working pressure shall be 300 psig.
- B. Provide pressure gauge adjacent to all pressure reducing valves to verify proper set point.

2.14. WATER PROOF PIPE PENETRATION SEALS

- A. Provide and install waterproof pipe penetration seals at all pipes that enter the building below grade or through exterior wall.
- B. Link seals are to be Metraflex Metraseals, Model MS, Linkseal, or approved equal, black EPDM seal material, glass reinforced plastic pressure plates, zinc plated nuts and bolts, seals are to be resistant to sunlight and ozone, pressure rated to make a hydrostatic seal of up to 20 psig and up to 40 feet of head, temperature rated from –40 degrees F to 250 degrees F.

2.15. GAS PRESSURE REGULATORS

- A. Gas pressure regulators shall be as manufactured by Equimeter, Inc., Maxitrol Co., Rockwell, Fisher Controls, American Meter Co., Pietro Fiorentini, or approved equal. Gas pressure regulators shall maintain a constant downstream pressure with a variable inlet pressure.
- B. Gas pressure regulators shall comply with ANSI Z21.18 and shall be single stage, steel jacketed, corrosion-resistant type. Include atmospheric vent, elevation compensator, with threaded ends conforming to ASME B1.20.1 for 2 inch NPS and smaller and flanged ends

for 2 ½ inch NPS and larger.

- C. Gas pressure regulator shall be a positive lock-up type regulator where required by equipment manufacturer.
- D. Each pressure regulator shall have an identification stamped on diaphragm cover and shall be painted AGA grey. Regulator inlet and outlet pressures, and flow volume in cubic feet per hour of specified gas are as indicated on the contract drawings.
- E. Install water heater gas pressure regulators a minimum of 3 feet and no more than 8 feet from the water heaters per the manufacturer's requirements.
- F. Install paint spray booth gas regulators a minimum of 10 feet away from the paint spray booth gas valve train.

2.16. TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - 2. Description: PVC or CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
 - 2. Description: PVC or CPVC four-part union. Include brass threaded end, solvent-

cement-joint plastic end, rubber O-ring, and union nut.

PART 3. EXECUTION

3.1. GENERAL PIPING INSTALLATION REQUIREMENTS

- A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment on devices not to block access to doors, windows, manholes, or other access openings. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment, coils, etc., and installed so that there will be no interference with the installation of the equipment, ducts, etc. All valves and specialties shall be placed to permit easy operation and access and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be installed so as to avoid air or liquid pockets throughout the work. Ends of pipe shall be reamed so as to remove all burrs.
- B. All piping shall be graded to convey entrained air to high points where automatic air vents shall be provided. The size of supply and return pipes for each piece of equipment shall in no case be smaller than the outlets in the equipment.
- C. All piping shall be run to provide a minimum clearance of 2-inches between finished covering on such piping and all adjacent work. Group piping wherever practical at common elevations.
- D. All valves, strainers, caps, and other fittings shall be readily accessible.
- E. Rough-in and final connections are required to all equipment and fixtures provided under this Contract.
- F. Drain valves with hose connections shall be provided at low points for drainage of piping systems. Blow down valves shall be provided at the ends of all mains and branches so as to properly clean by blowing down the lines throughout in the direction of normal flow.
- G. Discharge lines from all relief valves shall be piped to within 4-inches of floor and extend to floor drains wherever floors are not pitched to drains. Pitch the relief valve piping away from the relief valve to insure that no fluid can be trapped in valve discharge. Support all relief valve piping to prevent exerting strain on the relief valve body. The end of the relief valve discharge piping shall not be threaded to prevent capping or plugging.
- H. All branches from water mains shall be taken from the top of the supply mains at an angle of forty-five (45) degrees above the horizontal, unless otherwise directed. Branches feeding down shall be taken from the side or bottom of the main on water mains only. All connections shall be carefully made to insure unrestricted circulation, eliminate air pockets

or trapped condensate, and permit the complete drainage of the system.

- I. Cutoff valves shall be provided on each branch line from the mains on all plumbing lines.
- J. Shut-off valves shall be installed at the inlet and outlet of each piece of equipment to permit isolation for maintenance and repair.
- K. Balancing valves shall be installed in all domestic re-circulating systems and at all pumps, and where indicated on the drawings.
- L. Unions shall be installed on all bypasses, at all connections to equipment, where shown on drawings or where required to facilitate removal of equipment whether shown or not.
- M. Spring clamp plates (escutcheons) shall be provided where pipes are exposed in the building and run through walls, floors, or ceilings. Plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface.
- N. If the size of any piping is not clearly evident in the drawings, the Contractor shall request instructions for the Engineer as to the proper sizing. Any changes resulting from the Contractor's failure to request clarification shall be at his expense. Where pipe size discrepancies or conflicts exist in the drawings, the larger pipe size shall govern.
- O. Install all valves with stem upright or horizontal, not inverted.
- P. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.
- Q. Provide clearance for installation of insulation and access to valves and fittings.
- R. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- S. All water containing pipes shall be routed clear of combustion air dampers and louvers to prevent freezing condition when dampers are open.
- T. Provide manual air vents at top of piping systems.
- U. Where access doors are required, install piping so that valves can be grouped together to minimize the quantity of access doors.
- V. Install manufactured U.L. listed firestop collars at all floor/wall penetrations for all PVC pipe penetrations.

3.2. THERMOMETER AND PRESSURE GAGE INSTALLATION REQUIREMENTS.

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
 - 1. Install with socket extending to one-third diameter of pipe.

2. Fill sockets with oil or graphite and secure caps.
- C. Install pressure gages in piping tees with pressure-gage valve located on a pipe at most readable location.
- D. Adjust faces of thermometer and gages to proper angle for best visibility.
- E. Clean windows of thermometer and gauges and clean factory-finished surfaces. Replace cracked and broken window, and repair scratched and marred surfaces with manufacturer's touch up paint.

3.3. VALVE INSTALLATION REQUIREMENTS

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Examine grooved ends for form and cleanliness. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- G. Do not attempt to repair defective valves; replace with new valves.
- H. Install valves as indicated, according to manufacturer's written instructions.
- I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- J. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- K. Locate valves for easy access and provide separate support where necessary.
- L. Install valves in horizontal piping with stem at or above the center of the pipe.
- M. Install valves in a position to allow full stem movement.
- N. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

3.4. COMPRESSED AIR PIPING INSTALLATION REQUIREMENTS

- A. Compressed air piping shall be installed in accordance with the American Society of Plumbing Engineers recommendations. To prevent build-up of moisture, all compressed air piping shall be pitched in the direction of flow, with drain valves installed at low points. Slope piping a minimum of one inch per 40 Ft., and provide manual shut-off valve.
- B. Install take-offs to outlets from top of main, with shut-off valve after take-off. Slope take-off piping to outlets. Provide drain leg and drain trap at end of each main, branch, and low point in piping.
- C. Install compressed air couplings, female quick connectors, regulators and pressure gauges where outlets are indicated.
- D. Install tees instead of elbow at changes in direction of piping. Fit open end of each tee with plug.
- E. Connect condensate drains to nearest floor drain. Unless otherwise noted all condensate drain piping shall be copper type "L".
- F. Install eccentric reducers where pipe is reduced in size in direction of airflow, with bottoms of both pipes and reducer flush.

3.5. WASTE AND VENT PIPING INSTALLATION REQUIREMENTS

- A. Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. All pipe when laid shall rest on the full length of the barrel and bell holes shall be dug in trench bottoms to make joints. Pipe shall not be adjusted to grade by use of block or wedges. Where rock or old foundations are encountered, trenches shall be excavated 6-inches below grade and crusher run limestone shall be used as a bedding material to support barrel of pipe.
- B. As the work progresses, the interior of the sewer shall be cleared of all dirt and superfluous materials of every description.
- C. Trenches shall be kept free from water until the pipe jointing material has set and pipe shall not be laid when the conditions of the trench or the weather is unsuitable for such work. At all times, when work is not in progress, all open ends of pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no trench water, earth or other substance will enter the pipe or fittings.
- D. Slip joints will be permitted only in trap seals or on the inlet side of the trap. Unions on the sewer side of the trap shall be ground faced, and shall not be concealed or enclosed. Install bell and spigot pipe with bell end upstream.
- E. Threaded joints shall be American Standard taper screw threads with permacel joint compound applied to the male thread. Connections between threaded pipe and cast iron pipe shall have a ring or half coupling screwed on to form a spigot end on the threaded pipe.

- F. Establish invert elevations, slopes for drainage to 1/8 inch per foot. Maintain gradients.

3.6. PIPE JOINTS INSTALLATION REQUIREMENTS

- A. Welded Joints: Joints in piping 2-1/2-inches and larger shall be fusion welded. Welding shall be in accordance with recommendations of the American Welding Society. Welding fittings shall conform in physical and chemical properties to the latest revisions of the American Society for Testing Materials.
- B. Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9 as applicable, for shop and project site welding of piping work. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB). Submit welders qualifications for approval.
- C. Grooved Joints: Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)
- D. Screwed Joints: All screwed joints shall be made with tapered threads properly cut. Screwed joints shall be made perfectly tight with a stiff mixture of graphite and oil, applied with a brush to the male threads on the fittings.
- E. Soldered Joints and Copper Piping: Joints in copper piping shall conform to the following minimum standards.
1. The pipes shall be cut to a length making certain that the ends are square, using a fins hacksaw blade or tube cutter. The ends of all pipes shall be reamed and all burrs removed.
 2. The outside end of the pipe and the cut end of the fitting shall be cleaned with steel wool, sand cloth, or steel wire brush. All dark spots shall be removed.
 3. The flux shall be applied evenly and sparingly to the outside end of the pipe and the inside of the outer end of the fitting until all surfaces to be jointed are completely covered. The piping and fitting shall be slipped together and reworked several times to insure an even distribution of the flux.
 4. The correct amount of solder per joint for each size pipe shall be used in accordance with the manufacturer's recommendations.
 5. Solder joints shall be made by using a direct flame from a torch.
 6. On pipe sizes larger than 1/4-inch, the fittings and valves in the pipe shall be moved or tapped with a hammer when the solder starts to melt to insure an even

distribution of the solder.

7. The excess solder shall be removed while it is still in the plastic state leaving a fillet around the cup of the fitting.
 8. Solder joints shall be suitable for working pressure of 100 psig and for working temperature of not less than 250 degrees F. The type of solder and flux used will be submitted for approval. Type 95-5 shall be the minimum standard.
 9. Lead and antimony-based solders shall not be used for potable water systems. Brazing and silver solders are acceptable.
- F. Where copper piping joins steel piping, approved bronze adapters shall be used.
- G. Prohibited Connections: No direct weld, soldered, or brazed connections, without unions or flanges, shall be made to valves, strainers, apparatus, or related equipment. Right and left couplings, long threads, or caulking of pipe threads or gasket joints will not be permitted.
- H. When installing gas piping which is to be concealed (i.e., in walls), unions, tube fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combination of fittings shall not be used. All concealed piping within walls shall be welded.
1. Gas Piping
 2. Final Gas Connections: Unless otherwise specified herein, final connections shall be made with rigid metallic pipe and fittings.
 3. Pipe Joints:
 - a. Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.
 - b. Threaded Metallic Joints: Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.
 - c. Welded Metallic Joints: Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.
 - d. Thermoplastic Joints: Jointing procedures shall conform to AGA 01. Solvent cement or heat of fusion joints shall not be made between different kinds of plastics.
 - e. Joining Thermoplastic to Metallic Piping: When compression-type mechanical joints are used, the gasket material in the fittings shall be compatible with the plastic piping and with the gas in the system. An

internal tubular rigid stiffener shall be used in conjunction with the fitting, and the stiffener shall be flush with the end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. A split tubular stiffener shall not be used.

- f. Special Requirements; Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall comply with NFPA 54.
 - g. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches (100mm) outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar epoxy-polyamide paint according to SSPC-Paint 16.
 - h. Install gas meter per manufacturer's requirements.
 - i. Install metal shut-off valves upstream and downstream of gas meter with full size normally closed bypass valve.
 - j. Install strainer on inlet of gas meter.
- 4. Install concrete filled, steel, schedule 40, painted pipe bollards around gas meter regulator and gas regulators serving generator.
 - 5. Gas pressure regulators shall be installed and located per the manufacturer's requirements for water heaters the gas regulators shall not be installed less than 3 feet nor more than 8 feet from the water heaters unless the manufacturer require otherwise. For boilers and paint spray booths, the gas regulators shall not be installed closer than 10 feet from the boilers, unless the manufacturer requires otherwise. Vent all gas regulator vent pipes to the building exterior prior NFPA-54 and CSD-1 requirements.
- I. Plastic piping solvent cement joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. PVC Piping: Join according to ASTM D2855.

3.7. HANGERS AND SUPPORTS INSTALLATION REQUIREMENTS

- A. General: All hangers shall be of an approved type arranged to maintain the required grading and pitching of lines to prevent vibration and to provide for expansion and contraction. Provide protection saddles between hangers and insulation on heating water insulated pipe. Saddles shall be Victaulic, Grinnells Figure 173/273, Sure-Joint, or approved equal. Provide approved spacers between saddles and pipe where flexible insulation is specified. Provide insulation protection shields for insulated piping without saddles. Shields shall be Carpenter Patterson, Grinnell Figure 167 or as approved equal.
- B. Spacing: Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping. For cast iron soil pipe, one hanger shall be placed at each hub or bell.

- C. Pipes to be supported off every joist/beam in the perpendicular direction or at 6 feet on center in the parallel direction. Piping 6 inches or greater shall have their own individual hangers.
- D. Vertical Lines: Shall be supported at their bases, using either a suitable hanger placed in a horizontal line near the riser, or a base type fitting set on a pedestal, foundation or support. All vertical lines extending through more than one floor level shall be supported at each floor with a riser clamp. Riser clamp shall be Carpenter Patterson, Grinnell Co.'s Figure 261, or approved equal. All vertical drops to pump suction elbows shall be supported by floor posts.
- E. Racks and Brackets: All horizontal piping on vertical walls shall be properly supported by suitable racks securely anchored into the wall construction. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction. Washer plates (Fib. 60, 60L) and other miscellaneous attachments, fasteners, etc., shall be Carpenter Patterson, Grinnell or as approved equal. All exterior hanger and bracket systems in their entirety shall be galvanized.
- F. Pipe Hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer.
- G. Select hangers and components for loads imposed. Secure rods with double nuts.
- H. Support of horizontal piping shall allow for vertical adjustment after installation of piping.
- I. Support overhead piping with clevis hangers.
- J. Do not support all parallel piping from the same joist. Stagger all supports in accordance with the structural engineer's recommendations.
- K. Refer to structural documents for appropriate connection/attachment materials to building.

3.8. AIR VENTING INSTALLATION REQUIREMENTS

- A. The top of each plumbing piping system and other points as indicated or where necessary for the removal of air from the system or equipment, shall be vented using an approved type of manual air vent.
- B. In addition to manual air vents at high points of system, each item of water heat transfer equipment shall be manually vented using an approved type manual air vent. All air vents shall be accessible.

3.9. DIRT POCKETS INSTALLATION REQUIREMENTS

- A. Dirt pockets shall be installed at the base of all risers, upstream of gas regulators, and ahead of all gas equipment and as indicated on the drawings.

3.10. EXPANSION LOOPS AND SWING CONNECTION INSTALLATION REQUIREMENTS

- A. Install expansion fittings according to manufacturer's written instructions.

- B. Install expansion fittings in sizes matching pipe size in which they are installed.
- C. Align expansion fittings to avoid end loading and torsional stress.
- D. Install pipe bends and loops cold sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- E. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.
- F. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- G. Connect risers and branch connections to plumbing equipment with at least four pipe fittings, including tee in riser.
- H. Connect mains and branch connections to plumbing equipment with at least four pipe fittings, including tee in main.
- I. Install expansion loops, guides, and anchors on all CPVC domestic water piping as required per manufacturer's instructions.

3.11. PIPING IDENTIFICATION REQUIREMENTS

- A. All piping shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color code and system identification shall comply with ANSI Standards and piping identification system shall comply with ASME A13.1-81., scheme for the identification of piping systems and ASHRAE Fundamentals Handbook, latest edition.
- B. Markings shall be plain block letters, stenciled on pipes, and shall be located near each branch connection, near each valve, and at least every 10 feet on straight runs of pipe. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such manner as to be easily legible from the floor. Pipe identification schedule shall be as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)
$\frac{1}{2}$ to $1\frac{1}{4}$	8	$\frac{1}{2}$
$1\frac{1}{2}$ to 2	8	$\frac{3}{4}$

2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
Over 10	32	3 ½

3.12. VALVE IDENTIFICATION REQUIREMENTS

- A. All valves shall be tagged with a numbered tag.
- B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.
- C. Provide a minimum of six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.
- D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in each mechanical equipment room including each air handling unit mechanical equipment room. Additional copies shall be provided in each copy of the O&M manuals.

3.13. CLEANING PIPING AND EQUIPMENT REQUIREMENTS

- A. All water, plumbing piping, and pumped condensate systems shall be cleaned by filling with a solution of one (1) pound of trisodium phosphate to each 50 gallons of water and circulating this solution for a period of six (6) hours during which time the system shall reach operating temperature. The systems shall then be flushed with fresh water and refilled with fresh water purged of all air.
- B. All water, plumbing, and pumped condensate piping system shall be flushed clean with fresh water. See Division 22 Sections, Plumbing Fixture and Plumbing Equipment for domestic potable water cleaning and sterilization.

3.14. BACKWATER VALVE INSTALLATION REQUIREMENTS

- A. Install backwater valve with access door to allow service and cleaning of ball check valve.
- B. Access door shall be adequate size to allow full clearance to backwater valves. Paint exterior of access door to match existing wall finish.
- C. Backwater valve size shall be as indicated on floor plans.

3.15. PRESSURE SEAL FITTING INSTALLATION REQUIREMENTS

- A. Viega, ProPress Pressure Seal bronze, Mueller Streamline, or approved equal or copper fittings: Sealing element shall be verified for the intended use. Tube ends shall be cut on a right angle (square) to the tube. Tube ends shall be reamed and chamfered, all grease oil or dirt shall be removed from the tube end with a clean rag. Visually examine the fitting sealing element to ensure there is no damage, and it is properly seated into the fitting. Utilizing a Viega Insertion Depth Inspection Gauge mark the tube wall, with a felt tip pen,

at the appropriate location, or insert the tube fully into the fitting and mark the tube wall at the face of the fitting. Always examine the tube to ensure it is fully inserted into the fitting prior to pressing the joint. ProPress fittings shall be installed according to the most current edition of the Viega installation guidelines. Installers shall attend a Viega ProPress installation training class.

- B. After ProPress, Mueller Streamline, or approved equal. Pressure seal fittings have been installed a “two step test” shall be followed. Pressurize the system with application appropriate test medium, water between 15 and 85 psi, or air/dry nitrogen between .5 and 45 psi. Check the pressure gauge for pressure loss. If the system does not hold pressure, walk the system and check for un-pressed fittings. Should you identify an un-pressed fitting ensure the tube is fully inserted into the fitting and properly marked, prior to pressing the joint. After appropriate repairs have been made, retest the system per local code, or specification requirements, not to exceed 600 psi with water or 200 psi when using air fitting.

END OF SECTION

DIVISION 22 SECTION 22 07 01
PLUMBING INSULATION
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SECTION 22 07 01
PLUMBING INSULATION

PART 1. GENERAL

1.1. REFERENCE

- A. The Conditions of the Contract and other General Requirements apply to the work specified in this Section. All work under this Section shall be subject to the requirements of Division 22 Section, Common Work Results for Plumbing.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. DESCRIPTION

- A. All piping and equipment installed under this Contract shall be covered as specified.

1.3. SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to all piping, equipment, and systems, in accordance with applicable project specifications and drawings, subject to the terms and conditions of the contract.

1.4. STANDARDS

- A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or use:
 - 1. American Society for Testing of Materials Specifications:
 - a. ASTM C 547, “Standard Specification for Mineral Fiber Preformed Pipe Insulation”.
 - b. ASTM C 533, “Standard Specification for Calcium Silicate Pipe & Block Insulation”.
 - c. ASTM C 55, “Standard Specification for Mineral Fiber Blanket and Felt Insulation”.
 - d. ASTM E 96, “Standard Test Methods for Water Vapor Transmission of Materials”.
 - e. ASTM C 585, “Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)”.
 - f. ASTM C 612, “Standard Specification for Mineral Fiber Block and Board Thermal Insulation”.
 - g. ASTM C 1136, “Standard Specification for Barrier Material, Vapor, “Type 1 or 2 (Jacket only).
 - h. ASHRAE 90.1 “Energy efficient design of new buildings except low-rise residential buildings”, latest edition.

- B. Insulation materials, including all weather and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.

1.5. SYSTEM PERFORMANCE

- A. Insulation materials furnished and installed hereunder should meet the minimum economic insulation thickness requirements of the North American Insulation Manufacturers' Association (NAIMA) (formerly known as TIMA), to ensure cost-effective energy conservation performance. Alternatively, materials should meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1, (latest edition) and "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), latest edition. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor. As minimum, all insulation thicknesses shall be as hereinafter specified.
- B. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of any one of the following specifications:
 - 1. American Society for Testing of Materials ASTM E 84
 - 2. Underwriters' Laboratories, Inc. UL 723
 - 3. National Fire Protection Association NFPA 255
- C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristics.

1.6. QUALITY ASSURANCE

- A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications listed in Section 1.4 above.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

1.7. DELIVERY AND STORAGE OF MATERIALS

- A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- B. The Contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The Contractor shall also use all means necessary to protect work and materials installed by other trades.
- C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install such material, and shall remove it from the job

site. An exception may be allowed in cases where the Contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer in writing for technical assistance.

- D. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements. Protect all insulation from water, construction traffic, dirt, chemical and mechanical damage.

1.8. ALTERNATES

- A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. GENERAL

- A. All materials to be insulated shall be thoroughly cleaned, after completion of successful tests, and shall be covered as specified below. Fiberglass insulation shall be Owens-Corning, Manville, Armstrong, or P.P.G, or as approved equal.

2.2. PIPE INSULATION MATERIALS

- A. Unless otherwise noted, insulation shall be one piece or half sectional molded fibrous glass with “K” rating of .23 at 75 degrees F mean temperature, for service temperatures between -60 degrees F and +450 degrees F with all service poly-encapsulated jacket. Pipe insulation shall be fiberglass ASJmax SSL II with double closure system as manufactured by Owens Corning, Johns Manville, Knauf or approved equal.
- B. Unless otherwise noted, pipe insulation jacket shall be factory-applied vinyl coated, embossed and reinforced vapor barrier laminate, with a perm rating of not more than 0.02 perms. All hot and cold, concealed, and exposed butt strips shall be of the same material as the jacket. Jacket and butt strips shall be sealed with field-applied Foster 85-20/85-50 or Childers CP-82 (5 gallon cans only) adhesive. Jacket and butt strips shall be off-white color and shall be equivalent to Owens-Corning Fiberglass 25-ASJ, Johns Manville, Knauf, or approved equal.
- C. For fittings on all piping, valves, and flanges, apply fiberglass molded or segmented insulation equal in thickness to the adjoining insulation and securely fasten in place using wire. Cold piping: Apply a tack coat of vapor barrier coating and reinforcing mesh. After ½ hour, apply second coat of same vapor barrier coating, UL labeled, Type C, for cold water piping. Hot piping, Type H for hot water piping: Apply tack of breather mastic. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of breather mastic over the reinforcing cloth, working it to a smooth finish. As an option to the above hot fittings, a polyvinyl chloride fitting cover may be supplied.
- D. All pipe insulation, jackets, or facings, and adhesives used to adhere jacket or facing to the insulation, including fittings and butt strips, shall have non-combustible fire and smoke

hazard system rating and label as tested by ASTM E-84, NFPA 225, and UL 73, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Accessories such as adhesives, mastic cements, tapes and cloth for fittings shall have the same ratings as listed above. All products or their shipping cartons shall bear the Underwriter's label indicating that flame and smoke ratings do not exceed the above criteria.

- E. For piping having a vapor barrier insulation and for all insulated piping requiring supports, hangers and supports shall be installed outside the insulation. Wherever hangers and supports are installed outside the insulation, pipe insulation protecting shields shall be provided. Where insulation is a load bearing material, of sufficient strength to support the weight of the piping, pipe shields one-third the circumference of the insulation and of a length not less than three times the diameter of the insulation (maximum length 24-inches) shall be provided. Insulation of 7-1/4 pound or greater density will be considered as load bearing for pipe sizes up to and including 2-inches. Where insulation is not of sufficient strength to support the weight of the piping, a half section of high density fiberglass or foam inserts, shall be provided. Vapor barrier and finish shall be applied as required to match adjoining insulation. In addition, shields shall be furnished as specified above.
- F. For piping located outside of the building, a corrugated aluminum weatherproof jacketing system shall be provided. This system shall be Micro-Lot ML as manufactured by Manville, Polyweld by Pabco Metals Corp., Childers, or as approved equal, and installed per the manufacturer's recommendations. Where outdoor piping is receiving electric heat tape, the insulation shall be oversized so that the heat tape is not compressed tightly to the pipe. Pipe jacketing shall be corrugated (3/16-inch) deep aluminum, .016-inch thickness of H-14 temper with aluminum strapping of .75-inch width and .020 inch thickness with moisture barrier. Aluminum jacketing elbows shall be smooth, .016-inch thickness and 1100 alloy. All jacketing shall have an integrally bonded moisture barrier over the entire surface in contact with the insulation. Longitudinal joints shall be applied so they will shed water and shall be sealed completely and shall be sealed completely with metal jacketing sealant. Sealant shall be Foster 95-44 or Childers CP-76. Circumferential joints shall be closed using preformed butt strips following manufacturer's recommendations for securement. Jacket seams shall be located on the bottom side of the horizontal piping.
- G. On cold systems such as domestic cold water, rainleaders, vapor barrier performance is extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a vapor barrier coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeance shall be 0.03 perms or less at 45 mils dry at test by ASTM E96.
- H. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of Fiberglass pipe insulation, Fiberglass pipe and tank insulation, Fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Where applicable, grooved joint PVC fitting valve and coupling covers shall be utilized. Grooved joint PVC covers shall be installed with matching pipe insulation jacketing material, vinyl tape, solvent weld adhesive and appropriate fasteners.
 - 1. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main

pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable weather or vapor-resistant mastic as dictated by the system location and service. Finish valve installation with a Tyvac jacket with ends that secure to adjacent piping.

2. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
 3. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion. All gauge and thermometer penetrations and extensions shall be correctly sealed and insulated to prevent surface condensation.
- I. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing must be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier must be continuous, including material covered by the hanger saddle.
1. Piping systems 3-inches (7.5cm) in diameter or less, insulated with Fiberglass insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation. Hangers saddles shall be minimum 16 gauge with a saddle arc of 120 degrees minimum.
 2. For hot or cold piping systems larger than 3-inches (7.5 cm) in diameter, operating at temperatures less than +200 degrees F (93 degrees C) and insulated with fiber glass, high density inserts such as foam with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +200 degrees F (93 degrees C), Owens-Corning Pink or IIG, Calcium Silicate pipe insulation shall be used for high density inserts.
 3. Owens-Corning Pink Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi (7kg/cm).
 4. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
 5. Thermal expansion and contraction of the piping and insulation system shall generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of insulation are being used and should be so noted on the contract drawings.
 6. On vertical runs, insulation support rings shall be used.

2.3. PIPING INSULATION THICKNESSES SCHEDULE

A. All piping shall be insulated with pipe insulation of the thicknesses indicted below:

PIPING INSULATION THICKNESS SCHEDULE SERVICES	THICKNESS
Above Grade Trap Priming Lines	½ -inch thickness
All Above Grade Floor Drain Piping Serving AHU Condensate Drains include Drain Sumps and Auxiliary Drain Pipes from Auxiliary Pans	1-inch thickness
All Domestic Hot and Cold Water Piping, including Re- circulating Piping	1-inch thickness
All Drain Piping from Cooling Coils/Evaporators	½-inch thickness
All Horizontal Roof Drain Piping Including Sumps	1-inch thickness
Electric Water Cooler Drains, Kitchen Equipment Drains	1-inch thickness
Emergency Fixture Tepid Water Piping	1-inch thickness
Floor Drain or Stormwater Piping that collects condensate	1-inch thickness
Tepid Water for Emergency Fixtures	1-inch thickness
Dental Vacuum Pump Exhaust Piping	1-inch thickness
Vertical and horizontal roof drain piping where the same handles A/C condensate.	1-inch thickness

2.4. EQUIPMENT INSULATION MATERIALS AND THICKNESSES

A. The following equipment shall be insulated with Fiberglass Rigid Board Insulation or Foam Plastic Insulation:

1. All piping within emergency and high-low mixing valve cabinets.
2. All Pump Volutes and Strainers.
3. Backflow Preventer Valve Bodies.
4. Domestic Booster Pump Suction and Discharge Headers.
5. Domestic Water Meters.
6. Expansion Tanks.
7. Hydro Pneumatic Tanks.

8. Make-up Water Valve Bodies.
 9. Make-Up Water Meters.
 10. Plumbing Pumps.
 11. Solenoid Valve Bodies.
- B. Insulation for cold surfaces shall be 1-1/2-inch thickness, 6 lb. density, 705 FRK with a "K" rating of .23 at 75 degrees F mean temperature. Insulation for hot surfaces except as otherwise noted shall be 1-1/2-inch thickness, 6 lb. density, 705 with a "K" rating of .23 at 75 degrees F mean temperature. Insulation shall be applied with staggered joints firmly butted and joined. The insulation shall be held in place by steel bands. Bands shall be 1-inch by 25 gauge galvanized steel spaced on not over 12-inch centers. All joints and voids shall be filled with Owens-Corning #110 cement, well troweled into openings. For 705 FRK insulation, all joints and voids shall be FRK taped and vapor sealed. There shall be applied over the insulation surface 1-inch galvanized wire netting laced together at all edges and wired to the steel bands with 16 gauge soft annealed wire. Over this shall be applied 2-inch thick layer of Owens-Corning #110 cement applied in two layers. Install metal corner beads at all corners and edges in order to provide a permanent installation. Onto the dry cement surface apply a brush coat of Foster Sealfas 30-36 or Childers CP-50AMV1 lagging adhesive at the rate of 60-70 square feet per gallon. Cleanouts, nameplates, and manholes shall not be insulated, and the insulation on surrounding surfaces shall be neatly beveled off at such openings.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from aluminum at least 0.040 inch (1.0 mm) thick.
 3. For below ambient services, install a vapor barrier coating at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
- D. Mechanical fasteners shall be utilized to hold insulation to surface with bands as required to hold the curvature of the material.
- E. Support rings shall be provided to support the top head insulation where required.
- F. Outdoor installations require a weather barrier mastic for protection of the insulation jacketing.
- G. Insulation types materials shall be suitable for temperatures encountered by each item of equipment.
- H. Install removable insulation sections at all cleanouts, test ports, and items that must be

periodically tested.

2.5. ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under this section shall include, but not be limited to:
 - 1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
 - 2. Field-applied jacketing materials - sheet metal, plastic, canvas, fiber glass cloth, insulating cement; PVC fitting covers, PVC jacketing.
 - 3. Support Materials - Hanger straps, hanger rods, saddles.
 - 4. Fasteners, weld pins/studs, speed clips, insulation washers.
 - 5. Metal mesh or expanded metal lagging.
- B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

2.6. FIELD-APPLIED JACKET

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer. VOC content not to exceed 250 g/L.
 - 3. Color: High Gloss White
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

PART 3. EXECUTION

3.1. WORKMANSHIP

- A. The Contractor shall take special care to prevent soiling equipment below or adjacent to areas being insulated. He shall be completely responsible for removing insulation cement splashes and smears and all surfaces that he mars or otherwise soils or defaces, and he will be totally responsible for restoring these damaged surfaces to their like-new condition when delivered to the site.

3.2. SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.3. PREPARATION

- A. Ensure that all pipe and equipment surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping systems has been completed prior to installing insulation.

3.4. INSTALLATION

A. Piping Systems

1. General:

- a. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- b. Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
- c. 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. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
- d. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tear or other damage. Seal all tears, punctures and other penetrations of the pipe insulation vapor barrier coating.
 - e. On exposed piping, locate insulation and cover seams in least visible location.
- 2. Fittings: Cover valves, fittings, unions, flanges, strainers, flexible connections, expansion joints, pump bodies, strainers, blowdowns, backflow preventers, autoflow valves and similar items in each piping system using one of the following:
 - a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
 - b. Insulation cement equal in thickness to the adjoining insulation.
 - c. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.
 - 3. Penetrations: Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.
 - 4. Joints:
 - a. Butt pipe insulation against hanger inserts. For hot pipes, apply 3-inch (7.5cm) wide vapor barrier tape or band over butt joints. For cold piping, apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3-inch (7.5cm) wide vapor barrier tape or band.
 - b. All pipe insulation ends shall be tapered and sealed, regardless of service.
 - 5. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- B. Equipment Insulation:
- 1. General:
 - a. Install insulation in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
 - b. Install insulation on equipment after installation of heat tracing, painting, testing, and acceptance tests.
 - c. Install insulation materials with smooth, even surfaces. Rework poorly fitted joints. Do not use joint sealer or mastic as filler for joint gaps and excessive voids resulting from poor workmanship. Apply insulation using staggered joint method for both single and double layer installation, applying each layer of insulation separately.
 - d. Coat insulated surfaces where specified on contract drawings with layer of

insulating cement, troweled in a workmanlike manner, leaving a smooth and continuous surface. Fill in seams, broken edges, and depressions. Cover over wire mesh and joints with cement sufficiently thick to remove surface irregularities.

- e. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage. Seal all tears, punctures and other penetrations of equipment insulation facing.
 - f. Where specification calls for field-applied all-service vapor barrier jacketing, it shall be neatly fitted and tightly secured. Lap seams 2-inches (5cm) (min.). Seal all joints with adhesive. Tape with 3-inches (7.5cm) matching pressure-sensitive tape or 3-inch (7.5cm) glass fabric and vapor barrier coating.
 - g. On exposed equipment, locate insulation and cover seams in least visible location.
- 2. Removable Insulation: Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance, such as vessel covers, fasteners, flanges, frames accessories, manholes, handholes, cleanouts ASME stamp, and manufacturer nameplates.
 - 3. Areas Left Uninsulated: Items such as manholes, handholes, clean-outs, ASME stamp, and manufacturers' nameplates should be left uninsulated unless omitting insulation would cause a condensation problem. When such is the case, provide removable insulation and appropriate tagging to identify the presence of these items. Provide neatly beveled edges at interruptions of insulation.
 - 4. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather barrier mastic protective finish or jacketing as recommended by the jacketing manufacturer.

3.5. FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.6. PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.7. SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard

hats, and eye protection.

- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.8. INSULATION COVERING

- A. Unless otherwise noted, all exposed equipment insulation shall have a field applied PVC jacket cover neatly cut and pasted over equipment insulation. PVC shall be high gloss white and shall be 20 mils thick. Exposed areas include, but are not limited to, all mechanical equipment rooms/fan rooms, above architectural ceiling clouds, mezzanines, penthouses, boiler rooms, janitor's closets, kitchens, electric rooms, and piping and ductwork exposed in an occupied space.
- B. Unless otherwise noted, all exposed pipe insulation required to be insulated shall be jacketed with a PVC Jacketing with fitting covers. PVC jacket shall be color fade resistant, white high gloss, U.S.D.A. authorized as manufactured by Proto Corporation or approved equal. PVC jacketing shall be high impact, ultraviolet resistant PVC. Minimum thickness shall be 20 mils, roll stock ready for shop or field cutting and forming.
- C. Where PVC jackets are indicated, install with 1 inch overlap at longitudinal seams and end joints, for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

END OF SECTION

DIVISION 22 SECTION 22 40 00
PLUMBING FIXTURES

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SECTION 22 40 00
PLUMBING FIXTURES

PART 1. GENERAL

1.1. GENERAL

- A. For General Mechanical Requirements, see Division 22 Section, Common Work Results for Plumbing & Division 01, General Requirements.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications apply to this Section.
- C. All exposed bolts, screws, etc., shall be vandal proof.
- D. All plumbing materials, equipment and fixtures shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.
- E. Piping and insulation are specified under other sections.
- F. Use "Sani-Sett" setting compound for fixtures.
- G. Provide all materials, equipment and perform all labor required to install plumbing system complete as specified, as drawings indicated and as required by the following:
 - 1. State of Delaware
 - 2. International Plumbing Code
 - 3. County of New Castle
 - 4. City of Newark Code
 - 5. All other authorities have jurisdiction.
- H. Comply with the current lead-free laws per the requirements of the state in which the project is being constructed.
- I. Provide stops for all plumbing fixtures and equipment. Stops are to be accessible.
- J. Provide P traps on fixtures for which traps have not been included as part of furnished equipment. Trap size to equal size of fixture tailpiece.
- K. All exposed metal parts of fixtures shall be chromium plated brass. Piping, fittings, valves, traps and accessories including escutcheons for piping shall be chromium plated where exposed in finished areas.
- L. All faucets for the following list shall be listed for drinking-water or commercial applications by the National Sanitation Foundation (NSF) or Underwriters Laboratory (U.L.). All required faucets shall comply with NSF Standard 61 for both lead content and leaching rate. Submit documentation indicating compliance for all required faucets.

1. Residential kitchen sinks
 2. Lavatories
 3. Commercial kitchen sinks
 4. Drinking fountains
 5. Bubblers
 6. Ice makers
- M. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
1. American Gas Association (AGA).
 2. National Sanitation Foundation (NSF).
 3. American Society of Mechanical Engineers (ASME).
 4. National Electrical Manufacturers' Association (NEMA).
 5. Underwriters Laboratories (UL).

1.2. REFERENCES

- A. ANSI/ASME A112.6.1 - Supports for Off-the-floor Plumbing Fixtures for Public Use
- B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
- D. ANSI/ASMI A112.19.2 - Vitreous China Plumbing Fixtures.
- E. ANSI/ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- F. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
- G. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowl, Tanks, and Urinals (Dimensional Standards).
- H. IAPMO/ANSI Z124.2 - Plastic Shower Receptors and Shower Stalls.
- I. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
- J. ANSI/ARI 1010 - Drinking-Fountains and Self- Contained, Mechanically Refrigerated Drinking Water Coolers.
- K. ANSI/NFPA 70 - National Electrical Code.
- L. IBC - International Building Code

1.3. DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01, Section General Requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.4. FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and per the manufacturer.
- B. Confirm that millwork is constructed with adequate provisions for the installation of counter top lavatories and sinks.

1.5. EXTRA MATERIALS

- A. Provide two sets of faucet washers and flush valve service kits to the Owner. Provide correspondence to Engineer that extra materials have been turned over to the Owner.
- B. For science room fixtures, furnish to Owner in a suitable container spare quantity of lime chips for each bottle trap of the project.
- C. For battery operated plumbing fixtures, furnish to Owner in a suitable container a spare set of batteries for each fixture.

1.6. GRAB BAR COORDINATION

- A. For handicapped plumbing fixtures coordinate location of flush valves with grab bars prior to installation.

1.7. ALTERNATES

- A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

PART 2. PRODUCTS

2.1. WALL-MOUNTED WATER CLOSETS

- A. WC-2 Wall Hung, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Model K-4325 Kingston
 - b. American Standard

- c. Crane
 - d. Sloan
 - e. Zurn
 - 2. Bowl:
 - a. Material: Vitreous china
 - b. Type: Siphon Jet
 - c. Style: Flushometer Valve
 - d. Height: Standard
 - e. Rim Contour: Elongated
 - f. Spud Size; Location: NPS 1-1/2; Top
 - 3. Flushometer Valve:
 - a. Diaphragm Type: Sloan Model #8111, Delany, Zurn or approved equal.
 - b. Chrome plated brass.
 - c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
 - d. Courtesy flush override button
 - e. Low Battery flashing LED
 - f. Infrared sensor range adjustment.
 - g. Initial set-up range indicator light.
 - h. Four (4) size AA batteries.
 - i. 1-inch I.P.S. screwdriver back check angle stop.
 - j. Spud coupling and flange.
 - k. Locking vandal resistant stop cap.
 - l. Adjustable tail piece.
 - m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
 - n. Sweat solder adapter with cover tube and cast set screw wall flange.
 - o. Split Ring Wall Support: Sloan Model J-312-A.
 - p. Provide 3-year limited Manufacturer's warranty.
 - 4. Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.
 - 5. Carrier: Zurn, Josam, or Watts cast iron watercloset Carrier with fittings as required. ANSI/ASME A112.6.1 adjustable cast iron frame integral drain hub and vent, adjustable speed, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.
- B. WC-2A Wall Hung, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button, Handicapped
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Model K-4325 Kingston
 - b. American Standard
 - c. Crane

- d. Sloan
 - e. Zurn
2. Bowl:
- a. Material: Vitreous china
 - b. Type: Siphon Jet
 - c. Style: Flushometer Valve
 - d. Height: A.D.A. Compliant
 - e. Rim Contour: Elongated
 - f. Spud Size; Location: NPS 1-1/2; Top
3. Flushometer Valve:
- a. Diaphragm Type: Sloan Model #8111, Delany, Zurn or approved equal.
 - b. Chrome plated brass.
 - c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
 - d. Courtesy flush override button
 - e. Low Battery flashing LED
 - f. Infrared sensor range adjustment.
 - g. Initial set-up range indicator light.
 - h. Four (4) size AA batteries.
 - i. 1-inch I.P.S. screwdriver back check angle stop.
 - j. Spud coupling and flange.
 - k. Locking vandal resistant stop cap.
 - l. Adjustable tail piece.
 - m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
 - n. Sweat solder adapter with cover tube and cast set screw wall flange.
 - o. Split Ring Wall Support: Sloan Model J-312-A.
 - p. Provide 3-year limited Manufacturer's warranty.
4. Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.
5. Carrier: Zurn, Josam, or Watts cast iron watercloset Carrier with fittings as required. ANSI/ASME A112.6.1 adjustable cast iron frame integral drain hub and vent, adjustable speed, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.2. FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

- A. WC-14 Floor Mounted, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button, Child Height
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Kohler Model K-96064-SS Primary
 - b. American Standard

- c. Crane
- d. Sloan
- e. Zurn

2. Bowl:

- a. Material: Vitreous china
- b. Type: Siphon Jet
- c. Style: Flushometer Valve
- d. Height: Standard
- e. Rim Contour: Elongated
- f. Spud Size; Location: NPS 1-1/2; Top

3. Flushometer Valve:

- a. Diaphragm Type: Sloan Model Optima Plus #8111, Delany, Zurn or approved equal.
- b. Chrome plated brass.
- c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
- d. Courtesy flush override button
- e. Low Battery flashing LED
- f. Infrared sensor range adjustment.
- g. Initial set-up range indicator light.
- h. Four (4) size AA batteries.
- i. 1-inch I.P.S. screwdriver back check angle stop.
- j. Spud coupling and flange.
- k. Locking vandal resistant stop cap.
- l. Adjustable tail piece.
- m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
- n. Sweat solder adapter with cover tube and cast set screw wall flange.
- o. Split Ring Wall Support: Sloan Model J-312-A.
- p. Provide 3-year limited Manufacturer's warranty.

- 4. Toilet Seat: Kohler Model K-4686-A, American Standard 5001G.055, solid plastic white seat with open front and check hinge.

2.3. WALL-HUNG URINALS

A. U-2 Wall Hung, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Model K-4991-ET Bardon
 - b. American Standard
 - c. Sloan
 - d. Zurn

2. Fixture:
 - a. Material: Vitreous china
 - b. Type: Washout
 - c. Rim Height: Standard
 - d. Spud Size; Location: NPS 3/4; Top
 - e. Outlet Size; Location: NPS 2; Back
 3. Flushometer Valve:
 - a. Diaphragm Type: Sloan Model Optima Plus #8186, Delany, Zurn or approved equal.
 - b. Chrome plated brass.
 - c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
 - d. Courtesy flush override button
 - e. Low Battery flashing LED
 - f. Infrared sensor range adjustment.
 - g. Initial set-up range indicator light.
 - h. Four (4) size AA batteries.
 - i. 3/4-inch I.P.S. screwdriver back check angle stop.
 - j. Spud coupling and flange.
 - k. Locking vandal resistant stop cap.
 - l. Adjustable tail piece.
 - m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
 - n. Sweat solder adapter with cover tube and cast set screw wall flange.
 - o. Split Ring Wall Support: Sloan Model J-312-A.
 - p. Provide 3-year limited Manufacturer's warranty.
 4. Carrier: Zurn, Josam or Watts cast iron urinal carrier with fittings as required. ANSI/ASME A112.6.1A; cast iron and steel frame with tubular legs, legs for floor and wall attachment, threaded fixtures studs for fixture hanger, bearing studs.
- B. U-2A Wall Hung, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button, Handicapped
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Model K-4991-ET Bardon
 - b. American Standard
 - c. Sloan
 - d. Zurn
 2. Fixture:
 - a. Material: Vitreous china
 - b. Type: Washout
 - c. Rim Height: A.D.A. Compliant
 - d. Spud Size; Location: NPS 3/4; Top

- e. Outlet Size; Location: NPS 2; Back
- 3. Flushometer Valve:
 - a. Diaphragm Type: Sloan Model Optima Plus #8186, Delany, Zurn or approved equal.
 - b. Chrome plated brass.
 - c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
 - d. Courtesy flush override button
 - e. Low Battery flashing LED
 - f. Infrared sensor range adjustment.
 - g. Initial set-up range indicator light.
 - h. Four (4) size AA batteries.
 - i. 3/4-inch I.P.S. screwdriver back check angle stop.
 - j. Spud coupling and flange.
 - k. Locking vandal resistant stop cap.
 - l. Adjustable tail piece.
 - m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
 - n. Sweat solder adapter with cover tube and cast set screw wall flange.
 - o. Split Ring Wall Support: Sloan Model J-312-A.
 - p. Provide 3-year limited Manufacturer's warranty.
- 4. Carrier: Zurn, Josam or Watts cast iron urinal carrier with fittings as required. ANSI/ASME A112.6.1A; cast iron and steel frame with tubular legs, legs for floor and wall attachment, threaded fixtures studs for fixture hanger, bearing studs.

2.4. WALL-MOUNTED LAVATORIES

A. LAV-2 Wall-Hung, Deck Mounted, Battery Operated, Infrared Sensor Faucet

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Model K-2032 Greenwich
 - b. American Standard Lucerne
 - c. Crane
 - d. Zurn
- 2. Fixture:
 - a. Material: Vitreous china
 - b. Type: Wall-Hung
 - c. Rim Mounting Height: Standard
 - d. Nominal Size: 20-3/4”L x 18-1/4”W
 - e. Faucet-Hole Punching: Three Holes, 4-inch centers
 - f. Faucet-Hole Location: Top
 - g. Color: White
 - h. Mounting Material: Concealed Arm Carrier

3. Faucet:
 - a. Chicago Faucet 116.221.AB.4 (0.35 GPM), Sloan, American Standard
 - b. Deck Mounted
 - c. Sensor and Solenoid above deck within faucet
 - d. Low-Flow, vandal-proof outlet
 - e. Polished Chrome Finish
 - f. 4-inch Spout
 - g. Integral check cartridges
 - h. Unit shall be A.D.A. Compliant
 - i. 6 Volt Lithium CRP2 Battery (included)
4. Strainer:
 - a. Chicago Faucet Model 327A, American Standard
 - b. 1-1/4-inch tailpiece
 - c. Non-removable brass strainer
 - d. Grid strainer waste
 - e. Chrome plated finished.
5. P-Trap:
 - a. Cast Brass 1-1/4-inch "P" trap
6. Stops:
 - a. Chicago Faucet Model l005-ABCP valve stops.
 - b. 3/8-inch loose key cap
 - c. Removable tee handle
 - d. Wall flange
 - e. Chrome plated finished.
7. Thermostatic Mixing Valves:
 - a. Provide and install below fixture.
 - b. See Part 2 “Thermostatic Mixing Valves”.
8. Carrier:
 - a. Zurn, Josam, or Watts cast iron and steel carrier.
 - b. ANSI/ASME A112.6.1
 - c. Cast iron and steel frame with tubular legs.
 - d. Lugs for floor and wall attachment.
 - e. Concealed arm supports.
 - f. Bearing plate and studs.
- B. LAV-2A Wall-Hung, Deck Mounted, Battery Operated, Infrared Sensor Faucet,
 Handicapped
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Kohler Model K-2032 Greenwich
 - b. American Standard Lucerne
 - c. Crane
 - d. Zurn
2. Fixture:
 - a. Material: Vitreous china
 - b. Type: Wall-Hung
 - c. Rim Mounting Height: A.D.A. Compliant
 - d. Nominal Size: 20-3/4”L x 18-1/4”W
 - e. Faucet-Hole Punching: Three Holes, 4-inch centers
 - f. Faucet-Hole Location: Top
 - g. Color: White
 - h. Mounting Material: Concealed Arm Carrier
3. Faucet:
 - a. Chicago Faucet 116.221.AB.4 (0.35 GPM), Sloan, American Standard
 - b. Deck Mounted
 - c. Sensor and Solenoid above deck within faucet
 - d. Low-Flow, vandal-proof outlet
 - e. Polished Chrome Finish
 - f. 4-inch Spout
 - g. Integral check cartridges
 - h. Unit shall be A.D.A. Compliant
 - i. 6 Volt Lithium CRP2 Battery (included)
4. Strainer:
 - a. Chicago Faucet Model 327A, American Standard
 - b. 1-1/4-inch tailpiece
 - c. Non-removable brass strainer
 - d. Grid strainer waste
 - e. Chrome plated finished.
5. P-Trap:
 - a. Cast Brass 1-1/4-inch "P" trap
6. Stops:
 - a. Chicago Faucet Model l005-ABCP valve stops.
 - b. 3/8-inch loose key cap
 - c. Removable tee handle
 - d. Wall flange
 - e. Chrome plated finished.
7. Thermostatic Mixing Valves:
 - a. Provide and install below fixture.

- b. See Part 2 “Thermostatic Mixing Valves”.
- 8. Carrier:
 - a. Zurn, Josam, or Watts cast iron and steel carrier.
 - b. ANSI/ASME A112.6.1
 - c. Cast iron and steel frame with tubular legs.
 - d. Lugs for floor and wall attachment.
 - e. Concealed arm supports.
 - f. Bearing plate and studs.
- 9. Lavatory Protective Enclosure:
 - a. Provide and install Truebro Model # 2018 lav shield lavatory enclosure on all lavatories with sensor operated faucets. Protective enclosure shall be ADA conforming, 20-inch x 18-inch wheelchair accessible. Unit shall have white finish, be constructed of high impact, stain resistant vinyl, and include seven (7) wall anchors.

2.5. MULTI-STATION LAVATORIES

- A. LAV-18A Two (2) Station, Hard-wired, Infrared Sensor Faucet, Handicapped
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Express SS-2N/IR
 - b. Sloan ELS-42000
 - 2. Station:
 - a. Double hand washing station
 - b. Wall Mounted
 - c. Infrared type faucets with concealed vandal-resistant stream formers.
 - d. Provide timing turn-off delay of 2-3 seconds.
 - e. 110/24 VAC plug-in transformer
 - f. Low-Flow Outlet of 0.5 GPM
 - g. Lavatory system shall include all waste and supply connections to wall, and thermostatic mixing valve with stop, strainer, and check valves.
 - h. Bowl material for each station shall be a cast polyester resin complying with ANSI Z124.3 and ANSI Z124.6. Bowl finish shall be decorative stone.
 - i. Lavatory system shall be secured to a rigid base concealing all supply and waste connections.
 - j. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
 - k. Certification to comply with ADA shall be furnished.
- B. LAV-18B Three (3) Station, Hard-wired, Infrared Sensor Faucet, Handicapped
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bradley Express SS-3N/IR
- b. Sloan ELS-43000

2. Station:

- a. Triple hand washing station
- b. Wall Mounted
- c. Infrared type faucets with concealed vandal-resistant stream formers.
- d. Provide timing turn-off delay of 2-3 seconds.
- e. 110/24 VAC plug-in transformer
- f. Low-Flow Outlet of 0.5 GPM
- g. Lavatory system shall include all waste and supply connections to wall, and thermostatic mixing valve with stop, strainer, and check valves.
- h. Bowl material for each station shall be a cast polyester resin complying with ANSI Z124.3 and ANSI Z124.6. Bowl finish shall be decorative stone.
- i. Lavatory system shall be secured to a rigid base concealing all supply and waste connections.
- j. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
- k. Certification to comply with ADA shall be furnished.

2.6. CHILD-HEIGHT LAVATORIES

LAV-20 Wall-Hung, Child Height, Deck Mounted, Battery Operated, Infrared Sensor Faucet

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

- a. Kohler Model K-2032 Greenwich
- b. American Standard Lucerne
- c. Crane
- d. Zurn

2. Fixture:

- a. Material: Vitreous china
- b. Type: Wall-Hung
- c. Rim Mounting Height: Child Height (27-inches a.f.f.)
- d. Nominal Size: 20-3/4”L x 18-1/4”W
- e. Faucet-Hole Punching: Three Holes, 4-inch centers
- f. Faucet-Hole Location: Top
- g. Color: White
- h. Mounting Material: Concealed Arm Carrier

3. Faucet:

- a. Chicago Faucet 116.221.AB.4 (0.35 GPM), Sloan, American Standard
- b. Deck Mounted
- c. Sensor and Solenoid above deck within faucet
- d. Low-Flow, vandal-proof outlet

- e. Polished Chrome Finish
 - f. 4-inch Spout
 - g. Integral check cartridges
 - h. Unit shall be A.D.A. Compliant
 - i. 6 Volt Lithium CRP2 Battery (included)
- 4. Strainer:
 - a. Chicago Faucet Model 327A, American Standard
 - b. 1-1/4-inch tailpiece
 - c. Non-removable brass strainer
 - d. Grid strainer waste
 - e. Chrome plated finished.
- 5. P-Trap:
 - a. Cast Brass 1-1/4-inch "P" trap
- 6. Stops:
 - a. Chicago Faucet Model l005-ABCP valve stops.
 - b. 3/8-inch loose key cap
 - c. Removable tee handle
 - d. Wall flange
 - e. Chrome plated finished.
- 7. Thermostatic Mixing Valves:
 - a. Provide and install below fixture.
 - b. See Part 2 "Thermostatic Mixing Valves".
- 8. Carrier:
 - a. Zurn, Josam, or Watts cast iron and steel carrier.
 - b. ANSI/ASME A112.6.1
 - c. Cast iron and steel frame with tubular legs.
 - d. Lugs for floor and wall attachment.
 - e. Concealed arm supports.
 - f. Bearing plate and studs.

2.7. MOP SINKS – SERVICE SINKS

- A. JS-1 Mop Sink, Corner Unit
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Stern Williams Model Corlow-SBC
 - 2. Fixture:

- a. Material: Terrazzo
 - b. Type: Corner, Floor-mounted
 - c. Receptor composed of pearl grey marble chips and white Portland unit, ground smooth, grouted, and sealed to resist stains.
 - d. Stainless steel cap of one piece 20 gauge, 302 stainless steel cast integral on threshold.
 - e. Provide and install stainless steel BP splash Catcher panels on adjacent walls.
- 3. Faucet:
 - a. Chicago Faucet 897-RCF, Speakman, American Standard
 - b. Rough Chrome Finish
 - c. Vacuum breaker spout
 - d. Stop in arms
 - e. 3/4-inch hose thread outlet.
 - f. Pail Hook
 - g. Wall Brace
 - h. Stern-Williams T-35 hose, bracket and mop hanger.
- B. JS-7 Service Sink (Stainless Steel)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Model B1C Dependabilt
 - b. Kohler
 - c. Just
 - 2. Fixture:
 - a. Material: Stainless Steel – 18-gauge
 - b. Type: Wall Mounted w/ stainless steel legs
 - c. Nominal Basin Size: 24"x24"x12"
 - d. Rim Guard: Stainless Steel
 - e. Wall Hanger Supports
 - 3. Faucet:
 - a. T&S Model B-0674-BSTR, Chicago Faucet 305-VBRCF
 - b. Rough Chrome Finish
 - c. Vacuum breaker spout
 - d. Adjustable Stop supply arms
 - e. 3/4-inch hose thread outlet.
 - f. Pail Hook
 - g. Vandal Proof Lever Handles
 - 4. Strainer:
 - a. Jomar Model SS-306 Snap-N-Loc basket strainer with brass locknut and tailnut.

- b. Deep cup body and basket shall be 300 series stainless steel
- 5. P-Trap:
 - a. Cast Brass 3-inch "P" trap
- 6. Thermostatic Mixing Valves:
 - a. Provide and install below fixture.
 - b. See Part 2 "Thermostatic Mixing Valves"

2.8. WATER COOLERS – FOUNTAINS

- A. EWC-2 Electric Water Cooler, Single Height, Surface Mounted, Handicapped, Bottle Filling Station
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Elkay Model LZS8WS](#)
 - b. Halsey Taylor
 - c. Haws
 - d. Oasis PG8EBF
 - 2. Fixture:
 - a. Barrier Free
 - b. Single Height with mounting frame
 - c. 8 GPH at 90°F ambient
 - d. 50°F outlet drinking water with 80°F inlet water
 - e. Top shall be stainless steel
 - f. Bubblers valve electronically controlled
 - g. Bubbler shall be vandal resistant
 - h. Activated by touch pads on sides and front for electronically timed period of flow.
 - i. Cabinet shall be powder coated on heavy gauge steel, color to be selected by Architect.
 - j. Supplied with plug-in, 3-wire grounding type service
 - k. Operation on 120 VAC, Single Phase, 60Hz
 - l. Spout Outlet shall be mounted 36-inches maximum above floor.
 - m. Water cooler and installation shall conform to all requirements of American Disabilities Act Guidelines and ANSI A117.1.
 - 3. Bottle Filling Station:
 - a. Electronic Sensor for No-Touch activation
 - b. Automatic 20 second shut-off timer
 - c. 1.1 GPM flow rate with laminar flow
 - d. Water Sentry® Plus, 3,000 gallon capacity filter
 - e. Certified to NSF/ANSI 61, UL 399 and CAN/CSA 22.2 No. 120.
 - f. Provide replacement filter pack (3 filters per pack) and turn over to Owner.

4. Refrigerant shall be R-134a or equivalent environmentally friendly refrigerant.
 5. Provide Carrier as manufactured by Elkay or approved equal.
 6. Provide cane apron for water cooler (required where water coolers project more than 4 inches into the corridor).
- B. EWC-4 Electric Water Cooler, Dual Height, Surface Mounted, Handicapped, Bottle Filling Station
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Elkay Model LZSTL8WS](#)
 - b. Halsey Taylor
 - c. Haws
 - d. Oasis PG8EBFSL
 2. Fixture:
 - a. Barrier Free
 - b. Dual Height with mounting frame
 - c. 8 GPH at 90°F ambient
 - d. 50°F outlet drinking water with 80°F inlet water
 - e. Top shall be stainless steel
 - f. Bubbler valve electronically controlled
 - g. Bubbler shall be vandal resistant
 - h. Activated by touch pads on sides and front for electronically timed period of flow.
 - i. Cabinet shall be powder coated on heavy gauge steel, color to be selected by Architect.
 - j. Supplied with plug-in, 3-wire grounding type service
 - k. Operation on 120 VAC, Single Phase, 60Hz
 - l. Lower Spout Outlet shall be mounted 36-inches maximum above floor.
 - m. Upper Spout Outlet shall be mounted 42-inches maximum above floor.
 - n. Water cooler and installation shall conform to all requirements of American Disabilities Act Guidelines and ANSI A117.1.
 3. Bottle Filling Station:
 - a. Electronic Sensor for No-Touch activation
 - b. Automatic 20 second shut-off timer
 - c. 1.1 GPM flow rate with laminar flow
 - d. Water Sentry® Plus, 3,000 gallon capacity filter
 - e. Certified to NSF/ANSI 61, UL 399 and CAN/CSA 22.2 No. 120.
 - f. Provide replacement filter pack (3 filters per pack) and turn over to Owner.
 4. Refrigerant shall be R-134a or equivalent environmentally friendly refrigerant.
 5. Provide Carrier as manufactured by Elkay or approved equal.

6. Provide cane apron for water cooler (required where water coolers project more than 4 inches into the corridor).

2.9. COUNTER SINKS

A. S-1 Counter Sink – Single Bowl

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co. – Lustertone LR/DLR Series
 - b. Just Manufacturing Co.
2. Fixture:
 - a. Type: Single Bowl, Counter Mounted, Self-Rimming.
 - b. Overall Dimensions (L x W x D) inches:

22 x 19-1/2 x 10
 - c. Material: 302 Stainless Steel, 18 gauge, fully coated underside.
3. Faucet:
 - a. Standard: ASME A112.18/CSA B125.1
 - b. General: Include hot and cold water indicators; coordinate faucet inlets with supplies and fixture hold punchings; coordinate outlet with spout and sink receptor.
 - c. Model: Chicago Faucet Model 201-AGN8AE3-317ABCP] [786-E3ABCP
 - d. Body Type: Centerset, 8” fixed centers
 - e. Finish: Chrome Plated
 - f. Handle(s): Model 317 Wrist Blade Handles, A.D.A. Compliant
 - g. Mounting Type: Deck, concealed.
 - h. Spout Type: Swivel gooseneck.
 - i. Spout Outlet: E3 Aerator
4. Strainer: Jomar Model SS-306 Snap-N-Loc, or Just J-35 basket strainer and brass locknut and tailnut. Deep cup body and basket shall be 300 series stainless steel. Provide 1 ½-inch tailpiece.
5. P-Trap: Cast Brass 1 ½ -inch "P" trap.
6. Stops: Chicago Faucets Model 1005ABCP valve stops with riser supply, 3/8-inch loose key cap and removable tee handle, wall flange, chrome plated finish.

B. S-1A Counter Sink – Single Bowl (Handicapped)

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

- a. Elkay Manufacturing Co. – Lustertone LRAD Series
 - b. Just Manufacturing Co.
2. Fixture:
- a. Type: Single Bowl, Counter Mounted, Self-Rimming.
 - b. Overall Dimensions (L x W x D) inches:

22 x 19-1/2 x 5-1/2
 - c. Material: 302 Stainless Steel, 18 gauge, fully coated underside.
3. Faucet:
- a. Standard: ASME A112.18/CSA B125.1
 - b. General: Include hot and cold water indicators; coordinate faucet inlets with supplies and fixture hold punchings; coordinate outlet with spout and sink receptor.
 - c. Model: Chicago Faucet Model 201-AGN8AE3-317ABCP
 - d. Body Type: Centerset, 8" fixed centers
 - e. Finish: Chrome Plated
 - f. Handle(s): Model 317 Wrist Blade Handles, A.D.A. Compliant
 - g. Mounting Type: Deck, concealed.
 - h. Spout Type: Swivel gooseneck.
 - i. Spout Outlet: E3 Aerator
4. Strainer: Jomar Model SS-306 Snap-N-Loc, or Just J-35 basket strainer and brass locknut and tailnut. Deep cup body and basket shall be 300 series stainless steel. Provide 1 1/2-inch tailpiece.
5. P-Trap: Cast Brass 1 1/2 -inch "P" trap.
6. Stops: Chicago Faucets Model 1005ABCP valve stops with riser supply, 3/8-inch loose key cap and removable tee handle, wall flange, chrome plated finish.

2.10. TECH/MULTI-STATION SINKS

A. S-7 Wash Fountain

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Model #WF2803
 - b. Acorn Engineering Company
- 2. Wash Fountain:
 - a. Description: Semi-Circular, freestanding-design, wash-up fixture.
 - b. Arrangement: Wash-up stations facing central spray head.
 - c. Receptor Material: Precast terrazzo on base.
 - d. Receptor Color: As selected by Architect .

- e. Size: 36-inch (1370-mm) diameter.
- f. Number of Stations: Three
- g. Control: Infra-red actuation with thermostatic valve and check stops or field-installed check valves.
- h. Liquid Soap Dispensers: Manual, for each station.
- i. Mounting: Floor. Standard Height
- j. Supplies: NPS3/4 (DN20) copper tubing with ball, gate, or globe valves from bottom.
- k. Shroud: Stainless steel of size to cover supplies and vent piping.
- l. Drain: Grid with NPS2 (DN50) tailpiece.
- m. Trap Fitting: NPS2 (DN50) trap with waste and vent connections.
- n. Drain Piping: NPS2 (DN50), waste to floor.
- o. Vent Piping: Off line vent, NPS1-1/2 (DN40) to ceiling.
- p. Bowl depth: 9 inch (228mm)

2.11. SHAMPOO SINKS

A. S-8 Shampoo Sink

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Belvedere 3100 Cameo
 - b. Collins CB81
 - c. Approved Equal
- 2. Fixture:
 - a. Type: Single Bowl, Countertop Mounted.
 - b. Overall Dimensions: 22 inches wide x 10 inches deep x 19 inches front-to-back.
 - c. Material: Porcelain enamel cast iron.
 - d. Neck Rest: Belvedere Model 5001684 Rubber neck rest or approved equal.
- 3. Faucet:
 - a. Model: Belvedere Model 622T-228, Collins Model #570.
 - b. Body Type: Single Handed Faucet. Clear single handle control with lifting type diverter to direct flow.
 - c. Finish: Chrome Plated
 - d. Mounting Type: Deck, concealed.
 - e. Provide vacuum breaker.
 - f. Provide 42-inch whiz spray with screw on connector.
 - g. Spout: Swinging type with tailpiece.
- 4. P-Trap: Hair Interceptor (see below)
- 5. Stops: Chicago Faucets Model 1005ABCP valve stops with riser supply, 3/8-inch loose key cap and removable tee handle, wall flange, chrome plated finish.
- 6. Hair Interceptor: Zurn Z-1175, Watts, dura coated cast iron hair and solids

interceptor in lieu of fixture "P" trap, with 1 ½ -inch slip joint elbow inlet and 1 ½-inch threaded side outlet, perforated stainless steel basket removable from bottom, with flanged and gasketed slotted cleanout cover. Provide chrome plated finish, interior and exterior.

B. S-9 Pedicure Station

1. Provided under another division of these specifications. Under this Division provide rough-in and final connection. Install fixture shut-off valves for each utility.

2.12. SCIENCE ROOM SINKS - EQUIPMENT

A. SE-1 Science Room Sink

1. Provided under another division of these specifications. Under this Division provide rough-in and final connection including 1 quart polypropylene bottle trap with 1 ½ -inch side inlet of polypropylene pipe. Provide each bottle trap with limestone of calcium carbonate-concentrate of at least 90 percent. Install fixture shut-off valves for each utility.

B. SE-1A Science Room Sink (Handicapped)

1. Provided under another division of these specifications. Under this Division provide rough-in and final connection including 1 quart polypropylene bottle trap with 1 ½ -inch side inlet of polypropylene pipe. Provide each bottle trap with limestone of calcium carbonate-concentrate of at least 90 percent. Unit and installation shall be handicapped accessible. Sink Depth shall not exceed 6 ½-inches. Provide under counter insulation or skirt as required to cover piping. Install fixture shut-off valves for each utility.

C. SE-7 Fume Hood

1. Provided under another division of these specifications. Under this Division provide rough-in and final connection including 1 quart polypropylene bottle trap with 1 ½ -inch side inlet of polypropylene pipe. Provide each bottle trap with limestone of calcium carbonate-concentrate of at least 90 percent. Install fixture shut-off valves for each utility.

D. SE-9A Dual Gas Cock (90°)

1. Provided under another division of these specifications. Under this Division provide rough-in and final connection.

E. SE-9A Dual Gas Cock (180°)

1. Provided under another division of these specifications. Under this Division provide rough-in and final connection.

2.13. EMERGENCY FIXTURES

A. EM-1 Emergency Eyewash (Wall Mounted) (Handicapped)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Guardian GBF1721-T
 - b. Bradley S19-220BF
 - c. Approved Equal
2. Fixture:
 - a. Unit and installation shall comply with ANSI Z358.1, ANSI A117.1 and ADA latest edition.
 - b. 10-inch diameter stainless steel eyewash bowl.
 - c. Chrome plated brass spray head assembly.
 - d. Twin soft flow eye wash heads with dust covers.
 - e. Provide 1/2-inch brass stay-open eyewash valve operated by plastic push handle.
 - f. Furnish each unit with tailpiece and trap for connection to sanitary system per the Plumbing Code
 - g. Wraparound skirt shall be corrosion resistant stainless steel.
 - h. Provide wall mount support brackets, 1-1/2-inch trap, stop valves.
 - i. Mount top of unit at 36-inches above finished floor.
 - j. Provide and mount universal identification sign.
3. Units shall be tested per ANSI Z358.1 prior to turning over to Owner. Contractor shall train Owner in proper usage per Manufacturer's Instructions and ANSI requirements.
4. Furnish each unit with all equipment necessary for field testing of emergency fixtures per ANSI Z358.1 requirements.
5. Refer to Part 2 "Products" of this section for Emergency Mixing Valve.

B. EM-4 Combination Emergency Eyewash / Shower (Handicapped)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Guardian GBF1909
 - b. Bradley S19314TT
 - c. Approved Equal
2. Fixture:
 - a. Unit and installation shall comply with ANSI Z358.1, ANSI A117.1 latest edition and ADA requirements.
 - b. Shower Head: 10" diameter ABS plastic with 20 GPM flow control.
 - c. Shower Valve: 1" IPS chrome plated brass stay-open ball valve. Furnish with stainless steel actuating arm and 47" stainless steel pull rod.
 - d. Eye/Face Wash Bowl: 11" diameter stainless steel.

- e. Spray head assembly: Chrome plated brass eyewash spray head assembly.
 - f. Twin soft flow eye wash heads with dust covers, internal flow control and filter to remove impurities from water flow.
 - g. Eye/Face Wash Valve: Provide 1/2-inch brass stay-open eyewash valve operated by plastic push handle.
 - h. Unit to be floor mounted. Provide floor mount flange.
 - i. Supply: 1-1/4" NPT female top or side inlet.
 - j. Waste: 1-1/4" NPT female outlet. Outlet can be positioned at either 9" of 19" above finished floor.
 - k. Provide and install wrap around modesty curtain with each unit.
 - l. Provide and mount universal identification sign.
- 3. Units shall be tested per ANSI Z358.1 prior to turning over to Owner. Contractor shall train Owner in proper usage per Manufacturer's Instructions and ANSI requirements.
 - 4. Furnish each unit with all equipment necessary for field testing of emergency fixtures per ANSI Z358.1 requirements.
 - 5. Refer to Part 2 "Products" of this section for Emergency Mixing Valve.

2.14. SHOWERS

A. SH-1 Shower (Handicapped):

- 1. Enclosure:
 - a. Enclosure and surrounding shower walls are provided under the Architectural Division.
 - b. Provide Rough-in and Final connection of cold, hot water, vent and waste.
 - c. Provide floor drain as specified on contract drawings.
- 2. Shower Valve:
 - a. Manufacturer: Powers Model P910H, Bradley WS-1X
 - b. Type: Manually Operated Shower Valve
 - c. Unit shall include showerhead, arm and flange.
 - d. Provide round face plate with red/blue indication inset.
 - e. Escutcheon shall be chrome plated stainless steel.
 - f. Provide 60-inch hose and in-line vacuum breaker with slide for use as a hand held shower to showerhead.
 - g. Shower and installation shall conform to all requirements of American Disabilities Act Guidelines and ANSI A117.1
- 3. Shower head:
 - a. Manufacturer: Bradley, Bricor, Speakman or approved equal.
 - b. Low-Flow Outlet.
 - c. 1.5 GPM at 30 psig.
 - d. Water conserving pressure compensating autodevice.
 - e. Polished Chrome Finish.

- f. Provide 60-inch hose and in-line vacuum breaker with slide for use as a hand held shower to showerhead.
 - g. Provide and install Powers 141-600B three (3) port, in-line diverter valve to provide smooth transfer of water from hand held shower to showerhead.
 - h. Unit shall be ADA compliant and be finished with a stainless steel faceplate.
- 4. Shower Mixing Valve:
 - a. ASSE 1016 rated.
 - b. Combination pressure balancing/thermostatic mixing type.

2.15. CLOTHES WASHER - DRYER

A. LY-1 Residential Clothes Washer

- 1. Clothes washer provided by others. Provide rough-in, Outlet box(es) and final connections under this Division.
- 2. Sioux Chief: Model No. 696-R2313MF with 2-inch drain pipe, top supply, and shut-off valves with water hammer arresters. Provide flexible hose (3/4-inch) between Clothes washer and outlet box. Provide vacuum breakers on threaded outlets to prevent back siphonage. Unit shall be 16 gauge steel with white epoxy finish.
- 3. Inlet Hoses: Two, 60 inch long, ASTM D 3571, clothes washer inlet hoses with female hose-thread couplings.
- 4. Drain Hose: One, 48 inch long, ASTM D 3 3572 clothes washer drain hose with hooked end.
- 5. Auxiliary drain pans (for clothes washer): Plastic formed to slope from all directions to the drain connection.

2.16. OUTLET BOXES – WATER SUPPLY

B. OB-1 Refrigerator

- 1. Refrigerator provided in another Division of Specifications. Provide rough-in, Outlet box and final connections under this Division.
- 2. Sioux Chief: Model No. 696-RG1010MF with top supply and shut-off valve with water hammer arrester. Provide flexible hose (1/2-inch) between Refrigerator and outlet box. Provide vacuum breaker on threaded outlets to prevent back siphonage. Unit shall be 16-gauge steel with white epoxy finish.
- 3. Provide sufficient copper tubing to allow movement of refrigerator for cleaning.

2.17. DISHWASHERS

A. DW-1 Residential Dishwasher (Sink Connections)

1. Provided in another Division of these specifications. Under this Division provide rough-in and final connection including shut-off valve, shock absorber, waste piping, and air gap fitting.
2. Hoses: Include 5/8 inch ID inlet and 7/8 inch ID outlet hoses.
3. Air Gap Fittings: ASSE 1021, fitting suitable for use with domestic dishwasher and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 GPM; and inlet pressure of at least 5 psig at temperature of at least 140 degrees F. Air gap fittings shall be as manufactured by Sioux Chief, Moen, B&K Industries, Bristol or approved equal.

B. DW-2 Residential Dishwasher (Outlet Box)

1. Dishwasher provided in another Division of Specifications. Provide rough-in, Outlet box and final connections under this Division.
2. Outlet Box: Sioux Chief Model No. 696-2313MF with top supply and shut-off valve with water hammer arrester and Drain Box. Provide flexible supply hose (1/2-inch) and 2-inch Drain hose between Dishwasher and outlet box. Provide vacuum breaker on threaded outlets to prevent back siphonage. Unit shall be 16-gauge steel with white epoxy finish.
3. Provide sufficient length of supply and drain hose to allow movement of dishwasher for cleaning.

2.18. HOSE REELS

A. HR-1 Hose Reel (Retractable)

1. Hose Reel: Chicago Faucets Model 537-WC hose reel suitable for concealed installation. Unit shall include retractable hose reel with painted cover, spring valves, vacuum breaker for complete installation. Provide each unit with Watts No. 800 MCQT (chrome finished) pressure type vacuum breaker. Provide each unit with No. 770 shut-off valve, No. 767-8-VOC concealed two valve fitting, and No. 1771-C loose key check valves. Hose reel shall include 35 feet of 3/8-inch I.D. hose. Provide standard spray valve. Provide high velocity spray valve on units where located in can wash area. Provide chrome plated piping, unions and escutcheons.

2.19. HOSE BIBBS - HYDRANTS

A. HB-1 Hose Bibb

1. Chicago Faucet No. 952 or approved equal hose and faucet. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose threaded spout, polished chrome plated where exposed in finished areas, with hand wheel and removable key, integral vacuum breaker in conformance with ANSI/ASSE 1011.
2. Hose bibbs in finished areas shall be polished chrome finish.

3. Approved Manufacturers: Chicago Faucet, American Standard, Crane, T&S Brass, or Watts.

B. HYD-1 Wall Hydrant (Exterior)

1. Provide and install recessed anti-siphon wall hydrant, 3/4-inch non-freeze, key operated wall hydrant with hinged locking cover, polished bronze box and cover and bronze casing and integral vacuum breaker. Non-Freeze, exterior wall hydrants shall be Zurn Model Z-1320-XL, Josam, Wade, J.R. Smith, Mifab, Watts or approved equal.
2. Seat and disc shall be removable from front of the hydrant. Wall thickness; see architectural drawings. Wall hydrants shall conform to ANSI/ASSE 1019 with wall plate, lock shield and removable key.

C. HYD-2 Wall Hydrant (Interior)

1. Provide and install recessed wall hydrants where indicated on the contract drawings. Recessed wall hydrants shall be Zurn Model Z-1330, Josam, Ancon, Mifab, Watts or approved equal.
2. Units shall be encased Ecolotrol "anti-siphon" wall hydrant for interior wall installation. Unit shall be suitable for hot or cold water as indicated on Contract Drawings.
3. Each unit shall be complete with integral backflow preventer, all bronze interior parts, non-turning operating coupling with hemispherical neoprene plunger and 3/4-inch solder inlet.
4. Furnish each unit mounted in a stainless steel box and hinged cover with operating key lock and "water" stamped on cover.
5. Furnish each unit with the following accessories:
 - a. 3/4 inch – 90 degrees inlet elbow with union nut
 - b. Cylinder lock
 - c. Key operator

D. HYD-3 Wall Hydrant - Combination Hot & Cold Water (Exterior)

1. ZURN Z-1325 "Vari-Temp", Mifab, Watts, or approved equal, combination hot and cold water, non-freeze, encased wall hydrant for flush installation. Complete with bronze casing, all bronze interior parts, non-turning operating rods with free-floating compression closure valves, replaceable bronze seat and seat washer, and combination 3/4-inch female straight IP inlet. Polished bronze box and hinged cover with operating key lock and "water" cast on cover. Furnish unit with 3/4-inch IP 90 degrees F inlet elbow with union nut, cylinder lock, 3/4-inch adapter vacuum breaker, solder female inlet adapter and wall clamp.

E. HYD-4 Wall Hydrant - Combination Hot & Cold Water (Interior)

1. ZURN Z-1327, Mifab, Watts, or approved equal, combination hot and cold water, encased wall hydrant for flush installation. Complete with bronze casing, all bronze interior parts, non-turning operating rods with free-floating compression closure valves, replaceable bronze seat and seat washer, and 3/4-inch female straight IP inlets. Polished bronze box and hinged cover with operating key lock and "water" cast on cover. Furnish unit with 3/4-inch IP 90 degrees F inlet elbow with union nut, cylinder lock, 3/4-inch adapter vacuum breaker, solder female inlet adapters and wall clamp.

F. HYD-6 Hydrant – Roof

1. Roof hydrant shall be exposed, non-freeze roof hydrant with Dura-coated cast iron head and lift handle with lock option, bronze interior parts, galvanized steel casing, and bronze valve housing with 1/8 inch IP drain port in housing. Provide Dura-coated cast iron support sleeve with wide anchoring flange and clamp collar.
2. Approved Manufacturers: Zurn or approved equal.

2.20. STORM DRAINS

A. General Requirements

1. Provide Josam 26200, Watts, or Zurn vertical expansion joint in each rain leader that does not have 90 degrees offset downstream of the roof drain. The expansion sleeve shall be bronze and shall conduct the rainwater beyond the packing. Install expansion joints in accessible locations for repacking.

B. SD-3 Storm Drain – Combination Primary/Overflow Drain

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Z-163
 - b. MIFAB R1270
2. 15-inch diameter roof drain and overflow drain, Dura-Coated cast iron bodies with combination membrane flashing clamp/gravel guards, double Top-Set deck plate and low silhouette aluminum locking domes. Provide with support rings, adjustable tops with wide roof flanges, 24"x42" large, galvanized sump receiver with anchor flange, bottom outlets inside caulk connections and deck clamps. Provide Overflow Drain with 2" high internal water dam.

C. SD-7 Downspout Nozzle

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Z-199
 - b. MIFAB
 - c. Watts

2. Downspout Nozzle, all nickel bronze body, threaded inlet and decorative face of wall flange and outlet nozzle. Provide removable stainless steel screen. Size to match overflow drain pipe size. Color to be selected by Architect.

2.21. FLOOR DRAINS

A. General Requirements

1. Provide Nikaloy strainers on all floor drains unless specified otherwise.
2. Provide flashing clamps on all drains penetrating waterproofing membrane.
3. Provide suitable flashing material and clamping collar for drains which are not set in place when slab is poured.
4. Provide backwater valves for all floor drains connecting directly to the storm water system. Depending on conditions of the particular installation, backwater valves may be an integral part of the drains or a separate device. Accessibility to valves must be maintained for maintenance. Provide an adequately sized extension sleeve up to floor or grade as required.
5. Backwater valves are normally closed, flapper type with bronze or brass seat and disc and stainless steel pin.
6. Provide traps for all floor drains connected to the sanitary system.
7. Provide E & S, Sioux Chief, or PPP primer valve (one valve per trap, per floor drain) on all remote floor drains. When installed on fixture in finished area, primer valve shall be concealed behind a Josam 58650, Watts, or Zurn access door. In Mechanical Rooms, mezzanines, penthouses, and all other locations indicated on the contract drawing, priming lines shall be connected to automatic trap primer.
8. In lieu of joints specified in piping section, neoprene gaskets may be used if designed for use with the drains and cleanouts employed and if approved by the local plumbing authority.
9. Where applicable, for floor drains utilized for washing machines, provide a stainless steel lint screen/strainer.
10. When floor drains collect condensate from a neutralizer kit, the floor drains shall be provided with epoxy coating.
11. Approved Manufacturers: Josam, J.R. Smith, Zurn, Wade, Ancon, Mifab, Watts.

B. FD-1 Floor Drain – Round – Nickel Bronze Strainer

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn ZN-415B
 - b. Watts FD-100-A

2. Floor and shower drain, dura coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with seepage slots and Type "B" polished nickel bronze strainer. Provide with ½ -inch trap primer connection.

2.22. FLOOR SINKS

A. FS-1 Floor Sink (8"x8"x6")

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Z-1910
 - a. Watts
2. Sani-Flor receptor, 8-inch x 8-inch x 6-inch deep cast iron body and square slotted medium duty grate, with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.
 - a. Two (2) removable ½ grates with each unit.
 - b. ½ -inch trap primer connection.
 - c. Stainless steel mesh bucket screen.

B. FS-2 Floor Sink (12"x12"x6")

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Z-1900
 - b. Watts FS-730
2. Sani-Flor receptor, 12-inch x12-inch x 6-inch deep cast iron body and square, slotted grate with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.
 - a. Two (2) removable ½ grates with each unit.
 - b. ½ -inch trap primer connection.
 - c. Stainless steel mesh bucket screen.

C. FS-3 Floor Sink (12"x12"x8")

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Z-1901
 - b. Watts FS-740
2. Sani-Flor receptor, 12-inch x12-inch x 8-inch deep cast iron body and square, slotted grate with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.

- a. Two (2) removable ½ grates with each unit.
 - b. ½ -inch trap primer connection.
 - c. Stainless steel mesh bucket screen.
- D. FS-4 Floor Sink (12"x12"x10")
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Z-1902
 - b. Watts FS-750
 - 2. Sani-Flor receptor, 12-inch x12-inch x 10-inch deep cast iron body and square, slotted grate with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.
 - a. Two (2) removable ½ grates with each unit.
 - b. ½ -inch trap primer connection.
 - c. Stainless steel mesh bucket screen.
- E. FS-5 Floor Sink (16"x16"x12")
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Z-1926
 - b. Watts FS-850
 - 2. Sani-Flor receptor, 16-inch x 16-inch x 12-inch deep cast iron body and square, slotted grate with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.
 - a. Two (2) removable ½ grates with each unit.
 - b. ½ -inch trap primer connection.
 - c. Stainless steel mesh bucket screen.

2.23. TRENCH DRAINS

- A. TD-4 Trench Drains
 - 1. Zurn-882 12"-inch wide pre-sloped trench drainage system. Glass-filled polyester fiberglass drain channel with 1/8 -inch per foot bottom slope. All sections modular 8-foot length with interlocking ends. Complete with heavy duty, dura-coated steel frame at surface, combination anchor tabs/leveling devices at appropriate locations, and heavy duty galvanized steel grate suitable for automotive traffic. Install trench drain and all accessories per local codes and Zurn Industries, Inc. Instructions. A minimum of 4-inches of concrete must surround each trench segment.
 - 1. Catch Basins (Trench Drain Systems): Provide Zurn Z-817 catch basins in the quantity as indicated on the contract drawings. Catch basins shall be 12-inches x

24 -inches with external trench adapter supplied to make transition between the trench and basin. Catch basins shall be polyester glass-filled fiberglass reinforced body, complete with heavy duty, dura-coated steel frame and heavy duty galvanized steel grate suitable for automatic traffic. Provide sediment bucket with each catch basin and 2-inch trap primer connection in trap.

2.24. THERMOSTATIC MIXING VALVES (INDIVIDUAL FIXTURE TYPE)

- A. Furnish and install thermostatic mixing valves where indicated at public lavatories, and below all lavatories, hand sinks, and kitchen hand sinks that are provided with hot water temperatures above 109 degrees F.
- B. Thermostatic mixing valves shall be Bradley S59-4000A, Watts, Moen, Leonard Ecobix, Acorn, or approved equal for installation under lavatories. Provide in-line check valves, lead free body, escutcheon plates, inlet filters, and insulation as required. Thermostatic mixing valves shall be adjusted to deliver 105 degrees Fahrenheit hot water when supplied with 140 degrees Fahrenheit delivering hot water. Furnish with adjusting cap with locking feature.
- C. The thermostatic mixing valves shall be listed for use at the scheduled flow rate of the equipment served.
- D. The thermostatic mixing valves shall be ASSE standard 1070 listed.

2.25. PLUMBING FIXTURE SUPPORTS

- A. Wall mounted urinal supports, Josam 17810 plate type with cast iron headers, box steel stanchions, block type cast iron feet with bearing plate.
- B. Support for wall mounted urinals, lavatories, sinks, drinking fountains, etc.:
- C. Where fixtures are supported from concrete or cinder block walls, install No.10 USSG Steel plate on the opposite side of the wall and bolt hangers or supports through plate. Where opposite side of wall is exposed to view, place bolts in core of blocks and fill core with cement.
- D. Where lavatories with wall hangers have been specified and fixtures are supported from metal stud frame partitions, fixture brackets or mounting lugs shall be through bolted to steel channel crosspieces not less than 1-1/2-inch wide anchored to studs. Bolt heads shall be welded to channel web.
- E. Concealed arm type lavatory supports, Josam 17100 with cast iron headers, box steel stanchions, block type cast iron feet and header; and chrome plated cast brass threaded escutcheons for slab type lavatories.
- F. Flush mounted drinking water cooler supports, Josam 17550 plate type, box steel stanchions, block type cast iron feet.
- G. Water closet chair carriers, Josam 12000 Series for horizontal and vertical installations.

2.26. HANDICAPPED LAVATORY/SINK INSULATION

- A. All handicapped lavatories and sinks shall be provided with under counter pipe and trim insulation.
- B. Insulation shall be fully molded "P" trap and angle valve insulated Hand-I-Lav Guard, Truebro, Pro-Extreme Model #101, 102, and 105 to suit.
- C. Insulation to meet ADA #4 19.4, ANSI A117.1, ASTM C1822, Type III and International Plumbing Code.
- D. Self-extinguishing ASTM D635 burn characteristics, thermal conductivity ASTM C177 K-Value ' 1.17.
- E. Insulation thickness to be minimum 2 inch.
- F. Where lav. Guards are provided insulation may be omitted.

2.27. EMERGENCY EYEWASH MIXING VALVES

- A. Furnish and install factory fabricated, hot-and cold-water-tempering equipment with thermostatic mixing valve. Units shall be manufactured by Guardian Equipment, Power's, Speakman, Leonard or approved equal.
- B. Thermostatic mixing valve: Designed to provide 85 degree F (29 degree C) tepid, potable water at emergency eyewash stations to maintain temperature at plus or minus 5 degree F (3 degree C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow with Union connections, controls, integral strainer, metal piping adjustable high temperature unit, outlet and inlet, thermometers, check stops and where indicated a corrosion resistant enclosure.
- C. Capacity Range: As scheduled on Contract Drawings.
- D. Furnish each unit with painted, heavy duty mounting bracket from securing valve to panel on wall. Cabinet shall be stainless steel, lockable type.
- E. Units shall be provided such that inlets can be rotated 360 degrees for top or bottom supply.
- F. Where installed exposed in finish spaces units shall be chrome plated finish.
- G. Comply with ANSI requirements and lead free law per the requirements of the state in which the project is being constructed.
- H. Emergency fixture mixing valves shall be ASSE 1071 compliant.

2.28. EMERGENCY COMBINATION EYEWASH/SHOWER MIXING VALVES

- A. Furnish and install factory fabricated, hot-and-cold-water-tempering equipment with dual manifold thermostatic mixing valves. Units shall be manufactured by Guardian Equipment, Power's, Speakman, Leonard, or approved equal.
- B. Thermostatic Mixing Valves: Designed to provide 85 degree F (29 degree C) tepid,

potable water at emergency combination eyewash/shower stations to maintain temperature at plus or minus 5 degrees Fahrenheit (3 degrees C) throughout required 15 minute test period, and in case of unit failure to continue cold-water flow with union connections, controls, integral strainer, metal piping, adjustable high temperature limit, outlet and inlet thermometers, check stops, and where indicated a corrosion resistant enclosure.

- C. Capacity Range: As scheduled on Contract Drawings.
- D. Furnish each unit with painted, heavy duty mounting bracket from serving valve to panel on wall. Cabinet shall be fully recessed, stainless steel, and lockable.
- E. Units shall be provided such that inlets can be rotated 360 degrees for top or bottom supply.
- F. Where installed exposed in finish spaces units shall be chrome plated finish.
- G. Comply with ANSI Z 358-1 2009 and shall comply with the lead free laws per the requirements of the state in which the project is being constructed.
- H. Emergency fixture mixing valves shall be ASSE 1071 compliant.

2.29. FIXTURE STOPS/SUPPLIES

- A. For all lavatories/sinks stops and supplies shall be Chicago Faucets No. 1017-CR43829, Angle Stop Fitting with Supply Tube and Loose Key, Chrome plated solid brass construction. 2-1/4" Metal tee handles with tapered square. Slow compression check cartridge that shall open and close 360° for fine adjustment, valves shall close with water pressure, furnish with square tapered stem. 1/2" NPT female thread inlet 3/8" O.D. female compression outlet. Slip wall flange. 3/8" O.D. x 12" bullnose flexible supply riser. ECAST construction with less than 0.25% lead content by weighted average. This product shall be tested and certified to industry standards: ASME A112.18.1/CSA B125.1, Certified to NSF/ANSI 61, Section 9 by CSA, California Health and Safety Code 116875 (AB1953-2006), Vermont Bill S. 152, and NSF/ANSI 372 Low Lead Content.

PART 3. EXECUTION

3.1. GENERAL INSTALLATION REQUIREMENTS

- A. Install all equipment in accordance with manufacturer's instructions.
- B. Setting heights of lavatories, drinking fountains, etc., shall be as directed prior to installation and shall be coordinated with Architectural Contract Documents.
- C. Install floor mounted fixtures only after finished floor has been installed.
- D. Provide rubber concussion washers between vitreous china fixtures and supporting brackets.
- E. Protect chromium plated trim from corrosive solutions used to clean tile work.

- F. Provide white, silicone caulking where fixtures come in contact with walls and floors. Sealant shall be mildew resistant type in accordance with ANSI A-136.1.
- G. Install components plumb and level.
- H. Unless otherwise noted, drains are to be installed at the low point of floors. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- I. Install floor drains in low points so the top of grates are at or below the finished floor level.
- J. Drains not functioning properly shall be removed and re-installed properly at the expense of the contractor.
- K. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.
- L. Install and secure fixtures in place with wall supports, wall carriers and bolts.
- M. Solidly attach water closets to floor with lug screws. Lead flashing is not intended to hold fixture in place.
- N. Install flush valve handles on the open side of all ADA waterclosets in accordance with ANSI requirements.
- O. Fixtures shall be vitreous china unless otherwise noted. Cast iron fixtures shall have acid resisting enamel finish unless noted otherwise, color shall be white.
- P. Flush valves shall be self-closing, non-hold open type with vacuum breaker and perform satisfactorily when subject to inlet water pressure varying from 15 to 75 psi. Flush valves shall be as specified, Sloan, Delaney, Zurn, Toto, or approved equal.
- Q. Provide flexible risers and loose key stops for all lavatories and sinks. Provide 17 ga. chrome plated brass tail piece and trap with cleanout for all lavatories and sinks.
- R. Fittings for fixtures supplied by others, such as science sinks and kitchen equipment are provided under another division of these specifications. Connections of these fixtures to the plumbing system are provided under this section.
- S. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve a complete operating system.
- T. Field test all emergency eyewash units and combination eyewash/shower units per ANSI Z358.1 latest edition.
- U. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.
- V. All plumbing vents within a 10'-0" radius of any rooftop unit or intake louver shall be extended to a height of 3'-0" above fresh air intake.

- W. Slopes and invert elevations of all interior piping shall be established before any piping is installed in order that proper slopes will be maintained. All piping shall be located and determined where to be run to avoid conflict with other trades.
- X. Unless otherwise noted, all plumbing piping shall be routed as high as possible between bottom of roof joists and above ceiling to allow proper installation of ductwork, fire protection piping, conduits, etc.
- Y. Coordinate with Architectural Drawings before roughing in plumbing.
- Z. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.
- AA. See site plan for extent of all piping leaving and entering building.
- BB. See domestic water riser diagrams for location of valves, shock absorbers, etc.
- CC. Make proper HW, CW, re-cir., waste, and vent connections to all fixtures and equipment even though all branch main, elbows and connections are not shown.
- DD. Unless otherwise noted, sanitary waste piping shown is below floor and all other piping is overhead, above ceiling. Domestic hot, cold and recirculating water piping shall be installed between ceiling and attic insulation.
- EE. Unless otherwise noted, horizontal sanitary piping shall be pitched 1 percent.
- FF. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.
- GG. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.
- HH. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.
- II. For sizes of all sanitary and vent piping see plumbing fixture schedule and sanitary/vent riser diagrams.

3.2. PLUMBING SPECIALTY INSTALLATION REQUIREMENTS

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.
- C. Secure supplies to supports or substrate.
- D. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve as appropriate is not indicated.
- E. Install water-supply stop valves in accessible locations.

- F. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- G. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.

3.3. FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

- A. Fixtures such as built-in-sink in counters and kitchen equipment may be provided under other divisions of the specifications and are complete with strainer and tailpiece. Fittings, accessories and connection of these fixtures to the plumbing system are provided under this section.
- B. Rough-in and final connection includes but is not limited to all domestic water, waste, vent, gas and compressed air systems. Furnish stops, strainers, vacuum breakers, and under counter insulation where not furnished under another Division of these specifications.

3.4. TESTING

- A. After plumbing fixtures are connected, all piping and fixtures shall be tested for operation and a smoke or peppermint test shall be made on all soil, waste and vent piping.
- B. After the building has been occupied and the various equipment is in actual use, the Contractor shall make an operating test of all equipment at a time directed by the Engineer to determine that all contract requirements are met.

3.5. CLEANING AND STERILIZATION

- A. After final testing for leaks, all potable water lines shall be thoroughly flushed, by plumbing contractor, to remove foreign material. Before placing the systems in service, sterilize the new water lines in accordance with local health department codes and at a minimum according to the following procedure:
- B. Through a 3/4-inch hose connection in each branch main and building main, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine into system.
- C. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.
- D. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 ppm chlorine, retain this water in the system for at least three (3) hours.
- E. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system. It is not necessary to retain chlorine in any system for twenty-four hours to achieve sterilization. AWWA states that 200 ppm chlorine for three hours is sufficient.

- F. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.
- G. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 ppm.
- H. Obtain representative water sample from the system for analysis by an independent and recognized bacteriological laboratory.
- I. If the sample tested for coliform organisms is negative, a letter and laboratory report shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization. Additionally, this report shall be forwarded to the Owner as well as be included in the O&M Manual.
- J. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.
- K. Take precautions to avoid use of plumbing fixtures and domestic water systems during sterilization period. Place signs on all plumbing fixtures and outlets during sterilization period.

3.6. EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.7. PREPARATION

- A. Review the Kitchen Equipment Consultant's equipment cut sheets. Confirm rough-in location and size of fixtures and openings prior to commencing work.
- B. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.8. INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.9. ADJUSTING

- A. Adjust stops, valves, infrared fixtures for intended water flow rate to fixtures without splashing, noise, or overflow.

3.10. CLEANING

- A. At completion, clean plumbing fixtures and equipment. Polish all chrome plated faucets, accessories, equipment, and piping.
- B. All electric water cooler coils shall be cleaned of all construction dust and debris prior to

building occupation by Owner.

3.11. FIXTURE HEIGHTS

- A. Install fixtures to heights above finished floor as required by local Plumbing Code, Americans with Disabilities Act (A.D.A.), Authority Having Jurisdiction, and Architectural Contract Drawings. In the absence of a local code requirements, install fixtures to heights above finished floor as follows.
- B. Water Closet
 - a. Standard 15 inches to top of bowl rim.
 - b. Handicapped 18 inches to top of seat.
 - c. Child height 10 inches to top of bowl rim.
- C. Urinal
 - a. Standard 22 inches to top of bowl rim.
 - b. Handicapped 17 inches to top of bowl rim.
- D. Lavatory
 - a. Standard 31 inches to top of basin rim.
 - b. Handicapped 34 inches to top of basin rim.
 - c. Child Height 27 inches to top of basin rim.
- E. Drinking Fountain
 - a. Standard 36 inches to top of basin rim.
 - b. Handicapped 34 inches to top of basin rim.
- F. Water Closet Flush Valves
 - a. Standard 11 inches min above bowl rim.
 - b. Recessed 10 inches min. above bowl rim.
- G. Shower Heads
 - a. Adult male 80 inches to bottom of head.
 - b. Adult female 76 inches to bottom of head.
 - c. Handicapped (unisex) with handheld 76 inches to top of head arm.
 - d. Handicapped (unisex) without handheld 48 inches to top of head arm.
- H. Emergency Eye Wash
 - a. Handicapped 38-inches to receptor rim.
- I. Combination Emergency Shower/Eye Wash
 - a. Handicapped 84 inches to bottom of shower head and 38 inches to eye wash receptor rim.

J. Residential Clothes Washer

- a. Guy Gray box 42 inches above finished floor.

END OF SECTION

DIVISION 22 SECTION 22 40 05
PLUMBING EQUIPMENT
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SECTION 22 40 05
PLUMBING EQUIPMENT

PART 1. GENERAL

1.1. GENERAL

- A. For General Mechanical Requirements, see Division 22 Section, Common Work Results for Plumbing & Division 01, General Requirements.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications apply to this Section.
- C. All exposed bolts, screws, etc., shall be vandal proof.
- D. All plumbing materials and equipment shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.
- E. Piping and insulation are specified under other sections.
- F. Provide all materials, equipment and perform all labor required to install plumbing system complete as specified, as drawings indicated and as required by the State of Delaware, National Standard Plumbing Code , International Plumbing Code, City of Newark Code, the local code, and all other authorities have jurisdiction.
- G. Provide stops for all plumbing equipment. Stops are to be accessible.
- H. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- I. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 - 1. American Gas Association (AGA).
 - 2. National Sanitation Foundation (NSF).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - 5. National Electrical Manufacturers' Association (NEMA).
 - 6. Underwriters Laboratories (UL).
- J. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.2. REFERENCES

- A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

- B. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- C. ANSI/ASE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
- D. ANSI A112.21.1 - Floor Drains.
- E. ANSI A112.21.2 - Roof Drains.
- F. ANSI A112.26.1 - Water Hammer Arrestors.
- G. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
- H. PDI WH-201 Water Hammer Arresters.
- I. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- J. ASME Section VIII D - Pressure Vessels; Boiler and Pressure Vessel Codes.
- K. ANSI/NFPA 54 - National Fuel Gas Code.
- L. ANSI/NFPA 70 - National Electrical Code.
- M. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum).
- N. IBC - International Building Code

1.3. DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of General Requirements.
- B. Accept equipment on site in factory packaging. Inspect for damage.
- C. Protect installed equipment from damage by securing areas and by leaving factory packaging in place to protect equipment and prevent use.

1.4. FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and per the manufacturer.

1.5. ALTERNATES

- A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.6. EXTRA MATERIALS

- A. Provide one set of pump seals for each type of model of pump provided on this project.
- B. For all condensing water heaters, provide spare set of lime chips for all condensate

neutralizers.

- C. Furnish spare set of lime chips for the water heater condensate neutralizer.

PART 2. PRODUCTS

2.1. CLEANOUTS

- A. Provide cleanouts in sanitary and storm drainage systems at ends of runs, at changes in direction, near the base of stacks, every 50 feet in horizontal runs, of 4-inch diameter or less, every 100 feet in horizontal runs over 4-inches, and where indicated.
- B. Cleanouts shall be full size of pipe up to 4-inches and shall be 4-inches for larger sizes. Where installed in finished floors inserts shall match adjacent floor construction.
- C. Materials and Approved Manufacturers: Josam, J.R. Smith, Zurn, Wade or Ancon, Mifab, Watts, equal to Josam numbers given below:

- | | | |
|-----|--|------------|
| 1. | Concealed Piping | C.I. Pipe |
| 2. | Unfinished Areas | |
| 3. | Floors | 57000-Z-CI |
| 4. | Walls | 58600-PLG |
| 5. | Finished Areas Floors | |
| 6. | Terrazzo | 56040-13 |
| 7. | Composition Tile | 57000-X-12 |
| 8. | Ceramic Tile | 57000-X |
| 9. | Carpet | 56070-14 |
| 10. | Carpet insert to match adjacent carpet in type, color and grade. | |
| 11. | Finished Areas Walls | |
| 12. | Plaster/Dry Wall | 58640-COT |
| 13. | Tile/CMU | 58600-COT |

2.2. SHOCK ABSORBERS

- A. Provide shock absorbers equal to Josam Shokstops at all fast closing valves, at the top of all cold water risers, at each flush valve or battery of flush valves, and where indicated. Sizes and locations shall be in accordance with PDI Standard WH 201.
- B. Shock absorbers shall conform to ANSI A112.26.1, precharged suitable for operation in

temperature range -100 to 300 degrees F and maximum 250 psig working pressure.

- C. Approved Manufacturers: Josam, Wade, Zurn, J.R. Smith, Sioux Chief, Watts, or approved equal.

2.3. VACUUM BREAKERS

- A. Provide vacuum breakers on water connections to fixtures and equipment where minimum air gaps required by Plumbing Code are not possible and on hose bibbs and other outlets to which hoses can be attached.
- B. Vacuum breakers not subject to back pressure, Watts No. 288A; vacuum breakers subject to back pressure, Watts Series 9D or for hose threads, Watts Series 8A.
- C. Provide atmosphere vacuum breakers at all water connections to garbage disposers, hose spray units as required by Plumbing Code.
- D. Provide pressure type vacuum breakers with chrome finish at all water connections to hose reels, Watts Model 800 MCQT or equal.
- E. Hose connection backflow preventers shall be ASSE 1052, suitable for at least 5 gpm flow and applications with up to 10 foot head back pressure. Include two (2) check valves, intermediate atmospheric vent, and non-removable, ASME B1.20.7 garden-hose thread on outlet.
- F. Hose connection vacuum breakers shall be ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze finish hose connections may be rough bronze.
- G. Approved manufacturers: Watts, Beeco, B&K Industries, Zurn, Sparco, Conbraco or approved equal.

2.4. VACUUM RELIEF VALVES

- A. Provide vacuum relief valves on cold water supply to water heaters, where indicated on the contract drawings, or where required by the authority having jurisdiction.
- B. Vacuum relief valves shall be Watts Regulator Co. Series 36A, Josam, or approved equal.

2.5. DOMESTIC WATER CARTRIDGE TYPE RE-CIRCULATING PUMPS

- A. Provide and install domestic water re-circulating pumps of the size, capacity and electrical characteristics as indicated on the contract drawings. Pumps shall be in-line cartridge circulators as manufactured by Grundfos, Wilo, TACO, Bell and Gossett, Thrush, Armstrong, Patterson, or approved equal. Units shall be U.L. listed.
- B. Pumps shall be non-overloading throughout the range of the curves. Pumps shall have center line discharge for positive venting, flanged bodies, and same size suction and discharge.
- C. Motors shall be permanent split capacitor with built-in overload protection. Impellers shall

be non-metallic. Casings shall be bronze construction. Shafts shall be ceramic with carbon bearings. Units shall be rated for 125psi maximum pressure and 220 degrees F maximum temperature.

- D. All circulators utilized for domestic water service shall be all bronze construction. Shaft orientation and junction box orientation shall be installed per manufacturer's recommendations.

2.6. DOMESTIC WATER RECIRCULATING PUMPS

- A. Provide and install domestic water re-circulating pumps of the size, capacity and electrical characteristics as indicated on the contract drawings. Pumps shall be in-line circulators Model 113B as manufactured by TACO, Bell and Gossett, Thrush, Armstrong, Patterson, or approved equal.
- B. Pumps shall be non-overloading throughout the range of the curves. Pumps shall have center line discharge for positive venting, flanged bodies, and same size suction and discharge.
- C. Motors shall be resilient mounted, split phase motor with built-in overload protector and equipped with sleeve bearings for quiet operation. Impeller shall be one piece dynamically balanced with stainless steel shaft, bronze sleeve bearing, two piece carbon/ceramic seal assembly and one piece spring coupling.
- D. All circulators utilized for domestic water service shall be stainless steel or all bronze construction.

2.7. BACKWATER VALVES

- A. Backwater valves shall be provided at all connections of floor drains or area drains to stormwater piping systems and where indicated on contract drawings.
- B. Backwater valves shall be ANSI A112.21.2, coated cast iron body and cover, brass valve, access cover, extension sleeve and cover.
- C. Backwater valves shall be equal to Josam 67360-15.
- D. Extend access cover to finished floor and terminate in cleanout.
- E. Approved Manufacturers: Josam, Zurn, Wade, Smith, Ancon or approved equal.

2.8. GAS FIRED DOMESTIC WATER HEATERS

- A. Water Heater(s) shall be model BTH as manufactured by A. O. Smith, Lochinvar, State, Bradford White, Bock, PVI, or approved equal. Water heater(s) shall be of the seamless glass lined steel tank construction in which the glass coating is applied to the water side surfaces of the tank after the tank has been assembled and welded. The condensing flue coil shall be coated on the flue gas side with A. O. Smith's proprietary or equal acid resistant glass lining designed for use in condensing heaters.
- B. The heater shall be suitable for sealed combustion direct venting using PVC air intake pipe

and PVC exhaust pipe for a total distance of (50') equivalent feet of vent and 50' equivalent feet of intake. The heater shall be factory assembled and tested. The power burner shall be of a design that requires no special calibrations or start up. The heater(s) shall be approved for 0-inch clearances to combustibles.

- C. The control shall be an integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of temperature settings.
- D. The tanks shall be foam insulated and equipped with a ASME rated temperature pressure relief valve. The water heater shall be UL listed and exceed the minimum efficiency requirements of ASHRAE/IES 90.1b-1992.
- E. The heater shall be listed by SCAQMD Rule 1146.2 Low NOx. Water Heater shall comply with Delaware Pressure Vessel Code and ASME CSD-1.
- F. Provide unit with brass drain valve and install on 4-inch high housekeeping pad as detailed on the contract drawings.
- G. The water heater shall be tested at start-up by a qualified representative of the manufacturer. Provide a check list outlining start-up procedures to Engineer for review. A start-up report as provided by the manufacturer shall be completed and submitted before final acceptance of the domestic hot water heater system. Include copy of start-up report in O&M Manuals.
- H. Conduct flue gas analysis on unit as required by water heater manufacturer.
- I. Where multiple units are indicated furnish manifold kits to balance water flow through each heater.
- J. Furnish units with electronic temperature control with LED readout.
- K. Accessories: Air proving switch, housekeeping pad, low water cut-off, condensate neutralization kit, temperature and pressure relief valve. The temperature and pressure relief valve must be visible and accessible not hidden behind jacket.
- L. Warranty: Total unit warranty of five (5) years.
- M. A properly sized gas pressure regulator to be provided by the manufacturer and installed by the contractor.

2.9. BACKFLOW PREVENTER (REDUCED PRESSURE PRINCIPAL TYPE)

- A. Furnish and install reduced pressure principal backflow preventers at all cold water make-up connections to HVAC water systems and where indicated on contract drawings.
- B. Backflow preventers shall be of bronze body construction, inlet and discharge OS&Y gate valves, stainless steel check and relief valve seats, stainless steel relief valve shafts and flange bolts. Ball valve test cocks shall be bronze body.
- C. Pressure ratings shall be up to 175 psi and temperature ratings shall be up to 210 degrees

F continuous.

- D. Install unit per local code requirements and authorities having jurisdiction. Unless otherwise noted, install backflow preventers between 12 inches and 60 inches above finished floor.
- E. Units shall be approved by ASSE 1013, UPC, UL, and shall be No. 909 with air gap fitting and inlet/outlet gate valves as manufactured by Watts Regulator, Conbraco, Wilkens, or as approved equal. Pipe discharge to nearest floor drain/floor sink. Provide minimum 18-inch clearance for servicing and testing.
- F. Pipe discharge of backflow preventer full size to closest floor drain utilizing type "L" copper.
- G. Furnish test kit for field testing units. Watts Model TK-9A Analog Differential Gauge or approved equal.

2.10. BACKFLOW PREVENTER (DOUBLE CHECK VALVE ASSEMBLY TYPE)

- A. Furnish and install double check valve assembly backflow preventers at all cold water make-up connections to kitchen waste coolers, dishwashers, and where else indicated on contract documents.
- B. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module sets and seat discs shall be replaceable.
- C. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall include two resilient seated isolation valves and four top mounted, resilient seated test cocks.

1. Furnish each backflow preventer with the following accessories and options:

- a. bronze strainer
- b. quarter turn, full port, resilient seated ball valve shut-off
- c. union connections

- D. Provide minimum 18-inch clearance for servicing and testing.
- E. The assembly shall meet the requirement of ASSE Std 1015 and AMCA Std C510.
- F. Double check valve backflow preventers shall be Watts No. 007, Conbraco, Wilkens, Ancon, or approved equal.
- G. Furnish test kit for field testing units. Watts Model TK-9A Analog Differential Gauge or approved equal.

2.11. BACKFLOW PREVENTER (DOUBLE CHECK VALVE ASSEMBLY TYPE) (VERTICAL TYPE)

- A. Furnish and install vertical double check valve assembly backflow preventers at incoming water services and where else indicated on contract documents. Backflow preventers shall

be suitable and listed for vertical installation.

- B. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module sets and seat discs shall be replaceable.
- C. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall include two resilient seated isolation valves and four top mounted, resilient seated test cocks.
- D. Furnish each backflow preventer with the following accessories and options:
 - 1. OS & Y Gate Valves.
 - 2. Ball Valve Test Cocks.
 - 3. Approval for vertical up flow installation.
- E. Provide minimum 18-inch clearance for servicing and testing.
- F. The assembly shall meet the requirement of ASSE Std 1012 and AMCA Std C510.
- G. Double check valve backflow preventers shall be Watts No. 757, Conbraco, Wilkens, Ancon, or approved equal.

2.12. TRAP SEAL PRIMER VALVES (DIRECT CONNECT TO DOMESTIC WATER)

- A. Supply type, Trap-Seal primer Valves
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - 2. Standard: ASSE 1018.
 - 3. Pressure Rating: 125 psig minimum
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: NPS ½ (DN15) threaded union, or solder joint.
 - 6. Gravity Drain Outlet connection: NPS ½ (dn 15) threaded or solder joint.
 - 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
 - 8. Distribution Unit: Outlet quantities required.

9. Backflow Preventer: Atmospheric vented drain chamber.

2.13. TRAP PRIMING STATION-AUTOMATIC TRAP PRIMER

- A. Trap priming stations shall be Precision Plumbing Products, Inc., Electronic Trap Priming manifold Model PT, MIFAB, Sioux Chief, Watts, or approved equal. The manifold shall supply a minimum of 2 ounces of potable water per opening at 20 PSIG once in each 24 hour period. The Electronic Trap Priming Manifold must be capable of equally priming from 4 through 30 individual floor drain traps. Utilize where four (4) or more floor drains require priming pipes.
- B. The unit shall be factory assembled and prepiped, and shall include a bronze body 3/4-inch female NPT WOG rated ball valve 3/4-inch, Water Hammer Arrestor, copper barrel with brass piston and type "L" copper sweat connection, electronic brass body 3/4-inch solenoid valve, and type "L" copper manifold with brass 2-inch compression fitting and orifice opening for precision water distribution to each floor drain trap. Unit shall be pre-piped with atmospheric vacuum breaker.
- C. Electronic components shall include single point power connection at 120 volt 1 phase 60 hertz, manual over-ride switch, minimum 5 amp breaker, 24 hour geared timer with relay and 5 second dwell function. Separate water hammer arrestor can be provided outside station if integral arrestor is not available.
- D. All components shall be factory assembled, tested and supplied in a 16 gauge steel NEMA 1 enclosure suitable for surface or recess mounting, as indicated on contract drawings. In addition, all components must comply with nationally recognized standards. The Precision Plumbing Products Electronic Trap Priming Manifold shall be fully warranted for the life of the plumbing system.
- E. When only a single trap primer is required, as in the case of a restroom with one floor drain in a toilet (or similar) the contractor may submit, in lieu of an electronic multiple station, a single station for review by the Engineer. The fixture serving the trap primer must be within 10' of the trap. Components shall be brass, bronze, and chrome, of the highest quality.
- F. Access door shall be finished with a prime coat and fire rated where installed in a rated wall. Access door latch shall be Allen key type.

2.14. TRAP PRIMING STATION MINI-AUTOMATIC TRAP PRIMER

- A. The mini trap priming stations shall be Precision Plumbing Products, Inc., Electronic Trap Priming manifold Model MPB, MIFAB, Sioux Chief, Watts, or approved equal. The manifold shall supply a minimum of 8 ounces of potable water per opening at 60 PSIG once in each 24 hour period. The Mini Trap Priming Manifold must be capable of equally priming from 1 to 4 individual floor drain traps. Utilize where three (3) or less floor drains require priming pipes.
- B. The unit shall be factory assembled and prepiped, and shall include a bronze body 3/4-inch female NPT WOG rated ball valve 3/4-inch, Water Hammer Arrestor, copper barrel with brass piston and type "L" copper sweat connection, electronic brass body 3/4-inch solenoid valve, and type "L" copper manifold with brass 2-inch compression fitting and orifice

opening for precision water distribution to each floor drain trap. Unit shall be pre-piped with atmospheric vacuum breaker.

- C. Electronic components shall include single point power connection at 120 volt 1 phase 60 hertz, manual over-ride switch, minimum 2 amp breaker, 24 hour geared timer with relay and 12 second dwell function. Separate water hammer arrestor and can be provided outside station if integral arrestor is not available.
- D. All components shall be factory assembled, tested and supplied in a 16 gauge steel NEMA 1 enclosure suitable for surface or recess mounting, as indicated on contract drawings. In addition, all components must comply with nationally recognized standards. The Precision Plumbing Products Electronic Mini Trap Priming Manifold shall be fully warranted for the life of the plumbing system.
- E. When only a single trap primer is required, as in the case of a restroom with one floor drain in a toilet (or similar) the contractor may submit, in lieu of an electronic multiple station, a single station for review by the Engineer. The fixture serving the trap primer must be within 10' of the trap. Components shall be brass, bronze, and chrome, of the highest quality.
- F. Access door shall be finished with a prime coat and fire rated where installed in a rated wall. Access door latch shall be Allen key type. Furnish with distribution units as required.

2.15. DOMESTIC WATER METER WITH ATC INTERLOCK CAPABILITIES

- A. Furnish and install a bronze magnetic drive flanged turbo-water meter on incoming water service to building and where indicated. The water meter shall be Model WPX-211 as manufactured by Niagara, Rockwell, Hersey, or approved equal. Unit shall be sized and selected so as not to exceed the scheduled maximum pressure drop at design flow.
- B. Main cases for all sizes shall be cast Water Works bronze. Size, model and direction of flow shall be cast, in raised characters, on both sides of the Main cases.

Operating Characteristics		
Meter Size	Low Flow (95 percent minimum)	Normal Range (100.0 +/- 1.5 percent)
2-inch	3	4 to 160
3-inch	4	5 to 350
4-inch	10	15 to 1000
6-inch	20	30 to 2000
10-inch	55	55 to 5500

- C. Meters shall have performance capabilities of continuous operation up to the rated maximum flows as outlined above without affecting long term meter accuracy or causing undue wear. Meters shall also have a 25 percent flow capacity in excess of the maximum flows listed for intermittent flow demands.
- D. The measuring chamber shall be of unitized construction (i.e., complete with measuring element, calibration device and register in one assembly). The measuring chamber shall be capable of operating within above listed accuracy limits without recalibration when transferred from one main case to another. The measuring element shall be mounted on a

horizontal stationary shaft with sleeve bearings and be essentially weightless in water.

- E. The register shall be permanently hermetically sealed; all registers of similar size and registration to have a standard ratio gear reduction so as to permit interchange ability. The register shall be assembled to measuring chamber in a tamper proof manner so removal can be made only after measuring chamber is removed from the maincase. Sweep hand reading and odometer wheel details will conform to American Water Works Standard C-701, as most recently revised.
- F. All reduction gearing shall be enclosed in the permanently hermetically sealed register. The drive magnet shall be located in the measuring element, and the follower magnet shall be located inside the permanently hermetically sealed register. An intermediate magnetically active material shall be required to distribute the magnetic flux uniformly to the follower magnet, thereby improving the service life of the register's rotating components.
- G. All meters shall operate without leakage, damage or malfunction up to a maximum operating pressure of 150 pounds per square inch.
- H. The 6-inch and 10-inch size meters shall have external strainers as part of the meter package. Strainers shall have cover plate for inspection and removal of debris from the bronze screen without disturbing the pipeline.
- I. Flanges on 2-inch size meters shall be oval faced and drilled on the horizontal axis with a bolt circle diameter of 4 ½ -inch. Thickness shall be as required for Class 125 round flanges. Flanges for 3-inch, 4-inch, 6-inch and 10-inch size meters shall be of the Class 125 round type, flat faced, and shall conform to ANSI 16.1 for specified diameter, drilling and thickness. Companion flanges, if required with the meters, shall consist of one standard cast iron flange, tapped with American Standard internal taper pipe threads, and one flanged coupling adapter. The type and outside diameter of connecting pipe shall be provided for appropriate gasket sizing. All bolts, nuts and gaskets shall be provided.
- J. Turbine meters of similar design concept must be available for purchase in all of the sizes specified above. The turbine meters must have a minimum of five (5) years of satisfactory operating experience as marketable products. Limited experimental history is not acceptable. The meter manufacturer shall submit, in writing, a price schedule of its factory maintenance program for the measuring chambers.
- K. The water meter shall be fully field insulated and jacketed to prevent condensation.
- L. The water meter shall be provided with a high frequency pulse output device for interface with Automatic Temperature Control System. The Infrared Pulser shall be Model 860 as manufactured by Hersey or approved equal.
- M. A Pulse to DC converter shall be supplied with the Infrared Pulser. The device shall convert pulses from a variety of liquid flow sensing devices to a 4-20mA output signal which is proportional to the flow rate. This output shall transmit flow rate data over long distances with no loss of accuracy. The converter shall be Model 1005 as manufactured by Hersey or approved equal.
- N. At contractor's option a water meter provided by the ATC subcontractor may be utilized.

2.16. NATURAL GAS ZONE VALVE BOX

- A. The Zone Valve Box shall be constructed of 18 gauge steel with a white, baked enamel finish, and provided with two steel brackets to anchor the box to the wall. Anchor brackets shall be so designed to permit boxes to ganged together in a vertical stack. Single valve boxes require a rough wall opening of: 8-1/2-inch wide x 7-1/4-inch high and 4-inch deep.
- B. The valve shall be full flow, double seal, ball type with: bronze body, buna-N seals and O-ring packing, chrome plated brass ball and designed for working pressures up to 300 P.S.I.G. Only 1/4 turn of the handle shall be required to operate the valve from full "ON" to "OFF" position. In the "OFF" position, the valve handle shall protrude from the box to prevent the door from being shut. The valve shall be securely attached to the back of the box and provided with type L or K copper tube extensions for making connection to concealed piping outside of the box.
- C. The zone valve box assembly shall have a sliding, transparent door with a pull handle and release button which retains the door in the "OPEN" and "CLOSED" positions. In an emergency, the door shall "SNAP-OUT" without exposing sharp edges. The release button shall incorporate a locking device which prevents the valve from being operated by unauthorized persons. A molded plastic cover shall trim the box to the rough wall opening. The top and bottom of the cover shall have interlocking edges for vertical, gang mounting, installations. The front of the cover shall be trimmed with brushed finish stainless steel.
- D. Zone Valve Box shall be Puritan-Bennet, Medaes or approved equal.

2.17. DOMESTIC WATER EXPANSION TANKS

- A. Provide and install domestic water expansion tanks of size, capacity and as indicated on contract drawings. Domestic water expansion tanks shall be Therm-X-TROL as manufactured by AMTROL Inc., Flexcon, Wessels, Taco, Armstrong, or approved equal. Mount tank as detailed on the drawings.
- B. Domestic water expansion tanks shall be specifically designed for use in potable water systems. Tanks shall be pre-charged to require pressure at the factory. The maximum working pressure shall be 150 psig. The maximum operating temperature shall be 200 degrees F. Expansion tanks shall contain removable FDA approved butyl bladder.
- C. Before installation, Contractor shall adjust the tank air pre-charge pressures to equal city water pressure.
- D. The tank must be constructed in accordance with Section VIII of the A.S.M.E. boiler and pressure vessel code and stamped 150 psig working pressure.
- E. Accessories: Pressure gauge and air charging fitting, tank drain, pre-charge as indicated on contract drawings and factory installed clip angles.

2.18. DOMESTIC WATER BOOSTER PUMP SYSTEM (VARIABLE SPEED)

- A. Product(s) Supplied
 - 1. The authorized factory trained representative shall provide one prefabricated,

completely integrated, variable speed pumping station designed to provide constant pressure, at required flow rates with automatic lead/lag capability. The pumping station shall be the AquaForce™ variable speed pumping station by Goulds Pumps, G&L Pumps, Grundfos, Bell and Gossett, Syncroflow "Iron Heart", Armstrong, QuantumFlo, Flopak, Hydronics Modules, VC Systems and Controls, or approved equal. The pumping station shall include complete duplex or triplex stainless steel pumps, with appropriate variable speed (pump specific) variable speed controllers. It is the successful vendor's responsibility to include all necessary appurtenances to provide for a complete, automatic, smooth operating and reliable pumping system. The manufacturer shall supply a complete set of general arrangement drawings, electrical power schematics and control schematics in the operations and service manual, to include the complete pump and variable speed controller instruction manuals. All equipment shall be supplied by a single supplier (unitary source) to ensure system component compatibility.

B. References:

1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Standards for Testing Materials (ASTM)
4. Hydraulic Institute (HI)
5. American Society of Mechanical Engineers (ASME)
6. Underwriters Laboratories (UL)
7. International Standards Organization (ISO)

C. System Description

1. The pump station shall utilize 2 (duplex) stainless steel G&L Pumps, end suction or vertical multistage in conjunction with the Aquavar® variable speed pump controller as manufactured by G&L Pumps, A Goulds Pumps Company or equivalent products such a Grundfos, Bell and Gossett, Syncroflow "Iron Heart", Armstrong, or approved equal. Appropriate check and shutoff valves, pressure transducers, suction/discharge piping, pump and electrical protection shall be integrated into the pump controller package. Provide the following options: Input line reactors, lightning protection, phase loss protection, low suction pressure switch, temperature relief, flexible suction/discharge flanged connection, and flow meter.

D. Conditions of Service

1. Refer to schedules on Contract Drawings for condition of service and performance criteria.
2. Total pumping station system friction loss shall not exceed 5 psig.

E. Sequence of Operation

1. The station shall receive a 4-20mA signal from each pressure transducer, as provided by the pumping station manufacturer. A pressure transducer shall be provided for each pump controller. This shall provide a complete lead/ lag system coupled with a true back-up control. The pressure transducer shall monitor system discharge pressure and provide an analog signal (4- 20mA) to the pump control software, and allow the variable speed pump controller, to provide a variable Volts/ Hz output to the motor. Pressure transducer shall be remote mounted at the end of the distribution piping or logic shall be employed that adjusts the pressure setpoint to simulate the operation of a remote sensor. Once the pressure drops below the set system pressure, the pump shall start and provide system pressure (as determined by the station operator), if this pressure cannot be maintained by one pump, the next pump in sequence shall operate in a lead/lag capacity to provide the extra flow and pressure automatically without the use of additional panels or alternators. The sequence of the pumps shall be field adjustable, and completely automatic without additional panels or alternator controls. The variable speed pump controller shall be completely integrated with the VFD. Special type motors will not be allowed (see motor section). Pumps shall alternate based on elapsed run time. All program settings shall be based on centrifugal pump language and centrifugal pumps. Program settings must be field adjustable to provide on site adjustments. When the system experiences low demand, the variable speed pump controllers will reduce the speed of each pump, until demand has stopped. Pump controllers will stop each pump at zero demand, without the use of external switches or controls.
2. An additional high pressure sensor shall be provided to monitor discharge pressure at booster pump system discharge header. If discharge pressure at discharge header exceeds 80 psig (adjustable) booster pump shall de-energize and alarm sound.
3. During low demand the system shall automatically enter “sleep mode”, which will increase the system pressure to 5 psig above normal set point to force water into hydropneumatic tank to allow storage and complete system shut-down.

F. Submittals

1. Submit three copies of the following for approval:
 - a. General elevation drawings, wiring diagram, pump curves, operating and maintenance manuals and parts list.
 - b. Written certifications for listing with Nationally Recognized Testing Laboratory (NRTL) for the complete pumping system
 - c. Operation and Maintenance Manuals for pumps, controllers and complete pumping station.

G. Quality Assurance

1. The pump station shall be furnished by a single supplier entity, who shall have responsibility for the complete pumping station.

H. Qualifications

1. Manufacturer shall demonstrate proof of financial responsibility with respect to pump station delivery and performance.
2. Upon request from the engineer the manufacturer shall provide proof or evidence of facilities, equipment and capabilities required to produce the specified station.
3. Provide pumping station certified testing as an option.

I. Scheduling

1. The pump station manufacturer shall provide the following:
 - a. Estimated FOB delivery
 - b. Estimated NET weights
 - c. Unloading instructions
 - d. Acceptance at site procedures
 - e. Onsite storage and protection information and complete instruction manuals.

J. Warranty:

1. The manufacturer shall warrant the water pumping system to be free of defects in material and workmanship for one year (12 months) from date of authorized start-up, not to exceed eighteen (18) months from date of manufacturer's invoice. Complete terms and conditions shall be provided upon request.

K. Start-Up Service

1. When discharge piping, electrical connections, and electrical inspection have been completed, the pump station representative shall be contacted for start-up. A minimum one-week notice shall be given to manufacturer representative prior to scheduled start-up date. During start up, the complete pumping system shall be given a running test of normal start and stop, and fully loaded operating conditions. During this test, each pump shall demonstrate its ability to operate without undue vibration, or overheating, and shall demonstrate its general fitness for service. All defects shall be corrected and adjustments shall be made to the pumping station for satisfactory operation. System problems or concerns shall be corrected by the contractor or site station staff, in conjunction with the appropriate factory representative. Testing shall be repeated until satisfactory results are obtained, as determined by the engineer. Start-up assistance shall be provided and shall be at least one 8-hour day.

L. Station Manufacturer

1. The pumping system shall be manufactured by G&L Pumps, A Goulds Pumps, ITT Industries Company, Grundfos, Syncroflow "Iron Heart", Armstrong, Flopak, or approved equal. All systems shall be approved by the engineer prior to bid opening. The station shall be of the capacities as shown on the contract drawings. For consideration of a proposed equal system, the contractor shall furnish the

following data to the engineer at least 10 days prior to the date of the bid opening:

- a. A complete specification for the pumping system proposed as an equal.
- b. A statement of full conformance to the following specifications signed by a corporate officer of the manufacturer.
- c. A general arrangement drawing showing overall dimensions and all piping layouts.
- d. Complete submittal data for all major equipment (pumps, motors, valves, electrical controls, etc.).
- e. An electrical schematic, that provides power and control wiring.
- f. A copy of the appropriate Instruction Operation Manual (IOM) for the pump, pump controller and pumping station.
- g. Location of closest factory trained service centers.
- h. Manufacturer's system UL (or equal) file number.

M. Station Components

1. Pumps

- a. Pumps shall be constructed of 304 or 316L stainless steel and be of centrifugal, vertical multi-stage or end suction design. Pumps shall be the manufactured product of a US manufacturer, producing and selling pumps for a minimum of 10 years. Pump case, impellers, diffusers, seal spring, inner bowls, seal spring, shaft sleeve and retainer clip shall all be manufactured from stainless steel. Shaft bushing shall be from ceramic. Mechanical seal assembly shall be constructed of Carbon/ Silicon Carbide/ Viton as standard. Seat elastomers and casing o-rings shall be from Viton. Shaft sleeve shall be from stainless steel. Tie rods and nuts shall be from zinc coated steel. Pump curve shall rise continuously to shut off head. Best efficiency point of pump shall lie between 70% and 80% of maximum flow capacity of the pump. Pump connections shall be NPT or ANSI flanged, either class 150 or class 300. Maximum pressure rating for class 150 flanges shall be 200 psi and for class 300 shall be 360 psi. Pump shall accept a standard NEMA C-face motor, or JM frame and shall not require a specialty motor with special thrust bearings or integrated VFD. Vertical multistage pumps shall have thrust balanced within the pump. All pumps used shall have a standard NEMA frame motor, and be readily available from manufacturer.

2. Station Base

- a. The pump station base shall be designed and fabricated to provide proper structural support for all attached equipment, and provide anchor bolt support. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation to site, offloading, installation, and operation. Main structural members shall be constructed from heavy weight ¼ inch or 3/8 inch flat steel with a reinforcing channel for larger stations. Steel base shall be shot blasted, primed, and then painted as per paint specification. Provisions shall be made in the station base for off-loading and handling the station at the site of installation. Base shall include steel plate mounted under pump and motor and shall be of compact

design for most standard doorways.

3. Piping

- a. All piping shall be constructed from 304 stainless steel, schedule 40 type or heavier pipe as required to maintain a 3 to 1 pressure safety factor (including 1/16 inch corrosion allowance). All piping shall be hydrostatically tested to a minimum 150% of maximum shutoff pressure generated by the pumping station. Suction and Discharge manifolds shall be designed and constructed for minimal friction loss and compact design for most standard doorways.

4. Valves

- a. Pump isolation valves 2" and below shall be full-port ball valves. Full-port ball valves shall have a brass body, ball shall be chrome plated brass with brass stem. Valves shall be pressure rated to 600 psi WOG. Valves shall conform to MSS-SP-110. Ball valves shall be Watts® model FBV-3.
- b. Valves 2½" and above shall be either lug-type butterfly valves or grooved-end butterfly or ball valves. Butterfly valves body shall be constructed of ductile iron with a polyphenylene sulfide coating. Butterfly valves disc shall be aluminum bronze with a 416SS shaft. Butterfly valves shall have lever operators. Butterfly valve face-to-face dimensions shall comply with MSS-SP-67. Butterfly valves shall be pressure rated to 200 psi. Butterfly valves shall be Watts model BF-03. Grooved-end butterfly valves shall be constructed of ductile iron with an elastomer coated ductile iron disc. Grooved-end butterfly valves shall be pressure rated to 300 psi. Grooved-end butterfly valves shall be Victaulic® model VIC-300. Grooved-end ball valves shall be constructed of ductile iron with a nickel-plated ball and stem. Grooved-end ball valves shall be pressure rated to 1000 psi for sizes 2½" - 3" and 800 psi for sizes 4" - 6". Grooved-end ball valves shall have lever operators and shall be Victaulic Series 721.

5. Pump Check Valves

- a. Each pump discharge shall be equipped with a spring-loaded non-slam silent check valve, appropriately sized to allow no greater than 5 psi of head loss at full station rated capacity. Check valves 2" and below shall have a brass body and PTFE Teflon seat. Check valves 2" and below shall be pressure rated to 400 psi WOG. Check valves 2" and below shall be WATTS Series 600. Wafer style valves shall be provided in sizes from 2½" to 10" for installation between ANSI B16.5 class 150 or class 300 steel flanges. Wafer check valves shall be Val-Matic® Series 1440 or 1800 and conform to AWWA standard C508 for leakage rates. The operation of the valve shall not be affected by the position of installation. When pump is retired, valve shall function to close tightly before flow is reversed, and reducing the possibility of water hammer or shock.

6. Pressure Gauges

- a. Pressure gauges shall be liquid filled, bourdon tube type. Gauges shall be

supplied for both the suction and discharge manifolds. All gauges shall be bottom mounted and shall be glycerin filled to reduce wear due to vibration. Accuracy shall be within $\pm 1.5\%$. Gauge diameter shall be $2\frac{1}{2}"$. Range shall be at least 30% higher than the highest pressure attainable from the pumps at shutoff head conditions. Gauges shall include stainless steel back and copper alloy internals. Pressure gauges shall be manufactured by WIKA® or Equal.

7. Bolts

- a. All bolts used in the assembly of the pumping system shall be zinc plated to retard corrosion and shall be the proper size and gauge for rigid construction.

8. Motors

- a. Motor(s) for the main pump(s) shall be of United States manufacture, C-face or JM frame type open drip proof or TEFC enclosures 1.15 service factor, Min class F insulation. Motors shall be wound for the starting configuration as called out in the technical data sheet. Design pump brake horsepower shall not exceed 100% of motor horsepower exclusive of service factor. The motor shaft shall be high-strength steel. Motors shall be as manufactured by Baldor®, or approved equal. Motors shall be wound with ISR (Inverter Spike Resistant) wire for use with VFD's. Motor manufacturer must provide letter of compatibility of motor with another type of variable frequency or variable speed drive.
- b. Motor efficiencies shall be premium efficiency per NEMA standards.

N. Electrical Scope

- 1. Provide complete main fusible disconnect, variable speed pump controllers, pressure transducers, NEMA motors, instrumentation and controls to automatically start, stop and modulate pump speeds. To smoothly, efficiently and reliably provide pump variable flow rates at a constant discharge pressure. Pumping station shall provide full pump, motor and drive safety features needed to protect the equipment and piping system.
- 2. Main Fusible Disconnect Enclosure
 - a. Individual fusible disconnects shall be provided to completely isolate individual motors starting equipment from incoming power. Individual disconnects shall have a through door operator, and shall be sized as shown in the technical data sheet. Motor fusible disconnect panel shall be housed in a NEMA 4 enclosure with integral latches. The control enclosure shall be constructed of 12-gauge steel and the back plate assembly shall be constructed of 12-gauge steel. All indicating lights, reset buttons, individual selector switches and the operator interface device shall be mounted on enclosure door and also be rated NEMA 4. All internal components shall be mounted and secured to the removable back plate assembly with rigid steel brackets. Disconnects shall be manufactured by ABB Control Inc., Allen Bradley, A/C Tech, or approved equal.

3. The proposed booster pump electrical ampacity requirements cannot exceed scheduled values due to limitations of existing electrical supply.

O. Lightning and Surge Arrester Option

1. Individual fusible disconnects shall be provided to completely isolate individual motors starting equipment from incoming power. Individual disconnects shall have a through door operator, and shall be sized as shown in the technical data sheet. Motor fusible disconnect panel shall be housed in a NEMA 4 enclosure with integral latches. The control enclosure shall be constructed of 12-gauge steel and the back plate assembly shall be constructed of 12-gauge steel. All indicating lights, reset buttons, individual selector switches and the operator interface device shall be mounted on enclosure door and also be rated NEMA 4. All internal components shall be mounted and secured to the removable back plate assembly with rigid steel brackets. Disconnects shall be manufactured by ABB Control Inc, Allen Bradley, A/C Tech, or approved equal.

P. Variable Frequency Drive

1. The pump controller shall be the Goulds Pumps Aquavar® or Aquavar CPC variable speed pump controller or approved equal. The Aquavar shall provide an adjustable carrier frequency with IGBT power switching, and utilize PWM technology. The drive shall provide noiseless operation of the driving motor, short circuit and ground protection, phase loss protection and work with controlled sinusoidal current synthesis and dynamic over current limitations. The Aquavar controller shall be one complete integrated unit including the variable frequency drive, programmable phase loss protection, pump control logic, and include a NEMA 1 (CPC) or NEMA 4 (motor mount version) enclosure. Additional control panels, PLC's or other external devices, shall NOT be necessary to accomplish complete pump programming and variable speed control of pump and motor. Standard variable frequency drives that do not incorporate pump control logic as the primary control software; programming and features directly applicable to centrifugal pump applications shall not be considered equal.
2. The pumping station controller shall provide a LCD two line display with 16 characters per line and programming keypad for data entry. Unit(s) shall utilize user-friendly front panel programming in three languages that displays pump and motor language in clear text. Three colored LED's shall signal 'power on', 'pump running' and 'fault'. Program settings shall be changeable and stored in nonvolatile memory. Program settings shall be retained in memory in the event of loss of power to the controller, without the use of a backup battery. System operating pressure shall be clearly displayed in PSI or feet of head for ease of use and to provide an operator friendly interface. Additional parameters, where applicable, shall be displayed in units consistent with pumping systems. Generic control systems adapted from other applications shall not be considered equal.
3. The settings and program in whole or part may be locked out with the use of an operator selectable password. Standard system hydraulic settings shall include at a minimum the following functions: loss of suction, lack of NPSHa, pump run-out protection, "dead-head" protection, constant pressure setting with variable flow capability, constant flow with variable TDH (pressure) capability, quadratic differ-

ential flow calculation, system curve compensation, multiple pump operation with alternation, pump starting point with allowable adjustable pressure drop, minimum speed with time delay, pressure of flow sensor error, overpressure shutdown, and low flow shutdown.

Q. Pressure Transducer

1. Pressure transducer shall be utilized for providing all pressure signals for the pump control logic. Pressure transducer shall be a solid-state bonded strain gage type with an accuracy of plus/minus 0.20% and constructed of 17-4 pH stainless steel. Transducer shall be rated for station discharge pressure as scheduled and shall provide gauge pressure output, rather than an absolute. Pressure transducer constructed of plastic is not acceptable. Pressure transducer shall be 4-20mA analog type with 7- 33 VDC supply range and utilize a packard type connector to prevent moisture intrusion. Transducer shall be manufactured by Texas Instruments. Pressure transducer shall be remote mounted. Refer to Contract Drawings for locations.

R. Controls and Enclosure

1. The control panel with controls shall be built in accordance with the NEC, and shall comply with UL standards. Pump station manufacturer shall be authorized under UL508A to manufacture its own control panels, and the control panel shall be manufactured by the pump station manufacturer. All equipment and wiring shall be mounted within the enclosure and each device shall be labeled for proper identification. All adjustments and maintenance shall be accessible from the front of the control enclosure. A complete wiring circuit diagram and legend with terminals, components, and wiring completely identified shall be provided. Main disconnect shall be interlocked with door.
 - a. Panel face switches and lights:
 - i. Reset—Acknowledges pump station alarms.
 - ii. Individual pump disconnects.
 - iii. Individual pump run and alarm lights.
 - iv. Alarm horn.
 - v. Low suction pressure reset.
 - b. The pump station, including electrical components and enclosure, shall be UL labeled as a completed assembly with manufacturer's UL label applied to the pump station.
 - c. Refer to Division 23 Section, "Instrumentation and Controls for HVAC and Plumbing Systems" for additional interlock requirements with ATC system.

S. Finishes: Paint

1. Steel base and main disconnect panel stand shall be grit-blasted with #50 steel grit per SSPC-10 to a near white metal condition. The cleaned steel surfaces shall immediately thereafter be primed with an industrial grade primer to a thickness of 2½ to 3 mils epoxy primer. The finish coat shall be acrylic enamel to a thickness of no less than 3 mils. The control panel shall be dip cleaned, acid etched and neutralized, iron phosphate coated and painted with a finish coat of 1½ to 2 mils

of polyurethane.

T. Start up and Training

1. After the station startup has been completed, but before the technician leaves the job site, a training session shall be given to the owner or to the owner's representative, familiarizing that person (operator) with the pumping system operation, maintenance and adjustments.

U. Warranty Requirements

1. Provided that proper maintenance has been performed by the operator or user during warranty period, and a component failure occurs, the manufacturer shall provide the replacement part or component. Repairs done at manufacturer's expense must be pre-authorized. The start-up certificate must be on file with manufacturer to activate warranty. Manufacturer shall support a wide network of

2.19. PRE-PRESSURIZED DOMESTIC BOOSTER PUMP HYDROPNEUMATIC BLADDER TANKS

- A. Provide and install pre-pressurized domestic booster pump hydropneumatic bladder tanks of size, capacity and arrangement as indicated on contract drawings. Pre-pressurized domestic booster pump hydropneumatic bladder tanks shall be FXA as manufactured by Wessels, Flexcon, Hydrocumulator, Taco, Bell & Gossett or approved equal. Mount tank as detailed on the drawings.
- B. Pre-pressurized domestic booster pump hydropneumatic bladder tanks shall be specifically designed for use in potable domestic water booster pump systems. Tanks shall be pre-charged to required pressure at the factory. The minimum working pressure shall be rated for maximum suction pressure plus booster pump shut-off pressure. The maximum operating temperature shall be 240 degrees F. Pre-pressurized domestic booster pump hydropneumatic bladder tanks shall contain removable FDA approved butyl bladder. No water should come in contact with the walls of the tank.
- C. Before installation, Contractor shall adjust the tank air pre-charge pressure to schedule valve.
- D. The tank must be constructed in accordance with Section VIII of the A.S.M.E. boiler and pressure vessel code and stamped to scheduled working pressure.
- E. Accessories: Pressure gauge and air charging fitting with guard, tank drain, precharge as indicated on contract drawing and ASME nameplate.

2.20. DOMESTIC WATER SOLENOID SHUT-OFF VALVES

- A. Furnish and install emergency solenoid shut-off valves where indicated on the contract drawings. Valve sizes shall be identical to pipe size that solenoid valve is installed within. Solenoid valves shall be ASCO 8210 Series or approved equal.
- B. Solenoid enclosures shall have Red-Hat metal solenoid enclosure. Solenoid valves shall be normally closed. Type suitable for operation on electrical characteristics as indicated

on the contract drawings.

- C. Valves shall be suitable for operation in water with a operating differential pressure of 125 psig. Valves shall be suitable for operation at maximum fluid temperatures of 150 degrees Fahrenheit. Valve bodies shall be brass. Solenoid valves shall be U. L. listed.
- D. Provide signs, fittings, strainers, etc. as detailed on contract drawings. Power and control wiring shall be provided and installed by Electrical Contractor.

2.21. GAS SOLENOID SHUT-OFF VALVES

- A. Furnish and install gas solenoid shut-off valves where indicated on the contract drawings. Valve sizes shall be identical to pipe size that solenoid valve is installed within. Gas solenoid valves shall be ASCO 8215G Series or approved equal.
- B. Solenoid enclosures shall have "red-hat" metal solenoid enclosure. Solenoid valves shall be normally closed type, suitable for operation on electrical characteristics as indicated on the contract drawings. Valve body shall be aluminum with Buna "N" seating.
- C. Valves shall be suitable for operating with an operating differential pressure of 50 psig. Valves shall be suitable for operation at maximum fluid temperatures of 125 degrees F.
- D. Gas solenoid valves shall be U.L. listed and F.M. approved.
- E. Install gas solenoid valves above ceilings or in valve boxes as detailed on the contract drawings. Power and control wiring shall be provided and installed by Electrical Contractor.

2.22. COMPRESSED AIR SYSTEMS

- A. Furnish and install all components, piping, fittings, gauges, relief valves, flexible connectors, valves, drains, filters, air dryer, regulators, lubricators, hose reels necessary to form a complete and operating a shop compressed air systems to the extent indicated on the contract drawings utilizing new air compressor(s) and tank. This contractor is responsible for all equipment, rough-in and final connections as detailed on the contract drawings/specifications.
- B. Contractor shall mount air compressor/receiver on vibration isolation material and bolt to concrete housekeeping pad. Flexible piping shall be provided between receiver and piping systems. Contractor shall provide and install piping from each compressors tank drain and refrigerated air dryer drain to adjacent floor drain. Compressed air piping shall be pitched to drain at suitable locations in the system. Refer to Division 22 Section, Plumbing Piping, Fittings, & Valves for pipe material and installation requirements.
- C. Air compressors: Furnish and install lubricated, reciprocating air compressors of the size, capacity, arrangement, and electrical characteristics as detailed on the contract drawings. Air compressors shall be Champion, Gardner Denver, Quincy, Ingersol Rand, Kaeser or approved equal. Air compressors shall include the following performance features:
 - 1. Provide factory assembled and tested, duplex, packaged and assembled, 100 percent continuous duty rated, belt driven, splash or pressure lubricated, two stage

reciprocating, piston type, centrifugal air compressors as indicated, of capacities and electrical characteristics indicated on contract drawings.

2. Compressors shall be cast iron construction with multi-finned cylinders for maximum cooling, gasket free integral cylinder/head, ductile iron crankshaft, aluminum or cast iron pistons and connecting rods, Swedish steel disc type valves, balanced flywheel with fan cooling blades, large diameter, finned inter-coolers, positive acting centrifugal un-loader, tapered roller bearings, inter-stage pressure relief valves, heavy duty 5 micron inlet filter/mufflers, oil sight gauge and drain, low oil shutdown switch, enclosed OSHA belt guards, EPACT '92 energy efficient open drip proof motor, and U.L. listing.
3. Air compressors shall be tank mounted. Tank mounted compressors shall include ASME code 200 PSIG horizontal air receiver. Air receiver shall include 0-300 PSIG liquid filled pressure gauge with snubber and needle valve, bucket high drain valve, ASME code bronze pressure relief valve, hand operated ball valve, factory set pressure switch. The receiver shall have base ring or support legs for mounting to concrete housekeeping pad. Vibration isolators shall be provided for the receiver. Receiver shall include automatic timed solenoid drain as specified. Tank shall be fully primed and finished in manufacturer's standard finish.
4. Air compressor shall be arranged for automatic start-stop control. Each compressors shall be supplied with pressure switch to control each compressor. Each pressure switch shall have adjustable differential control.
5. Each air compressors shall be supplied with an air cooled after-cooler. After cooler shall bring compressed air discharge temperature to within 20 degrees F of ambient air temperature. Unit shall be finned radiator type and packaged directly on compressor. A packaged moisture separator and trap shall be provided to remove all condensate removed from compressed air.
6. Compressed air systems shall be supplied with unit mounted and wired control panel as follows:
 - a. Control panel shall be NEMA 1 general purpose indoor enclosure
 - b. Combination Magnetic motor starters with individual thru-the-door disconnects, motor overloads and external reset buttons
 - c. Hand-Off-Automatic Selector Switches
 - d. Control voltage transformers - Primary & Secondary
 - e. Low oil monitor with shutdown
 - f. Power on light
 - g. Compressor run light
 - h. Automatic alternator timed rotation alternator
 - i. Phase loss protection
7. Compressor package shall have one year parts warranty from date of start-up, or (18) months from date of shipment. Compressed air end shall have (60) month warranty from date of start-up or (66) months from date of shipment. This shall include parts and labor on compressor air end.

D. Refrigerated Air Dryer: Furnish and install a cycling refrigerator air cooled dryer with the

capacity and electrical characteristics as scheduled on the contract drawings. Refrigerated air dryer shall be Heatsink Model HSE as manufactured by Zeks, Arrow Pneumatics, Ingersoll-Rand or approved equal. Furnish refrigerated air dryer with the following performance features:

1. Unit shall be heat sink type and consist of a mechanical refrigeration system, equipped with automatic temperature control that will cycle the refrigerated system to match variable loads from 0 percent to 100 percent capacity.
 2. Specially formulated heat sink material shall surround a smooth bore copper tube on tube evaporative section. The heat sink material shall be cooled by the refrigeration system which in turn shall cool the tubes to cool the dry compressed air. Refrigeration compressor horsepower shall be as specified on contract documents and shall be hermetic type equipped with automatic start-stop capacity control.
 3. Moisture separator shall be low velocity centrifugal type.
 4. Unit shall be controlled by micro-processor controller including exchanger temperature, % savings digital display, dew point temperature, adjustable dew point setting, automatic solenoid drain with drain open/closed adjustment, drain test switch, anti-rapid cycle timer, high temperature alarm light with relay for remote, low temperature alarm light with relay for remote, Fahrenheit and Centigrade temperature display, refrigerant suction pressure gauge, installed drain trap, on/off switch with power on light.
 5. Unit shall be U.L. listed and furnished with packaged automatic solenoid drain. Pipe condensate trap to floor drain and install dryer on a 4-inch high housekeeping pad.
- E. Compressed Air filters: Furnish and install particulate and coalescing filters of capacity and quantity as indicated on the contract drawings. Filters shall be as follows:
1. 3-Micron Particulate filters - Units shall have corrosion resistant cast aluminum alloy head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O"ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 3-micron absolute removal. Unit shall be Zeks "PT" series, Arrow, Ingersoll-Rand, Kaeser or approved equal.
 2. 0.3 Micron Coalescing Filter - Unit shall have corrosion resistant cast aluminum alloy head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O" ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 0.3-micron absolute removal. Unit shall be Zeks "LT" series, Arrow, Ingersoll-Rand, Kaeser or approved equal.
 3. All filters and housings shall be constructed to withstand 250 psig maximum working pressure.

- F. Compressed Air Pressure Regulators: Provide and install pressure regulator where indicated with built-in safety relief valve. Outlet pressure is to be set as specified and to remain constant regardless of inlet air pressure and changes in downstream flow requirements. Unit to be provided with high pressure gauge on outlet and high pressure gauge on inlet. Provide three (3) valve bypass around pressure reducing station as detailed on contract drawings. Pressure regulator shall be constructed of aluminum alloy or Zinc, diaphragm operated, direct acting, spring loaded design with manual adjustment knob and rated 300 psig maximum. Unit shall be relieving type with balanced valve design. Main pressure regulator shall be Arrow, Hankison, Kaeser, Wilkerson or approved equal.
- G. Compressed Air Combination Pressure Regulator/Filter/Lubricator: Furnish and install combination pressure regulator/filters/ lubricators of the capacity and quantity as indicated on the contract drawings. Units shall be provided with built-in safety relief valve. Outlet pressure to be maintained at scheduled value regardless of inlet air pressure and changes in downstream flow requirements. Unit to be provided with high pressure gauge on outlet and inlet. Valve body shall be constructed of zinc. Assembly shall be diaphragm operated, direct acting, spring loaded design with balanced valve design. Filter shall be constructed of sintered polypropylene. Lubricator shall be equipped with drip chamber and sight dome for observing oil drop entering airstream, with a oil-feed adjustment screw and quick-release collar for easy bowl removal. Lubricant shall be non-detergent, petroleum base oil no heavier than SAE 10. The maximum oil droplet flow rate shall be one drop of oil for every SCFM air delivered at 80 psig. Combination units shall be Model C as manufactured by Wilkerson, Arrow, Hankison, Kaeser, Mastercraft, or approved equal.
- H. Each compressed air system shall be equipped with a main safety relief valve. Safety relief valves shall be ASME BPVC Section VIII DI and ASME BPVC Section IX Code stamped safety valve, for unfired pressure vessels, bronze, with threaded or flanged connectors; factory set and sealed.
- I. Provide and install pressure gauges at all locations shown on contract drawings. Pressure gauges shall be ANSI/ASME B40.1 rated, Accuracy Grade A, for air, with steel or brass case, and nonshatterable safety glass, and a pressure blowout back to prevent glass from flying out in case of an explosion. Gauges shall have a 3 1/2-inch minimum diameter dial and a dial range of approximately twice working pressure.
- J. Furnish and install as indicated on drawings, timed automatic condensate drain. Unit shall be 200 PSIG working pressure. Unit shall consist of condensate reservoir, timer operated solenoid drain. Unit shall have fully adjustable drain cycle time, fully adjustable valve open duration, power on light, valve open light, NEMA 4 UL/CSA approved housing, solid state timer, and eight foot, three prong power cord. Units shall be as manufactured by Arrow Pneumatics, Hankison, Zeks, Sparten or approved equal.
- K. Furnish and install adjustable pressure regulators at each compressed air drop, hose reel and equipment as detailed on the contract drawings. Pressure regulators shall include balanced valve design, spring loaded diaphragm, adjustment knob, built-in pressure gauge, drain plug and zinc body. Units shall be selected and constructed to withstand a maximum working pressure of 250 psig. Units shall be as manufactured by Arrow Pneumatic, Hankison, Zeks, Sparten, Vanguard or approved equal.
- L. Provide and install quick disconnect couplings at all drops and wherever indicated on contract drawing. Quick disconnect coupling shall be all brass and suitable for a working

pressure of not less than 200 psig. Female side of coupling shall (fixed end) have male thread connection with automatic shutoff. Provide male side of coupling with hose stem and ball check to bleed pressure from hose and prevent hose whipping. Provide two (2) quick disconnects at compressed air drops where indicated on contract drawings. Quick connect/disconnect hose couplings shall be as manufactured by Aero-Quip, Champion, Hansen, Schrader or approved equal.

- M. Provide and install compressed air hose reel assemblies at all locations shown on the contract drawings. Hose reel assemblies shall be Model HRL 35-35 as manufactured by Appleton, Reelcraft, or approved equal. Each hose reel shall be complete with 35 Ft of ½-inch diameter hose rated for a minimum of 250 psig. Hose reels shall include ball stop, locking ratchet, four roller hose guides with adjustable arms, orange epoxy/polyester finish, and Model SHRL-A swivel base for full 360° rotation. Hose reels shall be mounted as approved by Structural Engineer. Provide structural support extension steel so as to not exceed manufacturer's maximum mounting height.
- N. Where indicated on contract drawings, contractor shall provide rough-in and final connection to equipment provided by owner or under another Division of these specifications.
- O. Factory start-up shall be provided by manufacturer's representative. Start-up shall include a minimum (4) hours and should include complete operational check of compressed air system, pressure switch adjustments, motor amp draw, and correct operation of all system components. Manufacturer's representative shall also instruct owner's personnel on operation and maintenance of the compressed air system components.

2.23. HIGH/LOW MIXING VALVES WITH CABINET

- A. Furnish and install high/low thermostatic controller valves of the size, capacity and arrangement as scheduled on the contract drawings. Units shall be pre-piped and installed within a surface mounted cabinet.
- B. Each unit shall consist of two (2) thermostatic controllers with swivel action check stops, removable cartridge with strainer, stainless steel piston and liquid fill thermal motor with bellows element mounted out of water, inlet manifold piping, pressure reducing valve (PRV), two (2) pressure gauges, two (2) ball valves, bi-metal dial thermometer (3-inch face, range 201 – 240 degrees F), wall bracket, connecting piping and fittings to cabinet limit.
- C. All equipment and piping shall be finished in rough bronze and/or copper. Bottom supplies and top outlet. Field insulate all piping within the cabinet as specified in Division 22 Section, Plumbing Insulation.
- D. Cabinet shall be surface mounted with 16 gauges body, white baked enamel finish, 12 gauge left hinged door with cylinder lock and key.
- E. Complete unit shall be factory assembled and tested. Field insulate all piping within enclosure.
- F. High/low mixing valves shall be Symmons, Lawler, Powers, Acorn, or approved equal.

- G. High/low mixing valves must be piped per the manufacturer's recommendations.
- H. High/low mixing valves shall be ASSE 1017 rated.

2.24. GAS/COMPRESSED AIR ZONE VALVE BOX

- A. The Zone Valve Box shall be constructed of 18 gauge steel with a white, baked enamel finish, and provided with two steel brackets to anchor the box to the wall. Anchor brackets shall be so designed to permit boxes to be ganged together in a vertical stack. Size and select valve boxes to accommodate quantity of pipes and valves as indicated on the Contract Drawings.
- B. Manual valves, where indicated shall be full flow, double seal, ball type with: bronze body, buna-N seals and O-ring packing, chrome plated brass ball and designed for working pressures up to 300 P.S.I.G. Only 3 turn of the handle shall be required to operate the valve from full "ON" to "OFF" position. In the "OFF" position, the valve handle shall protrude from the box to prevent the door from being shut. The valve shall be securely attached to the back of the box and provided with type L or K copper tube extensions for making connection to concealed piping outside of the box. Electric solenoid valves shall be as herein specified.
- C. The zone valve box assembly shall have a sliding, transparent door with a pull handle and release button which retains the door in the "OPEN" and "CLOSED" positions. In an emergency, the door shall "SNAP-OUT" without exposing sharp edges. The release button shall incorporate a locking device which prevents the valve from being operated by unauthorized persons. A molded plastic cover shall trim the box to the rough wall opening. The top and bottom of the cover shall have interlocking edges for vertical, gang mounting, installations. The front of the cover shall be trimmed with brushed finish stainless steel.
- D. Zone valve boxes shall be selected to accommodate the type, size and quantity of valves as indicated on the contract drawings. Zone valve box shall be Puritan-Bennet, Medaes, Potter Rhoemer, or approved equal.

2.25. THERMOSTATIC MIXING VALVES (INDIVIDUAL FIXTURE TYPE)

- A. Furnish and install thermostatic mixing valves where indicated at lavatories, and kitchen hand sinks that are provided with hot water temperatures above 109 degrees F.
- B. Thermostatic mixing valves shall be Bradley S59-4000A, Watts, Acorn, Sloan, Caleffi, or approved equal for installation under lavs. Provide in-line check valves, lead free body, escutcheon plates, inlet filters, and insulation as required. Thermostatic mixing valves shall be adjusted to deliver 105 degrees Fahrenheit hot water when supplied with 140 degrees Fahrenheit delivering hot water. Furnish with adjusting cap with locking feature.
- C. The thermostatic mixing valves shall be ASSE standard 1070 listed.

2.26. INDUSTRIAL HOSE STATION

- A. Industrial hose station shall be thermostatic hot water/cold water mixer type. Units shall be model THS-25-VBD-CW as manufactured by Leonard, T&S, Fisher or approved equal.

- B. Units shall be fully recessed with 16 gauge stainless steel cabinet body and 12 gauge stainless steel #4 finish cover. Inlets shall be located on top.
- C. Inlets: 3/4-inch IPS hot water, 3/4-inch IPS cold water.
- D. Controls: Two stop and check valves with color coded heat resistant handles on inlets. All internal parts shall be stainless steel construction. Unit shall include thermostatic mixing valve with adjustable temperature control, color coded scale and high temperature limit stop.
- E. Thermostat: Duratrol solid bi-metal type directly linked to valve porting.
- F. Dial Thermometer: Outlet type with 20 degrees F – 240 degrees F range.
- G. Hose Nozzle: Industrial application type nozzle suitable for 180 degrees F with finger touch spring control, self-closing automatic shut-off, stainless steel body and stainless steel internal parts.
- H. Accessories: Vacuum breaker hose connection, chrome plated finish, stainless steel hose rack, 3/4-inch EPDM cream color hose with 30 Ft length, couplings, stainless steel spring protector.

2.27. ICE MAKER COLD WATER INLET FILTER

- A. Provide and install a cartridge type water filter on the cold water inlet to the kitchen ice maker as detailed on the contract drawings. Housing shall be constructed of PVC with 3/4-inch NPT connections. Heads shall be cast bronze nickel plated with nickel plated "T" handle cap nut. Unit shall have pet cock bottom drain. Housing shall contain two (2) 20 micron cartridge filters. The entire filter assembly shall be rated for 150 psig. Unit shall be capable of handling a minimum 6 gpm. Housing shall be as manufactured by Keystone or approved equal.
- B. Install filter housing to allow access for service and filter replacement.

2.28. ELEVATOR PIT SUMP PUMP

- A. Furnish and install an elevator pit submersible sump pump of the size, capacity and electrical characteristics as shown on the drawings. System shall include submersible pump, 2-inch discharge flange/piping, grate with cover, float switches, oil sensor, remote mounted control panel and control system. Pumps and accessories shall be by Stancor Oil Minder, Zoeller, Liberty, Bell & Gossett, or approved equal.
- B. Pumps:
 - 1. Pump Design: The pump shall be capable of handling clean water waste. The pump(s) shall be capable of handling liquids with temperatures to 104 degrees F continuous, 160 degrees F intermittent, and shall be capable of running dry for extended periods. Pump shall include thermal and overload protection.
- C. Pump Construction:

1. The volute, seal plates, impeller and motor housing shall be constructed of high quality #304 stainless steel. The pump(s) shall be painted with a water based air dry enamel of 2.0 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. The pump construction shall contain no points of critical clearance nor require periodic adjustment or replacement to maintain operating efficiency. Discharge connection shall be a standard 2-inch NPT in the vertical position. All gaskets shall be of the compression square ring type eliminating critical slip fits and the possibility of damage during service associated with sliding o-ring sealing arrangements.
2. The impeller shall be of the non-clog design with pump out vanes on the back side. The impeller shall be dynamically balanced to ISO G6.3 specifications.
3. The unit shall utilize a single mechanical shaft seal which shall operate in an oil atmosphere. The materials of construction shall be carbon for the rotating face and ceramic for the stationary face, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and all elastomer parts to be of Buna-N. The seal shall be commercially available and not a proprietary design of the manufacture.
4. The pump shall be designed to be non-overloading throughout the entire pump curve. The rotor and stator assembly shall be of the standard frame design and secured to the pump seal plate by four threaded fasteners allowing for easy serviceability. Motor designs incorporating shrink or press fit assembly between the stator and motor housing shall not be acceptable. The motor shall be constructed with the windings operating in a sealed environment containing clean dielectric oil, making it capable of operating in a totally, partially or non-submerged condition for extended periods of time without damage due to the heat being generated. Air-filled motors shall not be acceptable. The motor windings shall be of Class "F" insulation. The motor shall meet the standard NEMA design L for single phase and NEMA design B for three phase. The motor shaft shall be of 416 stainless steel. The lower bearing shall be of the single ball type to accept radial and thrust loads, and the upper bearing of the sleeve or ball design, for radial loads. Bearings shall operate in an oil bath atmosphere for superior life. Permanently lubricated bearings are not acceptable.
5. Thermal sensors shall be used on three phase units to monitor stator temperatures. The stator shall be equipped with a thermal switch embedded in the end coil of the stator winding. This shall be used in conjunction with external motor overload protection and wired to the control panel. Single phase shall have an overload switch on the motor windings and do not require any external protection. Three (3) phase motors shall include phase loss protection.
6. The pump shall be equipped with type neoprene jacketed power cable and connected to the motor via quick disconnect spade terminals length as required. Crimp connected cords are not acceptable. Heat shrink tubes shall be used to connect power cord leads with motor leads. A master heat shrink tube shall be provided and filled with epoxy to seal the outer cable jacket and the individual strands to prevent water from entering the motor housing. A secondary rubber pressure grommet shall be provided as an additional sealing point and strain relief at the point of cable entry. Cable entry designs utilizing terminal boards to connect

power cord leads with motor leads shall not be acceptable.

7. The sump grate shall be custom sized to accommodate the dimensions of the sump. Grate shall be galvanized steel and have openings for all pipes/conduits as required.

D. Pump Test:

1. The pump manufacturer shall perform the following inspections and tests in accordance with Hydraulic Institute type B standards before shipment from the factory.
2. A check of the motor voltage and frequency shall be made as shown on the name plate.
3. A motor and cable insulation test for moisture contents or insulation defects shall be made per UL criteria.
4. The pump shall be completely submerged and run to determine that the unit meets three pre-determined hydraulic performance points.
5. A written report shall be available showing the aforementioned tests have been performed in accordance with the specifications.

E. Start-Up:

1. The pump(s) shall be tested at start-up by a qualified representative of the manufacturer. A start-up report as provided by the manufacturer shall be completed before final acceptance of the pump(s).
2. Warranty: Two (2) years from substantial completion.

F. Float Level Controls:

1. Provide and install three (3) level controls as detailed on the drawings. Two (2) level controls shall be utilized for the pump operation and the remaining level control shall be utilized for high water level alarm. Level controls shall be provided in a pipe mounted configuration with 25 feet of cable. Level controls shall be pilot duty devices which shall control the function of motor load devices, contactors, motor starters and power relays, to automatically cycle pumps. Switches shall be rated at 4.5 Amps at 115 VAC RES, Provide pole and stainless steel clamps and hardware.
2. Where required, provide custom length of cables to accommodate distance between sumps and control panels where the minimum 25 feet length is insufficient.

G. Valves:

1. Provide and install discharge valves on the pump as detailed on the drawings. Ball check valves shall be provided with removable threaded plug and natural rubber

ball. Valve body shall be ASTM class 30. Cast iron valve shall be able to withstand 150 psig.

2. Ball Valves:

- a. Ball valves shall be True Union Type manufactured of Type 1 Schedule 80 PVC with EPDM O-rings for superior chemical and corrosion resistance. Valves shall be quick disconnect type for ease of maintenance. Ball valves shall be suitable for pressures up to 150 psig.

H. Control Panel:

1. The pump manufacturer shall supply a completely self-contained motor control panel. The control panel shall be provide with short circuit and overload protection for the pump. Furnish control panel with 8 pin twist lock receptacle, dual solid state oil sensor relays with reliable sensitivity settings, over current relay, sensor probe, horn, alarm silencing switch, terminal board and remote monitoring contacts. Furnish sufficient cable between pump and control panel. Furnish sufficient cable and plug for the control panel.
2. The motor controls shall be housed in a NEMA 4X enclosure. The enclosure shall be formed of 16 or 14 gauge, G-90 galvanized steel, with all surfaces phophatized then finished inside and out with ANSI 61 gray polyester powder finish. The door shall be equipped with two galvanized hinges with stainless steel hinge pins. The enclosure shall have external mounting tabs for wall mounting.
3. A magnetic starter shall be provided for each pump motor. The starter shall be equipped with a three (3) pole bimetalic overload relay with ambient compensation and Class 10, quick trip heaters. Heaters must be properly sized for motor load. The overload relay shall provide the terminals for connection of the pump motor cable.
4. A control transformer shall be provided to supply low voltage as required for the control circuit. The transformer shall be continuous duty machine tool type, size to meet the load requirements of the control circuit. The transformer primary shall be connected to the load side of the circuit breaker. One side of the secondary winding shall be grounded to the component mounting panel.
5. A terminal block shall be provided for connection of level controls, oil sensor, alarms, remote monitoring and other control wiring as required for proper pump installation.
6. Control panel shall be interlocked with floats and oil sensor to allow pumping of water while containing oil. Control panel shall be fully automatic and shall provide for an alarm and LED lights in the event of any of the following:
 - a. Presence of oil in the sump.
 - b. High water level.
 - c. High amps.
 - d. Locked rotor.

7. Furnish additional contacts/relays for remote monitoring of high water alarm and oil presence alarm on facility automatic temperature control system. Coordinate with Division 23 Section, Instrumentation and Controls of HVAC and Plumbing Systems.
8. The control panel shall be wired in accordance with all applicable requirements of the National Electrical Code. Control wiring shall be sixteen (16) AWG red for control circuits and white for neutral grounded conductors. Power wiring shall be a minimum of 14 AWG black. Each conductor shall be numbered. The ends of all wires shall be tinned with 60/40 lead tin alloy sold. All wiring shall be performed in a neat and orderly manner.

2.29. OIL INTERCEPTOR WITH INTEGRAL HOLDING TANK

- A. Furnish and install packaged oil interceptors with integral holding tanks of size, capacity, and dimensions as indicated on the contract drawings. Units shall be MiFab Series MI-O-HU, Rockford, Zurn, or approved equal.
- B. Units shall be constructed of sanitary Neutra-Rust coated inside and outside 10 gauge steel. Units shall include sediment bucket with perforated inlet, deep seal trap, covered lid, security bolts, removable baffle assembly and cross bar, stainless steel calibrated orifice plate, adjustable automatic draw-off assembly, double vent connections on each side, steel coated non-skid heavy duty re-enforced (load rated – 10,000 lbs.) rectangular lids. Furnish units with integral holding tank for temporary additional waste oil storage.
- C. Units shall be provided with the following additional accessories:
 1. Anchor flange and membrane clamp.
 2. Extensions as required to bring lids up to grade.
 3. Internal air relief bypass.

2.30. IN-LINE COLD WATER INLET FILTER

- A. Provide and install a cartridge type water filter on the cold water inlet to the water heaters as detailed on the contract drawings. Housing shall be constructed of PVC with 3/4-inch or 1 inch NPT connections. Heads shall be white talc reinforced polypropylene head. Housing shall contain one (1) 10 micron cartridge filters. The entire filter assembly shall be rated for 150 psig with maximum 5 psig pressure drop. Unit shall be capable of handling a minimum 15 gpm. Cartridge shall be nominal 4" diameter, 20" long pleated polypropylene, pleated polyester or other NSF safe material as required to meet specified performance. Provide filter with wall mounting bracket. Housing shall be as manufactured by Keystone, AMTROL, Watts, ITT Water Equipment, Culligan, International, or approved equal.
- B. Install filter housing to allow access for service and filter replacement.
- C. Provide 5 spare cartridges. Document in writing that cartridges have been turned over to Owner and forward copy to the Architect.

2.31. OPEN HUB DRAIN

- A. Furnish and install open hub drain valves with integral ball float valve as detailed on the Contract Drawings. Open hub drains shall be Josam model 67100A series, Zurn, Mifab, Watts, or approved equal.
- B. Open hub drain shall be coated cast iron backwater valve, plastic ball float, elastomer seat, bronze cage, and bottom outlet spigot connection. Size shall be as indicated on Contract Drawings.
- C. Connect to stormwater system or as indicated on the Contract Drawings.
- D. Insulate and jacket all piping/equipment to prevent condensation.

2.32. GREASE INTERCEPTOR (OUTDOOR CONCRETE TYPE)

- A. Furnish and install an underground concrete grease interceptor of the size, capacity, and arrangement as shown on the Contract Documents.

2.33. INDUSTRIAL RETRACTABLE WATER HOSE REEL

- A. Industrial Retractable Water Hose Reel shall be Model 7850 OLPSW57 as manufactured by ReelCraft or approved equal.
- B. Unit shall be capable of mounting to structural steel. Include applicable mounting bracket.
- C. The reel's base and guide arm shall be formed from high-grade steel and engineered with structural forms and gussets to yield the greatest amount of strength. Reel shall be used for water.
- D. Unit shall come with full flow, stress free swivel to insure maximum service life. Hose shall be plumbed into the base to eliminate the risk of undue stress on the swivel.
- E. Hose reel shall have a long life drive spring. De-clutching arbor shall be provided to eliminate possibility of spring damage due to reverse winding.
- F. All components of Hose Reel shall have individually powder coated components to prevent corrosion.
- G. Inlets: 1/2-inch NPT cold water. Hose Outlet: 3/4-inch NPT.
- H. Pressure: 300 psi max. Temperature: 150°F max.
- I. Hose Nozzle: Industrial application type nozzle suitable for 180 degrees F with finger touch spring control, self-closing automatic shut-off, stainless steel body and stainless steel internal parts.
- J. Accessories: Vacuum breaker hose connection, powder coated finish, stainless steel hose rack, 3/4-inch EPDM hose with 50 Ft length, couplings, stainless steel spring protector.

PART 3. EXECUTION

3.1. GENERAL INSTALLATION REQUIREMENTS

- A. Install all equipment in accordance with manufacturer's instructions.
- B. Install components plumb and level.
- C. Cleanouts in vertical pipes shall be installed in tees near floor. Cleanouts in horizontal pipes shall be installed with wyes on long sweep quarter beds. Cleanouts punching water proofing membranes shall have flashing clamps. Cleanout access covers in dry wall or gypsum board shall be painted to match walls.
- D. Extend cleanouts to finish floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- E. Encase exterior cleanouts in concrete flush with grade.
- F. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, ANSI/NFPA 54, UL requirements and Delaware Boiler and Pressure Vessel Safety Act and Regulations. For gas fired water heaters, conduct a combustion flue gas analysis. Submit flue gas analysis report to Engineer for review. Record and submit design and actual draft at appliance vent connection.
- G. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve a complete operating system.
- H. Install domestic water storage tanks in accordance with manufacturer's instructions.
- I. Provide painted steel pipe support for tanks independent of building structural framing members.
- J. Clean and flush domestic water heater tanks after installation. Seal until pipe connections are made.
- K. Support piping adjacent to all pumps such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches (100 mm) and over.
- L. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- M. Align and verify alignment of base mounted pumps prior to start-up.
- N. For sump pumps ensure shaft length allows sump pumps or ejector to be located minimum 24 inches (600 mm) below lowest invert into sump pit and minimum 6 inches (150) clearance from bottom of sump pit.
- O. All plumbing, vents in exterior walls shall be offset a minimum of 3'-0" in ceiling at roof

before penetration.

- P. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.
- Q. All plumbing vents within a 10'-0" radius of any rooftop unit or intake louver shall be extended to a height of 3'-0" above fresh air intake.
- R. Slopes and invert elevations of all interior piping shall be established before any piping is installed in order that proper slopes will be maintained. All piping shall be located and determined where to be run to avoid conflict with other trades.
- S. Unless otherwise noted, all plumbing piping shall be routed as high as possible between bottom of roof joists and above ceiling to allow proper installation of ductwork, fire protection piping, conduits, etc.
- T. Coordinate with Architectural Drawings before roughing in plumbing.
- U. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.
- V. See site plan for extent of all piping leaving and entering building.
- W. See domestic water riser diagrams for location of valves, shock absorbers, balance valves, etc.
- X. Make proper HW, CW, recirculating, waste, and vent connections to all equipment even though all branch main, elbows and connections are not shown.
- Y. Cleanouts shall be provided near base of each vertical waste or solid stack. Provide 18" minimum clearance for access.
- Z. Domestic hot, cold and recirculating water piping shall be installed between ceiling and roof insulation.
- AA. Unless otherwise noted, horizontal sanitary piping pitches shall be 1 percent.
- BB. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.
- CC. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.
- DD. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.
- EE. For sizes of all sanitary and vent piping see plumbing fixture schedule and sanitary/vent riser diagrams.
- FF. Set fill pressure on airside of hydropneumatic tanks to the pressure required by the booster pump manufacturer to allow shut-down of booster pump set during periods of no flow.

3.2. DOMESTIC WATER HEATER INSTALLATION REQUIREMENTS

- A. Install units on concrete bases, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- B. Anchor units to substrate.
- C. Install combustion air and flue vents as detailed on contract drawings. Terminate and install combustion air and flue vent piping per manufacturer's requirements.
- D. Install condensate hose below exhaust elbow per manufacturer's requirements. Extend condensate hose continuous downward pitch and discharge into condensate neutralizer. Install lime chips in condensate neutralizer.
- E. Install temperature and pressure relief valves in top portion of storage tank shells of units with storage. Use relief valves with sensing elements that extend into shells. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain. Install union on relief valve discharge piping. Install automatic air vent at top of hot water supply piping with union ball valve.
- F. Install pressure relief valves in water piping for units without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- G. Install vacuum relief valves in cold water inlet piping.
- H. Install unit drain piping as indirect waste to spill into open drains or over floor drains. Install hose end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section, Plumbing Piping, Fittings and Valves for drain valves.
- I. Install thermometers on unit inlet and outlet piping. Refer to Division 22 Section, Plumbing Piping, Fitting and Valves for thermometers. Install pressure gages on unit piping.
- J. Fill unit with water. Install domestic water expansion tank and charge with air. Install piping adjacent to units to allow service and maintenance.
- K. Connect hot and cold water piping with shutoff valves and unions. Connect hot water circulating piping with shutoff valve, check valve, and union.
- L. Make connections with dielectric fittings where piping is made of dissimilar metal.
- M. Electrical Connections: Power wiring is specified in Division 26 Sections. Arrange wiring to allow unit servicing.
- N. Ground equipment
 - 1. Tighten electrical connectors and terminals according to manufacturers published torque tightening values. If manufacturer's torque values are not indicated, use

those specified in UL 486A and UL 486B. Engage a factory authorized service representative to perform startup service.

- O. In addition to manufacturer's written installation and startup checks, perform the following:
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
 - 2. Verify that piping system tests are complete.
 - 3. Check for piping connection leaks.
 - 4. Check for clear relief valve inlets, outlets, and drain piping. Check operation of circulators.
 - 5. Test operation of safety controls, relief valves, and devices. Energize electric circuits.
 - 6. Adjust operating controls.
 - 7. Adjust hot water outlet temperature settings. Do not set above 140 deg F 60 deg C unless piping system application requires higher temperature.

3.3. PLUMBING SPECIALTY INSTALLATION REQUIREMENTS

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Install backflow preventers of type, size, and capacity indicated, at each water supply connection to mechanical equipment and systems, and to other equipment and water systems as indicated. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment. Install air gap fitting on units with atmospheric vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer. Label all piping downstream of backflow preventers as "non-potable" water.
- C. Field test all backflow preventers and submit test reports to Engineer. Furnish test kits as required for field testing.
- D. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- E. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve, and where indicated.
- F. Install hose bibbs with integral or field installed vacuum breaker.
- G. Install wall hydrants with integral or field installed vacuum breaker.
- H. All hose bibbs shall be mounted 18" above finished floor, unless otherwise specified.

- I. All wall hydrants shall be mounted 24" above finished grade unless otherwise specified.
- J. Install roof hydrants 41 inches above finished roof.
- K. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of one percent and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow. Install trap priming stations plumb and level with adequate access for servicing and maintenance.
- L. For all trap primer pipes label the same as to the location of the floor drain served.
- M. For floor drains located in toilet rooms and similar spaces where flush valves are utilized. Contractor may utilize trap primer line from flush valve tail piece.
- N. Install backwater valves in building drain piping as indicated. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing. Fasten wall hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated. For exterior installation provide handhole with hinged cover and top mounted to be flush with grade.
- O. Fasten recessed, wall mounting plumbing specialties to reinforcement built into walls.
- P. Secure supplies to supports or substrate.
- Q. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve as appropriate is not indicated.
- R. Install water supply stop valves in accessible locations.
- S. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons if required to conceal protruding pipe fittings.
- T. Include wood blocking reinforcement for recessed and wall mounting plumbing specialties.
- U. Install ball valves at all shock absorbers to allow removal for service/replacement.

3.4. WATER METER INSTALLATION REQUIREMENTS

- A. Install water meters, piping, and specialties according to AWWA M6 requirements.
 - 1. Install plate strainer upstream of water meter.
 - 2. Install displacement type water meters with shutoff valve on water meter inlet. Install valve on water meter outlet and valved bypass around meter, unless prohibited by authorities having jurisdiction.
 - 3. Install compound type water meters with shutoff valves on water meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on

brick or concrete piers.

4. Install detector type water meters with shutoff valves on water meter inlet and outlet and on full size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers. Install roughing in piping and specialties for water meter installation according to utility's instructions and requirements.
- B. Install power and control wiring from water meter to ATC system.
- C. Field insulate and jacket water meter to prevent condensation.
- D. Provide spare strainer screen for all water meters with integral strainers.
- E. Install power wiring to water meter and encoder/reader.

3.5. FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

- A. Fixtures such as built in sink in counters and kitchen equipment are provided under other divisions of the specifications and are complete with strainer and tailpiece. Fittings, accessories and connection of these fixtures to the plumbing system are provided under this section.
- B. Rough-in and final connection includes but is not limited to all domestic water, waste, and vent, gas and compressed air systems. Furnish stops, strainers, vacuum breakers, and under counter insulation where not furnished under another Division of these specifications.

3.6. KITCHEN EQUIPMENT INSTALLATION

- A. The kitchen equipment plumbing fixtures are provided under the Architectural Division of these specifications. Rough-in and final connection shall be provided under this Division. Coordinate final connection and rough-in dimensions with Architectural Contract drawings.
- B. The rough-in requirements are as scheduled on the drawings. The equipment No's are per the kitchen equipment drawings.
- C. Water Inlets:
 1. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be placed on the fixture to prevent siphoning. Where exposed to view, piping and fittings shall be chrome-plated.
- D. Drain Lines:
 1. Plumbing Contractor shall provide and install indirect waste lines from equipment which will discharge into floor drains or safe wastes in accordance with Plumbing Rough-In plans, chrome-plated where exposed. Extend to a point at least 1-inch (or as required by local codes) above the rim of the floor drain, cut bottom on 45

degree angle and secure in position.

2. All horizontal piping lines shall be run at the highest possible elevation and not less than 6-inch above finished floor, through equipment where possible.
3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks of more than one thread at the fitting.
4. Provide suitable pressure regulating valves for all equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions.

E. Sealants:

1. Provide and apply sealant where kitchen equipment plumbing fixtures come in contact with walls and floors.
2. Sealant, shall conform to ASTM C920; type S Grade NS, Class 25, Use Nt, with characteristics that when fully cured and washed meets requirements of Food and Drug Administration Regulation 21 CFR 177.2600 and N.S.R. RTV-732 for use in areas where it comes in contact with food.
3. Dow-Corning #780 or General Electric "Silastic", or approved equal, in either clear or approved color to match surrounding surfaces and applied in accordance with manufacturers recommendations for a smooth, sealed finish.

3.7. TESTING

- A. After plumbing fixtures are connected, all piping and fixtures shall be tested for operation and a smoke or peppermint test shall be made on all soil, waste and vent piping.
- B. After the building has been occupied and the various equipment is in actual use, the Contractor shall make an operating test of all equipment at a time directed by the Engineer to determine that all contract requirements are met.

3.8. CLEANING AND STERILIZATION

- A. After final testing for leaks, all potable water lines shall be thoroughly flushed, by plumbing contractor, to remove foreign material. Before placing the systems in service, sterilize the new water lines in accordance with local health department codes and at a minimum according to the following procedure:
 1. Through a 3/4-inch hose connection in each branch main and building main, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine into system.
 2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.
 3. When chlorinated water has been brought to every faucet and tap with a minimum

concentration of 200 ppm chlorine, retain this water in the system for at least three (3) hours.

4. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system. It is not necessary to retain chlorine in any system for twenty-four hours to achieve sterilization. AWWA states that 200 ppm chlorine for three hours is sufficient.
5. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.
6. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 ppm.
7. Obtain representative water sample from the system for analysis by an independent and recognized bacteriological laboratory.
8. If the sample tested for coliform organisms is negative, a letter and laboratory report shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization. Additionally, this report shall be forwarded to the Owner as well as be included in the O&M Manual.
9. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.
10. Take precautions to avoid use of plumbing fixtures and domestic water systems during sterilization period. Place signs on all plumbing fixtures and outlets during sterilization period.

3.9. EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.10. PREPARATION

- A. Review the Kitchen Equipment Consultant's equipment cut sheets. Confirm rough-in location and size of fixtures and openings prior to commencing work.
- B. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.11. INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.12. CLEANING

- A. At completion, clean plumbing equipment.

3.13. ELEVATOR PIT SUMP PUMP INSTALLATION REQUIREMENTS

- A. Provide access space around pump for service and motor replacement.
- B. Install all float wiring and water level controls.
- C. Install all interlock wiring from pump to oil minder control panel and automatic temperature control system.
- D. Furnish and install removable galvanized steel grate to match pit sump opening size.
- E. Provide factory start-up and training.
- F. Test/Balance Engineer to test pump and all controls and submit results in the TAB report.

3.14. DOMESTIC BOOSTER PUMP INSTALLATION REQUIREMENTS

- A. Set up and adjust all sensors, control panels, alarms, and controls.
- B. Provide factory authorized startup and training.
- C. Interlock domestic booster pump control panel with ATC system as required to provide monitoring requirements indicated on the control diagram and points list. Coordinate with ATC subcontractor.
- D. Test and Balance Contractor to test domestic booster pumps as specified.
- E. Furnish, install, and interlock remote pressure sensor and monitor on automatic temperature control system. Coordinate with ATC subcontractor.

END OF SECTION

DIVISION 22 SECTION 22 61 13
COMPRESSED-AIR PIPING FOR DENTAL SYSTEMS
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SECTION 22 61 13
COMPRESSED-AIR PIPING FOR DENTAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Dental compressed-air piping, designated "dental air."
2. Gas-powered-tool compressed-air piping, designated "instrument air."
3. Shape-memory-metal couplings.
4. Pressure-seal fittings.
5. Flexible pipe connectors.
6. Zone valve box assemblies.
7. Ball valves.
8. Check valves.
9. Gas safety valves.
10. Compressed-air service connections.
11. Compressed-air manifolds.

B. Related Requirements:

1. Section 123553.13 "Metal Laboratory Casework" for compressed-air outlets in laboratory casework.
2. Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework" for compressed-air outlets in laboratory casework.
3. Section 123553.19 "Wood Laboratory Casework" for compressed-air outlets in laboratory casework.
4. Section 123570 "Healthcare Casework" for compressed-air outlets in healthcare casework.

5. Section 221513 "General-Service Compressed-Air Piping" for general-service compressed-air piping and specialties.
6. Section 226119 "Compressed-Air Equipment for Dental Systems" for air compressors and specialties.

1.3 DEFINITIONS

- A. Compressed-Air Piping Systems: Include medical air, dental air, instrument air, and laboratory air.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Seismic Qualification Data: Certificates, for compressed-air manifolds, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Material Certificates: Signed by Installer, certifying that dental compressed-air piping materials comply with requirements in NFPA 99 for positive-pressure dental gas systems.
- D. Brazing certificates.
- E. Field Quality-Control Reports: Brazing certificates.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For dental compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Medical Air Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 and NFPA 99 for medical-gas-system installers.

2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer in accordance with ASSE Standard #6040 and NFPA 99.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 1. Qualify testing personnel in accordance with ASSE Standard #6020 and NFPA 99 for medical-gas-system inspectors and ASSE Standard #6030 and NFPA 99 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2/B2.2M.

PART 2. PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Dental air operating at 80 to 100 psig (550 to 690 kPa).

2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical air piping materials.
 1. All positive-pressure compressed-air piping, tubing, and fittings shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.
 - a. Each length of tubing shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.
 - b. Fittings and other components shall be delivered manufacturer sealed and labeled, and kept sealed until prepared for installation.
- B. Comply with ASME B31.1 for laboratory air piping operating at more than 150 psig (1035 kPa).
- C. Comply with ASME B31.9 for laboratory air piping operating at 150 psig (1035 kPa) or less.
- D. Copper Medical Gas Tube: ASTM B819, Type K, seamless, drawn temper. Include standard color marking "MED" or "OXY/MED" in green for Type K tube and in blue for Type L tube.
- E. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.
- F. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- G. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3-mm) maximum thickness, full-face type.
 2. Flange Bolts and Nuts: ASME B18.2.1 carbon steel.
- H. Shape-Memory-Metal Couplings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aerofit, Inc.
 - b. CAMERON; A Schlumber Co.
 - c. Motion Industries.
 - d. Smart Tap; Smart Technology, Inc.
 2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy.
- I. Pressure-Seal Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. Viega LLC.
 2. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 3. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.
- J. Flexible Pipe Connectors:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Hyspan Precision Products, Inc.
 - d. Mercer Rubber Co.
 - e. Metraflex Company (The).
 - f. Proco Products, Inc.
 - g. Universal Metal Hose.
 2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 200 psig (1380 kPa) minimum.

- b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape: PTFE.

2.4 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged in accordance with CGA G-4.1 for oxygen service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gauges.

1. Steel Box with Aluminum Cover:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Amico Corporation.
 - 2) BeaconMedaes.
 - 3) CONCOA.
 - 4) Ohio Medical Corporation.
 - 5) Oxequip Health Industries; a division of Allied Healthcare Products Inc.

2. Description: Formed-steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gauges and in sizes required to permit manual operation of valves. Medical air tubing, valves, and gauges may be incorporated in zone valve boxes for medical gases.

- a. Positive-pressure compressed-air valves shall have been manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.
 - 1) Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
- b. Interior Finish: Factory-applied white enamel.
- c. Cover Plate: Aluminum with frangible or removable windows.
- d. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, in accordance with NFPA 99.

3. Steel Box with Stainless Steel Cover:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Tri-Tech Medical.
 - 2) Amico Corporation.
 - 3) BeaconMedaes.

- 4) Ohio Medical Corporation.
- b. Description: Formed-steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gauges and in sizes required to permit manual operation of valves.
- c. Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.
- 1) Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
- d. Interior Finish: Factory-applied white enamel.
- e. Cover Plate: Stainless steel with frangible or removable windows.
- f. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, in accordance with NFPA 99.

C. Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. BeaconMedaes.
 - d. Marwin Valve; Richards Industries.
 - e. NIBCO INC.
 - f. Ohio Medical Corporation.
 - g. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
 - h. Tri-Tech Medical.
- 2. Standard: MSS SP-110.
- 3. Description: Three-piece body, brass or bronze.
- 4. Pressure Rating: 300 psig (2070 kPa) minimum.
- 5. Ball: Full-port, chrome-plated brass.
- 6. Seats: PTFE or TFE.
- 7. Handle: Lever type with locking device.
- 8. Stem: Blowout proof with PTFE or TFE seal.
- 9. Ends: Manufacturer-installed ASTM B819, copper-tube extensions and manufacturer-installed ASTM B819, copper-tube extensions with pressure gage on one copper-tube extension.
- 10. Positive-pressure medical air valves shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.

- a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. BeaconMedaes.
 - d. Marwin Valve; Richards Industries.
 - e. NIBCO INC.
 - f. Ohio Medical Corporation.
 - g. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
 - h. Tri-Tech Medical.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed, ASTM B819, copper-tube extensions.
6. Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

E. Gas Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. CEODEUX Meditec.
 - d. UCSF Health Environment of Care.
2. Bronze body.
3. ASME-construction, poppet, pressure-relief type.
4. Settings to match system requirements.
5. Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.

- a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

F. Compressed-Air Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.
4. Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

G. Pressure Regulators:

1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for 250-psig (1725-kPa) minimum inlet pressure.
5. Capable of controlling delivered air pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.
6. Positive-pressure medical air regulators shall be manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

2.5 MEDICAL COMPRESSED-AIR SERVICE CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amico Corporation.
 2. BeaconMedaes.
 3. Ohio Medical Corporation.
 4. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
 5. Tri-Tech Medical.

B. General Requirements for Medical Compressed-Air Service Connections:

1. All positive-pressure compressed-air-service connections shall be manufacturer cleaned, purged, and sealed as for oxygen service in accordance with CGA G-4.1.
2. Suitable for specific medical air pressure and service listed.
3. Include roughing-in assemblies, finishing assemblies, and cover plates.
4. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
3. Double seals that will prevent air leakage.
4. ASTM B819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:

1. Brass housing with primary check valve.
2. Double seals that will prevent air leakage.
3. Cover plate with gas-service label.

E. Quick-Coupler Pressure Service Connections:

1. Outlets for medical air with noninterchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

F. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.

1. Medical Air: D.I.S.S. No. 1160.
2. Instrument Air: D.I.S.S. No. 1160.

G. Cover Plates:

1. One piece.

2. Stainless steel.
3. Permanent, color-coded, identifying label matching corresponding service.

PART 3. EXECUTION

3.1 PREPARATION

- A. Cleaning of Medical Air Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
 1. Clean medical air tube and fittings, valves, gauges, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service in accordance with CGA G-4.1.
 2. Wash medical air tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

- A. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install seismic restraints on compressed-air piping.
- C. Comply with NFPA 99 for installation of compressed-air piping.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping with 1 percent slope downward in direction of flow.

- I. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- J. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- K. Install branch connections to mains from top of main. Provide drain leg at end of each main and branch at low points.
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and for branch connections.
- O. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 226119 "Compressed Air Equipment for Dental Systems," and to equipment specified in other Sections requiring medical air service.
- P. Piping Restraint Installation: Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- Q. Install service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- R. Connect piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
- S. Install unions in copper tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section 220500 "Common Work Results for Plumbing."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section 220500 "Common Work Results for Plumbing."

3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on compressed-air piping where reduced pressure is required.
- F. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of cleaned tubing and fittings before assembly.
- C. Threaded Joints: Apply appropriate tape to external pipe threads.
- D. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.
- E. Soldered Joints: Apply ASTM B813, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828.
- F. Extruded-Tee Outlets: Form branches in copper tube in accordance with ASTM F2014, with tools recommended by tube manufacturer.
- G. Flanged Joints:
 - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.
- H. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 COMPRESSED-AIR SERVICE COMPONENT INSTALLATION

- A. Install compressed-air pressure-control panel in walls. Attach to substrate.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Division 23 Section 230548, "Vibration Controls for HVAC, Plumbing & Fire Protection Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices specified in Division 22 Section 220500 "Common Work Results for Plumbing."

- C. Vertical Piping: MSS Type 8 or Type 42 clamps.
- D. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52 spring hangers.
- G. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- H. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- I. Support vertical runs of copper tubing to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 IDENTIFICATION

- A. Install identifying labels and devices for dental compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section 220500 "Common Work Results for Plumbing."
- B. Install identifying labels and devices for dental compressed-air piping systems in accordance with NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Dental Air: Black letters on yellow background.

3.8 FIELD QUALITY CONTROL FOR DENTAL COMPRESSED-AIR

- A. Testing Agency:
 - 1. Owner will engage a qualified testing agency to perform tests and inspections.
 - 2. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections[with the assistance of a factory-authorized service representative].
- D. Tests and Inspections:

1. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of medical gas piping systems.
 2. Preparation: Perform the following Installer tests in accordance with requirements in NFPA 99 and ASSE Standard #6010:
 - a. Initial blowdown.
 - b. Initial pressure test.
 - c. Cross-connection test.
 - d. Piping purge test.
 - e. Standing pressure test for positive-pressure medical compressed-air piping.
 - f. Repair leaks and retest until no leaks exist.
 3. System Verification: Perform the following tests and inspections in accordance with NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
 - a. Standing pressure test.
 - b. Individual-pressurization cross-connection test.
 - c. Valve test.
 - d. Master and area alarm tests.
 - e. Piping purge test.
 - f. Piping particulate test.
 - g. Piping purity test.
 - h. Final tie-in test.
 - i. Operational pressure test.
 - j. Medical air-purity test.
 - k. Verify correct labeling of equipment and components.
 4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed, and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- E. Piping will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.9 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.

3.10 PIPING SCHEDULE

- A. Connect new tubing to existing tubing with memory-metal couplings.
- B. Flanges may be used where connection to flanged equipment is required.
- C. Dental Air Piping, NPS 3 (DN 80) and Smaller Shall Operate between 15 psig (103 kPa) and 50 psig (345 kPa): Type L copper tubing; wrought copper fittings; and brazed joints.

3.11 VALVE SCHEDULE

- A. Zone Valves: Ball valve with manufacturer-installed ASTM B819, copper-tube extensions with pressure gauge on one copper-tube extension.

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DIVISION 22 SECTION 22 61 19
COMPRESSED-AIR EQUIPMENT FOR DENTAL SYSTEMS
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SECTION 22 61 19
COMPRESSED-AIR EQUIPMENT FOR DENTAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Dental air compressors.
 - 2. Dental air-compressor control panels.

1.3 DEFINITIONS

- A. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in acfm (actual L/s).
- B. Laboratory Air Equipment: Compressed-air equipment and accessories for nonmedical laboratory facilities.
- C. Medical air equipment includes dental air compressors and accessories for healthcare facilities.
- D. Standard Air: Free air at 68 deg F (20 deg C) and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm (standard L/s).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For air compressors and compressed-air dryers.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Seismic Qualification Certificates: For air compressors, accessories, and components from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressed-air equipment to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Air-Compressor, Inlet-Air Filter Elements: Equal to 25% percent of quantity installed, but no fewer than two (2) units.
 - 2. Belts: Two (2) for each belt-driven compressor.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Laboratory Air Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.
 - 2. Medical Air Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed-air equipment testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2. PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design compressed-air equipment mounting.
- B. Seismic Performance: Air compressors and accessories shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the air compressor and receiver will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.

2.2 GENERAL REQUIREMENTS FOR AIR COMPRESSORS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 544, "Medical and Dental Equipment," for medical compressed-air equipment.
- C. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- D. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to alternate lead-lag air compressors for duplex air compressors.
 - 7. Instrumentation: Include discharge-air and receiver pressure gages, air-filter maintenance indicator, hour meter, air-compressor discharge-air and coolant temperature gages, and control transformer.

8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- E. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors and bearing appropriate code symbols.
 2. Interior Finish: Corrosion-resistant coating.
 3. Accessories: Include safety valve, pressure gage, automatic drain, and pressure regulator.
- F. Mounting Frame: Fabricate base and attachment to air compressor and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.3 INLET-AIR FILTERS

- A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.
- B. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.
1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 2. Capacity: Match total capacity of connected air compressors, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.4 COMPRESSED-AIR FILTER ASSEMBLIES

- A. Compressed-Air Filter Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Pneumatics, Inc.
 - b. Dollinger; Celeros Flow Technology.
 - c. Donaldson Company, Inc.
 - d. EMSE Corporation.
 - e. Ingersoll Rand.

- f. Parker (Parker Hannifin).
 - g. Pioneer Air Systems, Inc.
 - h. SPXFLOW, Air Treatment.
 - i. Van Air Systems, Inc.
 - j. Zeks Compressed Air Solutions.
- 2. Description: Filter assemblies suitable for compressed air, in parallel duplex arrangement. Size each assembly for maximum capacity of connected equipment and operating pressure of compressed-air system. Include automatic ejection of condensate from airstream, inlet and outlet pressure gages, and shutoff valves.
 - a. Option: Factory-fabricated filter system consisting of three air filters equivalent to those specified, pipe, fittings, valves, differential pressure switch, and enclosure; and with additional automatic drain traps and gages.
- 3. Size filter assemblies for 5-psig (34.5-kPa) maximum air-pressure drop when filters are new and clean, at system rated capacity, and at 100-psig (690-kPa) pressure.
- 4. Differential Pressure Switch: Adjustable, diaphragm type, with electrical connections for alarm system, to indicate when air-pressure drop through filters rises to more than 2 psig (13.8 kPa) greater than when new and clean.
- 5. Particulate Filters: Collection efficiency of 98 percent retention of particles 1 micrometer and larger.
- 6. Odor and Taste Filters: Vapor-absorbing, activated charcoal.
- 7. Coalescing Filters: Collection efficiency of 99.9 percent retention of particles 0.3 micrometer and smaller.
- 8. Include automatic drain trap for each filter.

2.5 DENTAL AIR COMPRESSORS

A. Dental Air Compressors

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Pneumatics, Inc.
 - b. Dollinger; Celeros Flow Technology.
 - c. Donaldson Company, Inc.
 - d. EMSE Corporation.
 - e. Ingersoll Rand.
 - f. Parker (Parker Hannifin).
 - g. Pioneer Air Systems, Inc.
 - h. SPXFLOW, Air Treatment.
 - i. Van Air Systems, Inc.

- j. Zeks Compressed Air Solutions.
- 2. Description: Factory-assembled, -tested, and -packaged; automatic, dental compressed-air system that will deliver air of quality at least equal to intake air; suitable for dental applications and capable of producing air at 80 psig (550 kPa).
- 3. Air Compressor(s): Oilless reciprocating type.
 - a. Option: Construction may be oil-free, sliding-vane or scroll type.
- 4. Compressor Controls: Adjustable, tank-mounted, pressure switches and alternator for duplex air compressors.
- 5. Check Valves: In discharge piping of each air compressor.
- 6. Air Filter: Integral with air compressor or separate unit for field installation in compressed-air piping.
- 7. Dryer: Desiccant type integral with air compressor.
- 8. Receiver: Steel tank rated for at least 100 psig (690 kPa) with rubber isolators on feet.
 - a. Pressure Regulator: Adjustable.
 - b. Safety Valve: ASME relief valve with setting of 100 psig (690 kPa) or less.
 - c. Drain: Automatic valve.
- 9. Cabinet: Enameled steel, with control panel with manual on-off switch, on light, and pressure gage.
- B. Capacities and Characteristics: As indicated on the Contract Drawings.

2.6 DENTAL AIR-COMPRESSOR CONTROL PANELS

- A. Dental Air-Compressor Control Panels:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Pneumatics, Inc.
 - b. Dollinger; Celeros Flow Technology.
 - c. Donaldson Company, Inc.
 - d. EMSE Corporation.
 - e. Ingersoll Rand.
 - f. Parker (Parker Hannifin).
 - g. Pioneer Air Systems, Inc.
 - h. SPXFLOW, Air Treatment.
 - i. Van Air Systems, Inc.
 - j. Zeks Compressed Air Solutions.

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.
 4. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.
 5. Description: Wall-mounted type with visual indicators to indicate equipment in operation and to perform the following:
 - a. Shut off dental air equipment.
 - b. Shut off water supply to dental air equipment. Include solenoid-operated valve for installation in water piping.
 - c. Remote switch with timer.
- B. Control panels may be combined with dental vacuum pump control panels in single dental equipment control panels.

2.7 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 22 Section 220500, "Common Work Results for Plumbing."

PART 3. EXECUTION

3.1 PREPARATION

- A. Clean compressed-air equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for dental air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 COMPRESSED-AIR EQUIPMENT INSTALLATION

- A. General Requirements for Compressed-Air Equipment Installation:
1. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.
 2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.
 3. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 4. Install equipment to allow right of way for piping installed at required slope.

5. Install the following devices on compressed-air equipment:
 - a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
 - b. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
 - c. Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.
- B. Dental Air System Equipment Installation:
 1. Install according to ASSE 6010 and NFPA 99.
 2. Install dental air system units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 22 Section 220500, "Common Work Results for Plumbing."
 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration Controls for HVAC, Plumbing & Fire Protection Equipment"
 4. Maintain manufacturer's recommended clearances for service and maintenance.
 5. Install control panels for dental compressed-air equipment on wall near equipment.

3.3 CONNECTIONS

- A. Comply with requirements for water-supply piping specified in Division 22 "Plumbing Piping, Fittings, and Valves." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for drain piping specified in Division 22 "Plumbing Piping, Fittings, and Valves." Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Comply with requirements for compressed-air piping specified in Section 226113 "Compressed-Air Piping for Dental Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.
- E. Connect compressed-air piping to compressed-air equipment, accessories, and specialties with shutoff valve and union or flanged connection.
- F. Connect water supply to compressed-air equipment that requires water. Include backflow preventer.

3.4 IDENTIFICATION

- A. Identify medical compressed-air equipment system components. Comply with requirements for identification specified in Division 22 “Common Work Results for Plumbing” and with NFPA 99.

3.5 FIELD QUALITY CONTROL FOR DENTAL COMPRESSED-AIR EQUIPMENT

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Dental Compressed-Air Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air equipment concurrently with tests, inspections, and certification of medical compressed-air piping systems.
 - 2. Preparation: Perform medical compressed-air equipment tests according to requirements in NFPA 99 for the following:
 - a. Air-quality purity test.
 - b. System operation test.
 - 3. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical compressed-air equipment.
 - 4. Replace damaged and malfunctioning controls and equipment.
 - 5. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- D. Components will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

2. Check for lubricating oil in lubricated-type equipment.
 3. Check belt drives for proper tension.
 4. Verify that air-compressor inlet filters and piping are clear.
 5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
 7. Check for proper seismic restraints.
 8. Drain receiver tank(s).
 9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 10. Test and adjust controls and safeties.
- B. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, compressed-air dryers and compressed-air filter assemblies.

END OF SECTION

DIVISION 22 SECTION 22 62 13
VACUUM PIPING FOR DENTAL SYSTEMS
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SECTION 22 62 13
VACUUM PIPING FOR DENTAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Dental vacuum piping, designated "dental vacuum."
 - 2. Oral evacuation piping, designated "HVE."
- B. Related Requirements:
 - 1. Section 226219 "Vacuum Equipment for Dental Facilities" for vacuum producers and accessories.

1.3 DEFINITIONS

- A. HVE: High-volume (oral) evacuation.
- B. WAGD: Waste anesthetic gas disposal.
- C. Vacuum Piping Systems: Include dental vacuum and HVE piping systems.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Seismic Qualification Data: Certificates, for compressed-air manifolds, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Material Certificates: Signed by Installer, certifying that medical vacuum piping materials comply with requirements in NFPA 99 for medical vacuum systems.
- D. Brazing certificates.
- E. Field quality-control reports.
- F. Source Quality Control Reports:

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Medical Vacuum Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 and NFPA 99 for medical-gas-system installers.
 - 2. Pressure-Seal Joining Procedure for Copper Tubing: An authorized representative who is trained and approved by manufacturer.
 - 3. Extruded-Tee Outlet Procedure: An authorized representative who is trained and approved by manufacturer.
 - 4. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer in accordance with ASSE Standard #6040 and NFPA 99.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel in accordance with ASSE Standard #6020 and NFPA 99 for medical-gas-system inspectors and ASSE Standard #6030 and NFPA 99 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2/B2.2M.

PART 2. PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Dental vacuum operating at 12 in. Hg (305 mm Hg).
- B. HVE operating at 5 in. Hg (125 mm Hg).

2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical vacuum piping materials.
- B. Copper Dental Gas Tube: ASTM B819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or in accordance with CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
- C. Copper Water Tube: ASTM B88/ASTM B88M, Type M, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service.
- D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or in accordance with CGA G-4.1 for oxygen service.
- E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
 - 2. Flange Bolts and Nuts: ASME B18.2.1 carbon steel.
- G. Shape-Memory-Metal Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aerofit, Inc.
 - b. CAMERON; A Schlumber Co.
 - c. Motion Industries.
 - d. Smart Tap; Smart Technology, Inc..
 - 2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service in accordance with CGA G-4.1.
- H. Pressure-Seal Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. FNW; Ferguson Enterprises, Inc.
 - b. NIBCO INC.
 - c. Viega LLC.
 - 2. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

3. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.
- I. Extruded-Tee Outlets: ASTM F2014 procedure for making branch outlets in copper tube.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. T-DRILL Industries Inc.
- J. Flexible Pipe Connectors:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Hyspan Precision Products, Inc.
 - d. Mercer Rubber Co.
 - e. Metraflex Company (The).
 - f. Proco Products, Inc.
 - g. Universal Metal Hose.
 2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
 - b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux in accordance with ASTM B813.
- B. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys.
- C. Threaded-Joint Tape: PTFE.

2.4 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged in accordance with CGA G-4.1 for oxygen service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
 1. Zone-Valve Boxes:
 - a. Steel Box with Stainless Steel Cover:

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

- (a) Flex-Hose Co., Inc.
- (b) Flexicraft Industries.
- (c) Hyspan Precision Products, Inc.
- (d) Mercer Rubber Co.
- (e) Metraflex Company (The).
- (f) Proco Products, Inc.
- (g) Universal Metal Hose.

- b. Description: Formed-steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valve. Dental vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.

- 1) Interior Finish: Factory-applied white enamel.
- 2) Cover Plate: stainless steel with frangible or removable windows.
- 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, in accordance with NFPA 99.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tri-Tech Medical.
 - b. Allied Healthcare Products Inc.
 - c. Amico Corporation.
 - d. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - e. BeaconMedaes.
 - f. Marwin Valve; Richards Industries.
 - g. NIBCO INC.
 - h. Ohio Medical Corporation.
2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig (2070 kPa) minimum.
5. Ball: Full-port, chrome-plated brass.

6. Seats: PTFE or TFE.
7. Handle: Lever type with locking device.
8. Stem: Blowout proof with PTFE or TFE seal.
9. Ends: Manufacturer-installed ASTM B819, copper-tube extensions and manufacturer-installed ASTM B819, copper-tube extensions with pressure gauge on one copper-tube extension.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tri-Tech Medical.
 - b. Allied Healthcare Products Inc.
 - c. Amico Corporation.
 - d. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - e. BeaconMedaes.
 - f. Marwin Valve; Richards Industries.
 - g. NIBCO INC.
 - h. Ohio Medical Corporation.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B819, copper-tube extensions.

2.5 MEDICAL VACUUM SERVICE CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Tri-Tech Medical.
 2. Allied Healthcare Products Inc.
 3. Amico Corporation.
 4. BeaconMedaes.
 5. Ohio Medical Corporation.
 6. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
- B. General Requirements for Medical Vacuum Service Connections:

1. Suitable for specific medical vacuum service listed.
 2. Include roughing-in assemblies, finishing assemblies, and cover plates.
 3. Individual cover plates are not required if service connection is in multiple units or assembly with cover plate.
 4. Recessed-type units made for concealed piping unless otherwise indicated.
- C. Roughing-in Assembly:
1. Steel outlet box for recessed mounting and concealed piping.
 2. Brass-body inlet block.
 3. Seals that will prevent vacuum leakage.
 4. ASTM B819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
- D. Finishing Assembly:
1. Brass housing with primary check valve.
 2. Seals that will prevent vacuum leakage.
 3. Cover plate with gas-service label.
- E. Quick-Coupler Suction Service Connections:
1. Inlets for dental vacuum with noninterchangeable keyed indexing to prevent interchange between services.
 2. Constructed to permit one-handed connection and removal of equipment.
 3. With positive-locking ring that retains equipment stem in valve during use.
- F. D.I.S.S. Suction Service Connections:
1. Inlets complying with CGA V-5.
 2. Threaded indexing to prevent interchange between services.
 3. Constructed to permit one-handed connection and removal of equipment.
 4. Medical Vacuum: CGA V-5, D.I.S.S. No. 1220.
 5. WAGD: CGA V-5, D.I.S.S. No. 2220.
- G. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

- H. Cover Plates:
 - 1. One piece.
 - 2. Stainless steel.
 - 3. Permanent, color-coded, identifying label matching corresponding service.

PART 3. EXECUTION

3.1 PREPARATION

- A. Cleaning of Dental Vacuum Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
 - 1. Clean dental vacuum tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service in accordance with CGA G-4.1.
 - 2. Wash medical vacuum tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

- A. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of vacuum piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install piping with 1 percent slope downward in direction of flow.

- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Provide drain leg and drain trap at end of each main and branch and at low points.
- K. Install piping to permit valve servicing.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
- N. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Dental Systems," and to equipment specified in other Sections requiring dental vacuum service.
- O. Install vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- P. Install vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.
- Q. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
- R. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 "Common Work Results for Plumbing."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 "Common Work Results for Plumbing."

3.3 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.
- B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

- E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Apply appropriate tape to external pipe threads.
- D. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.
- E. Soldered Joints: Apply ASTM B813, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828.
- F. Extruded-Tee Outlets: Form branches in copper tube in accordance with ASTM F2014, with tools recommended by tube manufacturer.
- G. Flanged Joints:
 - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.
- H. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.
- I. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices specified in Division 22 "Common Work Results for Plumbing."
- B. Vertical Piping: MSS Type 8 or Type 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

- E. Base of Vertical Piping: MSS Type 52 spring hangers.
- F. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- H. Support vertical runs of copper tubing to comply with MSS SP-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 IDENTIFICATION

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Division 22 “Common Work Results for Plumbing.”
- B. Install identifying labels and devices for medical vacuum piping systems in accordance with NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Dental Vacuum: Black boxed letters on white-and-black diagonal stripe background.
 - 2. HVE: Black boxed letters on white-and-black diagonal stripe background.

3.7 FIELD QUALITY CONTROL FOR DENTAL VACUUM PIPING

- A. Testing Agency:
 - 1. Owner will engage a qualified testing agency to perform tests and inspections.
 - 2. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
 - 1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of dental compressed-air piping systems.
 - 2. Preparation: Perform the following Installer tests in accordance with requirements in NFPA 99 and ASSE Standard #6010:
 - a. Initial blowdown.

- b. Initial pressure test.
 - c. Cross-connection test.
 - d. Piping purge test.
 - e. Standing pressure test for vacuum systems.
 - f. Repair leaks and retest until no leaks exist.
3. System Verification: Perform the following tests and inspections in accordance with NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
- a. Standing pressure test.
 - b. Individual-pressurization or pressure-differential cross-connection test.
 - c. Valve test.
 - d. Master and area alarm tests.
 - e. Piping purge test.
 - f. Final tie-in test.
 - g. Operational vacuum test.
 - h. Verify correct labeling of equipment and components.
4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed, and certify report results. Include the following:
- a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.

E. Piping will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.

3.9 PIPING SCHEDULE

- A. Connect new copper tubing to existing copper tubing with memory-metal couplings.
- B. Connect PVC pipe to copper tube with transition fittings.
- C. Flanges may be used where connection to flanged equipment is required.
- D. Dental Vacuum Piping: Use copper water tube, wrought-copper fittings, and joints.
- E. HVE Piping: Use the following piping materials for each size range:

1. NPS 4 (DN 100) and Smaller: Copper medical gas water tube, wrought-copper fittings, and brazed joints.
2. NPS 5 to NPS 8 (DN 125 to DN 200): Type M (C), copper water tube; wrought-copper fittings; and brazed joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves:

1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B819, copper-tube extensions.

B. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B819, copper-tube extensions with pressure gage on one copper-tube extension.

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DIVISION 22 SECTION 22 62 19
VACUUM EQUIPMENT FOR DENTAL SYSTEMS
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SECTION 22 62 19
VACUUM EQUIPMENT FOR DENTAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Dental vacuum pumps.
 - 2. Dental vacuum pump control panels.
- B. Related Requirements:
 - 1. Section 226400 "Medical Gas Alarms" for vacuum equipment local alarms.

1.3 DEFINITIONS

- A. Actual Air: Air delivered at vacuum producer inlet. Flow rate is air measured in acfm (actual L/s).
- B. HVE: High-volume oral evacuation for dental applications in healthcare facilities.
- C. Medical Vacuum Equipment: Includes dental and HVE vacuum producers and accessories for healthcare facilities.
- D. Standard Air: Free air at 68 deg F (20 deg C) and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm (standard L/s).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For vacuum producers.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Seismic Qualification Certificates: For vacuum producers, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For vacuum equipment to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Belts: Two for each belt-driven vacuum producer.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Medical Vacuum Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum equipment testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2. PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Vacuum producers and accessories shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.5.

2.2 GENERAL REQUIREMENTS FOR VACUUM PUMPS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.
- C. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.
- D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty vacuum pumps and receivers.
- E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to alternate lead-lag vacuum pumps for duplex vacuum pumps.
 - 7. Instrumentation: Include vacuum pump inlet and receiver vacuum gages, hour meter, vacuum pump discharge-air and coolant temperature gages, and control transformer.
 - 8. Alarm Signal Devices: For connection to alarm system to indicate when backup vacuum pump is operating.
- F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols.

1. Interior Finish: Corrosion-resistant coating.
 2. Accessories: Include vacuum relief valve, vacuum gage, and drain.
- G. Mounting Frames: Fabricate base and attachment to vacuum pump and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.3 DENTAL VACUUM PUMPS

A. Dental Vacuum Pumps:

1. Description: Factory-assembled, -tested, and -packaged; duplex; automatic, dental vacuum system; suitable for dental applications and capable of producing not less than 12 in. Hg (305 mm Hg).
2. Duplex Vacuum Pumps: For mounting on concrete base.
 - a. Vacuum Pumps: Brass water-injection or liquid-ring type with rubber isolators on feet. Include fitting and tubing for circulation of approximately 80 percent of water through vacuum pump.
 - b. Cabinet: Enameled steel; open construction with sound-insulated cover. Include control panel with alternator, adjustable vacuum control for each vacuum pump, manual on-off switches, on light, and vacuum gage.

B. Capacities and Characteristics: Refer to Contract Drawings.

2.4 DENTAL VACUUM PUMP CONTROL PANELS

A. Dental Vacuum Pump Control Panels:

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.
3. Description: Wall-mounted type with visual indicators to indicate equipment in operation and to perform the following:
 - a. Shut off dental vacuum equipment.
 - b. Shut off water supply to dental vacuum equipment. Include solenoid-operated valve for installation in water piping.
 - c. Remote switch with timer.

B. Control panels may be combined with dental air compressor control panels in single dental equipment control panels.

2.5 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 22 “Common Work Results for Plumbing.”

PART 3. EXECUTION

3.1 PREPARATION

- A. Clean vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for medical vacuum applications, according to CGA G4.1, "Cleaning Equipment for Oxygen Service."

3.2 VACUUM EQUIPMENT INSTALLATION

- A. Install vacuum equipment for healthcare facilities according to ASSE 6010 and NFPA 99.
- B. Equipment Mounting:
 - 1. Install vacuum producers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 22 “Common Work Results for Plumbing.”
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 “Vibration Controls for HVAC, Plumbing and Fire Protection Equipment.”
 - 3. Comply with requirements for vibration isolation devices specified in Section 230548 “Vibration Controls for HVAC, Plumbing and Fire Protection Equipment.”
- C. Install vacuum equipment anchored to substrate.
- D. Orient equipment so controls and devices are accessible for servicing.
- E. Maintain manufacturer's recommended clearances for service and maintenance.
- F. Install the following devices on vacuum equipment:
 - 1. Thermometer, Vacuum Gage, and Pressure Relief Valve: Install on each vacuum pump receiver.
 - 2. Drain Valves: Install on receivers and separators. Discharge receiver condensate over nearest floor drain. Discharge separator oral evacuation fluids by direct connection into sanitary waste piping system.
- G. Dental Vacuum System Equipment Installation:
 - 1. Install according to ASSE 6010 and NFPA 99.

2. Install dental vacuum system units on concrete bases with elastomeric mounts with a minimum deflection of 2 inches. Vibration isolation devices and installation requirements are specified in Section 230548 “Vibration Controls for HVAC, Plumbing and Fire Protection Equipment.”
3. Maintain manufacturer's recommended clearances for service and maintenance.
4. Install control panels for dental vacuum equipment on wall near equipment.

3.3 CONNECTIONS

- A. Comply with requirements for water-supply piping specified in Division 22 “Plumbing Piping, Fittings and Valves.” Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for drain piping specified in Division 22 “Plumbing Piping, Fittings and Valves.” Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Comply with requirements for vacuum piping specified in Section 226213 "Vacuum Piping for Dental Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.
- E. Connect vacuum piping to vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.
- F. Connect water supply to vacuum equipment that requires water. Include backflow preventer.

3.4 IDENTIFICATION

- A. Identify nonmedical laboratory vacuum equipment system components. Comply with requirements for identification specified in Division 22 Section 220500, “Common Works Results for Plumbing.”
- B. Identify medical vacuum equipment system components. Comply with requirements for identification specified in Division 22 Section 220500, “Common Works Results for Plumbing” and with NFPA 99.

3.5 FIELD QUALITY CONTROL FOR DENTAL VACUUM EQUIPMENT

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Preparation: Perform medical vacuum equipment tests according to requirements in NFPA 99 for the following:
 - a. System operation test.
 2. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical vacuum equipment.
 3. Replace damaged and malfunctioning controls and equipment.
- D. Components will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check for lubricating oil in lubricated-type equipment.
 3. Check belt drives for proper tension.
 4. Verify that vacuum producer outlet piping is clear.
 5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 6. Check safety valves for correct settings.
 7. Check for proper seismic restraints.
 8. Drain receiver and separator tank(s).
 9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 10. Test and adjust controls and safeties.
- B. Verify that vacuum equipment is installed and connected according to the Contract Documents.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in electrical Sections.
- D. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

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

END OF SECTION