

## SECTION 220500

### COMMON WORK RESULTS FOR PLUMBING

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Provide all labor, materials, tools, and services for a complete installation of equipment and systems contained in contract documents.
- B. Principal features of work included are:
  - 1. Plumbing system.
  - 2. Medical gas system.
  - 3. Demolition of existing equipment, and piping.
  - 4. Seismic bracing and anchorage for equipment, and piping.

##### 1.02 RELATED WORK

- A. Electrical power and interlock and control wiring and conduit.
- B. Field painting of equipment, and piping.

##### 1.03 INNOVATION MEMORANDUMS

- A. The owner has obtained purchase agreements for select equipment and materials. These purchase agreements are documented as Innovation Memorandums and are to be included as part of this project.
- B. Innovation Memorandum No. 6: All plumbing fixtures and related products to be purchased from Ferguson Enterprises. Refer to Section 224300.
- C. Innovation Memorandum No. 7: All piping, valves, pipe fittings and related products to be purchased from Ferguson Enterprises. Refer to Sections 221116, 221119, 221316, 221319, 221400.

##### 1.04 GENERAL

- A. The contract documents form a guide for a complete system. Provide all items necessary to provide a complete system but not specifically mentioned, such as hangers, transitions, offsets, and drains.
- B. Layouts indicated on drawings are diagrammatical only. Coordinate exact location of equipment, ductwork, and piping to eliminate conflict with other divisions. Designer reserves right to make reasonable changes in location of equipment, ductwork, and piping prior to construction.
- C. Should Contractor find during progress of work that in his judgment existing conditions make desirable a modification, report such item promptly to Designer for instructions. Do not make deviations from contract documents without review of Designer.
- D. Supervise all work with a competent mechanic specifically qualified in mechanical discipline.

- E. All products used for dispensing potable drinking water must be lead free and meet the requirements of NSF 61 and NSF 372 test standards via third party testing and certification.
- F. All piping and valves to be purchased from Ferguson Enterprises. Contact Bettina Dawson office (615) 316-1920 cell (931) 239-0466 or email HCA@Ferguson.com.

1.05 PERMITS

- A. Secure and pay for permits, licenses, and inspections for work under this Division, including water and sewage connections.

1.06 CODES

- A. Comply with all pertinent local, state, and national codes.

1.07 STANDARDS

- A. Comply with all pertinent standards. This list is provided as a convenience to Contractor and is not to be considered all inclusive.
  - 1. American Gas Association (AGA).
  - 2. CISPI Standard 301.
  - 3. ASTM A 74.

1.08 SUBMITTALS

- A. Submit for review complete brochures and shop drawings for materials and equipment proposed.
  - 1. Brochures: Submit complete descriptions, illustrations and specification data for materials and equipment proposed. Clearly indicate proposed items when other items are shown on same sheet. Submit samples on request and/or set up for inspection. Samples will be returned to Contractor.
  - 2. Submittals shall be submitted in line by line format. Each submittal shall be provided with a cover letter and supporting documentation indicating how the submittal meets each line of the referenced specification section. All discrepancies between the construction documents and the submitted product shall be clearly identified for engineer evaluation.
  - 3. If a product other than the basis of design is rejected by the engineer for any reason, the Contractor shall provide the basis of design product at no additional cost to the Owner.
  - 4. Shop Drawings:
    - a. Complete equipment and piping systems in area of renovation.
    - b. Owner furnished equipment rough-in layouts.
    - c. Firestop systems.
  - 5. Seismic Certification: Submit letter of certification from each equipment manufacturer verifying that equipment is designed to withstand horizontal forces using a "cp" factor of 0.75 applied in any direction.

1.09 PROJECT MAINTENANCE MANUALS

- A. Prior to final acceptance of project, provide Owner with bound maintenance manuals.

#### 1.10 PROJECT TECHNICAL INSTRUCTION

A. Prior to final inspection of project, provide technical instruction to Owner as follows:

1. Field Instruction: Provide explanation of how systems and equipment are to operate during each season and during emergencies.
2. Field Demonstration: Demonstrate operation and routine maintenance for systems and equipment.
3. Videotape: Provide videotape or DVD of field instruction and demonstration to Owner at completion.

#### 1.11 CONSTRUCTION RECORD DOCUMENTS



A. Provide construction record documents. Keep at the project one set of drawings and daily record changes at the time they are made. Give drawings to Owner at project completion.

#### 1.12 EXISTING SERVICES

A. Maintain existing services in operation during construction. Coordinate and schedule all service interruptions with Owner.

### PART 2 PRODUCTS

#### 2.01 MATERIALS AND EQUIPMENT

- A. Provide materials and equipment of domestic manufacturer bearing the U.L. label when such label is available.
- B. Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute  and listed by NSF  International.

### PART 3 EXECUTION

#### 3.01 COORDINATION

- A. Coordinate locations of equipment, and piping to eliminate conflict with other divisions.
- B. Carefully examine contract documents to be thoroughly familiar with items which require plumbing or mechanical connections and coordination.
- C. Provide proper chases and openings. Place sleeves and supports prior to pouring concrete or installation of masonry.

#### 3.02 CUTTING AND PATCHING

- A. Repair or replace routine damage caused by cutting in performance of contract.
- B. Correct unnecessary damage caused due to installation of plumbing work.
- C. Perform repairs with materials that match existing in accordance with the appropriate section of these specifications.

### 3.03 FLASHING, COUNTERFLASHING, AND SEALING

- A. Flash, counterflash, and seal piping at penetrations of roofs and outside walls.

### 3.04 TRENCHING, EXCAVATION AND BACKFILLING

- A. Excavate to a depth at least 6" below bottom of pipe and a minimum of 36" above top of pipe. Fill below pipe, around pipe, and minimum of 12" above pipe with sand or Class "B" crushed stone tamped firm and even. Provide topsoil for final layer of dirt (12" minimum). Provide 6" spacing between pipes and between pipe and trench sides. Hand-grade with batterboards placed every 25'. Backfill by hand. Do not use rock or stone above sand or Class "B" crushed stone.

### 3.05 CONNECTION TO EQUIPMENT

- A. Rough-in and connect to Owner furnished equipment and provide a shutoff valve and union at each connection. Operating valves and/or controls for this equipment will be provided as an integral part of the equipment. Do not rough-in until shop drawings showing rough-in locations have been reviewed by Designer.

### 3.06 IDENTIFICATION

- A. Identify exposed or accessible piping with stenciling contents indicating pipe contents and direction of flow on piping not more than 20 feet apart, at valves, at access panels, and at least once above each space.
- B. Contractors option to identify exposed or accessible piping with snap-on or strap-on type markers. Color code markers in accordance with ANSI. Indicate pipe contents and direction of flow on marker. Install markers on piping not more than 20 feet apart, at valves, at access panels, and at least once above each space.
- C. Color code piping exposed in equipment rooms in accordance with the following schedule. Paint to be Sherwin Williams Metaltex or approved substitute.
  - 1. Domestic cold water - dark blue.
  - 2. Domestic hot water - rose red.
- D. Include design operating pressures in psig for compressed air services.
- E. Sanitary waste, storm and buried lines need not be marked.
- F. Identify all equipment with engraved brass, aluminum, or stainless steel nameplates or tags. Use equipment names and numbers appearing in schedules on drawings. Fasten nameplates to equipment using screws. Glue or adhesive is not acceptable. Fasten tags to equipment using brass, aluminum or stainless steel chains.
- G. Identify each valve with engraved brass, aluminum, or stainless steel identification tag indicating valve service and sequential identification number. Attach tag to valve handle with brass, aluminum or stainless steel chain. Provide two bound manuals to Owner listing each valve sequentially and indicating valve manufacturer, style, size, service, normal position, and specific location for each valve.

### 3.07 CLEANING

- A. Repair damaged factory finishes covering all bare places and scratches.

- B. Cleaning Domestic Water System: Flush domestic water system progressively by opening building outlets and permitting flow to continue from each until water runs clear. Sterilize system in accordance with requirements of State Department of Public Health by the following method or other method acceptable to local authorities:
1. Introduce chlorine or a solution of calcium or sodium hypochlorite, filling lines slowly and applying sterilizing agent at a rate of 50 ppm of chlorine as determined by residual chlorine tests at ends of lines. Open and close all valves while the system is being chlorinated.
  2. After sterilizing agent has been applied and left standing for 24 hours, test for residual chlorine at ends of lines. If less than 25 ppm is indicated, repeat sterilizing process.
  3. After standing for 24 hours and tests show at least 25 ppm of residual chlorine, flush out system until all traces of chemical used are removed.

### 3.08 TESTING

- A. Test all installed equipment and systems and demonstrate proper operation. Correct and retest work found defective when tested.
- B. Thoroughly check piping system for leaks. Do not add any leak-stop compounds to the system. Make repairs to piping system with new materials. Peening, doping, or caulking of joints or holes is not acceptable.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at a water pressure of 125 psig for two hours without leaks.
- D. Test drainage and venting system with necessary openings plugged to permit system to be filled with water and subjected to a minimum water pressure of 10 feet head at top of system. System to hold water for two hours without a water level drop greater than 4" in a 4" standpipe and without visible leakage. Test system in sections if minimum head can be maintained in each section.
- E. Conduct air or smoke test if in opinion of Designer reasonable cause exists to suspect leakage or low quality workmanship.
- F. Test foundation drain system in sections of 100 foot lengths before and after backfilling. Pass plumbers tape or Roto-Rooter through drain sections to ensure there are no restrictions to water flow.
- G. Test gas piping and compressed air piping with Nitrogen at 100 psi for two hours without leaks.
- H. Test flush valves for proper operation.

END OF SECTION



## SECTION 220548

### VIBRATION AND SEISMIC CONTROL FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

- A. Provide engineered seismic restraint systems for suspended and base mounted Domestic Water Piping and Valves, Sanitary Waste and Vent, Rain Water Leaders, Rain Water Overflow Drains, and Manifolds and Piping utilities compliant with the 2018 International Building Code (IBC) with local building code amendments.
- B. All equipment manufacturers shall submit, as part of the equipment submittal, compliance certifications. Contractor to provide equipment anchorage details specific to each unit provided.
- C. At seismic restraint installation locations, provide vertical support systems engineered to accommodate dead load plus seismic force reactions.

##### 1.02 RELATED SPECIFICATION SECTIONS

- A. Plumbing Piping.
- B. Plumbing Equipment.
- C. Medical Gas Piping.
- D. Medical Gas Equipment.

##### 1.03 REFERENCES

- A. Publications, codes and standards listed below form a part of this specification to the extent referenced.
  - 1. 2018 International Building Code (IBC)
    - a. Chapter 16 - Structural Design
    - b. Chapter 17 – Structural Tests And Special Inspections
  - 2. ASCE 7-16, Chapter 13, Minimum Design Loads For Buildings and Other Structures, American Society of Civil Engineers (ASCE).
  - 3. ACI 318, Building Code Requirements for Structural Concrete, American Concrete Institute (ACI).

##### 1.04 COMPONENT IMPORTANCE FACTOR

- A. In order to identify systems requiring seismic restraint and to define those from which restraints may be excluded, utility components are assigned an ASCE 7 Importance Factor ( $I_p$ ) on the basis of the following:
- B.  $I_p = 1.5$ 
  - 1. Seismic Use Group III Occupancy Category III or IV, essential facilities required for post earthquake recovery – all “Designated Seismic Systems” per IBC Chapter 17 required for the continued operation of the facility.

2. Life-safety component which is required to function after a seismic event including fire protection sprinkler systems.
3. Components that contain hazardous or flammable materials.

C.  $I_p = 1.0$ : All other components.

#### 1.05 SUBMITTALS

A. Equipment Certification.

1. Equipment manufacturer to provide certificate of compliance for 2018 IBC proxing on line capability for the project use group and seismic design category. Provide certifications for the following equipment: Components with hazardous contents, built up or field assembled plumbing equipment, fire suppression control panels, pre action control panels, and auxiliary or remote power supplies, and above ground storage tanks. Equipment manufacturer certification to be based on shake table or three dimensional shock testing or experience data as required by ASCE/SEI 7-16.
2. The following equipment is considered rugged and does not require a certificate of compliance: pumps, and valves.

B. Contractor to identify and convey each overhead deck condition to which seismic attachments will be made. Information to include type and density of concrete, concrete thickness, size and gage of metal deck and any point load limitations or restrictions.

C. Provide Seismic Design Force calculations per ASCE 7-16, Formulas 13.3-1 thru 13.3-3 stamped by a registered design professional qualified civil or structural engineer licensed to practice in the State where project is located. For multi-story projects, provide calculated Seismic Design Force for each floor.

D. Submit seismic restraint layouts stamped by a registered design professional qualified civil or structural engineer licensed to practice in the State where project is located. Seismic restraint layouts to show:

1. All vertical support and seismic brace locations.
2. All anchorage connections to structure. Anchor brand, type, quantity and size.
3. Vertical support and brace reaction point load at all connections to structure. For review by engineer of record in checking suitability of the building structure to accommodate imposed loads.
4. Plan set sheets showing appropriate installation details reflecting actual job site conditions.

E. Include cover sheet with Seismic Restraint Bracing Legend delineating:

1. Maximum Allowable Size or Utility Weight (Lbs/Lf).
2. Minimum Vertical Support Rod Diameter.
3. Support Rod Total Vertical Load.
4. Maximum Allowable Transverse Brace Spacing.
5. Transverse Brace Reaction.
6. Maximum Allowable Longitudinal Brace Spacing.
7. Longitudinal Brace Reaction.
8. Minimum Required Seismic Restraint Brace Arm Assembly.
9. Minimum Required Seismic Restraint Anchorage To Overhead Structure.
10. Installation Detail Drawing References.

#### 1.06 QUALITY ASSURANCE

A. Registered design professional completing seismic submittal to check suitability of structure to accommodate applied seismic loads.

- B. Registered design professional completing seismic submittal is to provide a "Statement of Special Inspections" in conformance with 2018 IBC, Chapter 17.
- C. Each contractor responsible for the construction of a "Designated Seismic System" shall submit to the building official and owner prior to the commencement of work on the system or component a written "statement of responsibility" per IBC Chapter 17.

## PART 2 PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Seismic restraint hardware and engineering by International Seismic Application Technology (ISAT), Mason Industries, Tolco, or approved equal.
- B. Vertical support and seismic restraint anchorages to utilize Cast-In Place Deck Inserts, or Post Installed Anchors. All deck inserts or post installed anchors to have a valid ICC ESR evaluation report (or equal) substantiating the insert or anchor capacity.
- C. Vertical support and seismic restraint connections to structural steel are to utilize fixed Beam Clamp connections or Welded or bolted connections.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. For conditions not covered within pre-engineered drawings, the required engineering is to be performed by a registered Engineer.
- B. Manufacturer shall provide field installation training prior to commencement of install.
- C. Field relocation of any seismic installation points away from that shown on the furnished shop drawing layouts shall be coordinated with registered design professional who completed seismic submittal.
- D. Consult registered design professional who completed seismic submittal when field conditions prohibit compliance with the supplied installation details.
- E. In order to satisfy ASCE 7 minimum yield strength requirements, the allowable brace spacing for non-ductile systems (eg. cast iron, plastic and glass pipe) shall be no more than half that for ductile systems.

### 3.02 EQUIPMENT CONNECTIONS

- A. Where seismic bracing is allowed to be omitted due to size or proximity to overhead deck, all terminations to fixed equipment, panels, etc. or to other portions of the system requiring seismic restraint are to utilize flexible connectors.
- B. Where seismic bracing is allowed by code to be omitted due to size or proximity to overhead deck, contractor shall be responsible for assuring that damaging impact or vertical support failure cannot occur.

### 3.03 SPECIAL INSPECTION

- A. Special Inspection Requirements: All Designated Seismic Systems are subject to Special Inspection per IBC Chapter 17.

- B. Special inspection for mechanical components shall be provided as follows:
1. For all Designated Seismic Systems within seismic design categories D, E or F.
  2. Periodic special inspection during the installation for flammable, combustible or highly toxic piping systems and their associated mechanical units in Seismic Design Categories C, D, E or F.
  3. Periodic special inspection during the installation of vibration isolation systems where the construction documents indicate a maximum clearance (air gap) between the equipment support frame and restraint less than or equal to 1/4 inch.
- C. Install identification tags at all seismic brace locations. Tags to include the following information:
1. Specific seismic forces (g-force) the location was designed to resist.
  2. Maximum brace reaction at connection to structure.
  3. For single hung items, the maximum pipe/conduit size the brace location was designed to accommodate.
  4. For trapeze supported items, the maximum weight (lbs/lf) the brace location was designed to accommodate.
  5. For suspended equipment, the maximum unit operating weight (lbs) the brace location was designed to accommodate.
  6. Location identifier cross matched to that on plan set layout.
  7. Company name of installing contractor.
- D. Upon completion of construction a Quality Assurance Representative of registered design professional who completed seismic submittal shall review the installation of the seismic-force-resisting system and provide documentation indicating general conformance to seismic restraint layout drawing.

END OF SECTION

## SECTION 220719

### PLUMBING INSULATION

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Contractor shall provide all necessary labor, materials, tools, and equipment to perform work required on the drawings and specified herein.
- B. Certain equipment and/or systems to be factory insulated by manufacturer. Factory insulation materials to be as specified in applicable sections of the specifications.
- C. All pipe fittings, valves, and strainers in insulated pipe systems to be insulated.
- D. Thermal resistance "R" values used herein are expressed in units of "Hour, Degrees F., Sq. Ft./BTU per Inch of Thickness" on a flat surface at a mean temperature of 75 degrees F.
- E. Note that where electric cable wrap is called for, insulation is to be applied over cable.

##### 1.02 DEFINITIONS

- A. "Exposed" equipment, and piping are areas which will be visible without removing ceilings or opening access panels.
- B. Outdoors is considered exposed to the weather.
- C. Underground is buried, whereas in a trench below grade is considered concealed.

##### 1.03 CERTIFICATION/QUALITY ASSURANCE

- A. Products shall meet applicable national, state, and local building codes and be U.L. (or other recognized testing lab) listed for intended service.
- B. All insulations, jackets, adhesives, coatings, sealers, and tapes shall have a flame spread rating of 25 or less and smoke development rating of 50 or less when tested in accordance with ASTM E-84, NFPA 225, U.L. 723, and further must meet the requirements of NFPA 90-A and applicable building, and plumbing, codes.
- C. All insulation materials shall be delivered and stored in manufacturers' containers and kept free from dirt, water, chemical, and mechanical damage.
- D. Insulation shall be applied in a workmanlike manner by experienced, qualified tradesmen.
- E. Insulation shall not be applied until all pressure testing has been completed, inspected, and released for insulation application.
- F. Surfaces shall be clean and dry.
- G. Insulation joints shall be butted firmly together and all jackets and tapes shall be smoothly and securely installed.

- H. Insulation for duct, pipe, and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 1" thickness in less than 53 seconds when tested in accordance with ASTM D-1692.

#### 1.04 APPLICABLE CODES AND STANDARDS

- A. ASTM E-84.
- B. U.L. 723.
- C. International Energy Code.

### PART 2 PRODUCTS

#### 2.01 EQUIPMENT REQUIREMENTS

- A. Materials for Pipe and Equipment: Provide factory pre-molded or shop or site mitered segment type insulation for pipe, pipe fittings, and valves. Fitting insulation to be of same thickness and material as adjoining pipe insulation. All insulation and related materials such as tape and mastic to meet applicable building code requirements for fire and smoke development.
  - 1. Fiberglass: Provide factory-formed, factory-jacketed fiberglass piping insulation. Product to be Manville "Micro-Lok 650" with "Type AP-T" jacketing or equivalent product manufactured by CertainTeed, Knauf, or Owens-Corning. Product to have continuous operational temperature limit of 850 degrees F and a minimum "R" value of 4.3 per inch ( $K=0.23$ ) at 75 degrees F mean temperature. Jacket to be fiberglass reinforced kraft paper with aluminum foil and pressure sensitive closure system. Vapor-barrier mastic for application to below ambient pipe insulation shall be fungus resistant per ASTM D 5590 with 0 growth rating; Water based; Permeance per ASTM E 96, Procedure B, 0.013 perm or less at 43-mil dry film thickness suitable for indoor and jacketed outdoor use. Products: Foster 30-80 AF. Color: White. A breather mastic for application to above ambient pipe insulation (fittings, tees, valves, etc) shall be water based Foster 46-50 mastic or Childers CP-10 / CP-11. Use fiberglass piping insulation for the following services:
    - a. Domestic hot water supply without recirculating system: 1-1/4" and under - 1/2" thick; 1-1/2" and greater - 1" thick.
    - b. Domestic hot water supply and recirculating return piping: All sizes – 1" thick.
    - c. Domestic cold water piping: 1/2" thick.
    - d. Horizontal rainwater leaders, overflow leaders, and roof drain bodies: 1" thick.

#### 2.02 MATERIALS FOR FITTINGS, VALVES, AND SPECIAL COVERINGS

- A. Provide coverings and finishes for specific items hereinafter specified.
  - 1. Use pre-molded insulation fabricated by the manufacturer of insulation material or shop or site mitered segment type insulation for all pipe fittings, elbows, tees, valves, and couplings.
  - 2. PVC fitting covers over blanket fiberglass are NOT acceptable.
- B. For fitting insulation when exposed-to-view inside building, finish with two coats of paint, custom color blended to match surrounding surfaces.
- C. When specifically approved by designer, when it is impossible to completely insulate pipe, fittings, or valves with specified insulation, Armstrong Armaflex insulation tape may be used to prevent condensate drip on small piping. Use of cork insulation tape is prohibited.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. No insulation shall be cut where a hanger is located. If hangers have been installed by pipefitter tradesmen which violates this strict requirement, notify Designer immediately.
- B. Piping systems shall be tested and found free of all leaks prior to installation of insulation covering.
- C. All surfaces shall be clean and dry when covering is applied. Covering to be dry when installed and during application of any finish, unless such finish specifically requires a wetted surface for application.
- D. All adhesives, cements, and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.
- E. Install insulation using professional insulators who have adequate experience and ability.
- F. Exposed-to-view insulation shall have a well tailored appearance.
- G. Treat insulated pipe in equipment rooms and where exposed to normal view, so surfaces may be painted with water base latex paint. Use of mastics, adhesives, or jacketing which cause "bleeding" is prohibited.

### 3.02 INSTALLATION OF PIPE AND EQUIPMENT COVERING

- A. Where fiberglass is used on piping sized 2" and larger, insert a section of foamglass insulation at hanger or support points between pipe and metal shield for full length of shield to prevent crushing of insulation. Insulation thickness to be same as adjoining insulation. Where insulation passes through pipe hangers and across trapeze supports, 12" long metal saddles shall be used. On cold pipe, vapor barrier should be carried through the hanger and sealed.
- B. Apply PVC insulated fitting covers and precut insulation inserts as follows:
  - 1. Installation for hot systems:
    - a. Place the precut fiberglass insert around the fitting, positioning the points of the insert on the inside radius of the elbow.
    - b. Butt the ends of the fiberglass insert against the ends of the pipe covering. Tuck and fold the insulation so that it covers all bare surfaces. Keep the fiberglass fluffed up to the thickness of the adjacent pipe insulation to assure maximum thermal efficiency.
    - c. Insert two stainless steel serrated tacks approximately 1/4" from one of the lap edges of the fitting cover. Then snap the cover in place over the fiberglass insulation.
    - d. After the fitting cover is in position, push the tacks into the overlapping throat seam. Apply color-matched, pressure-sensitive tape to the butt joints.
  - 2. Installation for cold systems:
    - a. Position, tuck, and fold the fiberglass insulation insert as described above in steps (a) and (b) for hot systems.
    - b. Apply a vapor barrier mastic around the edges of the adjoining pipe insulation. Apply the mastic along the inside of the fitting cover throat overlap seam.
    - c. Place the fitting cover over the insulation, lapping the mastic-covered edge over the other side of the throat seam.

- d. Apply color-matched, pressure-sensitive tape over the circumferential joints. The tape should extend over the adjacent pipe insulation and overlap itself by at least 2" on the downward side of the lap.

END OF SECTION

## SECTION 221113

### FACILITY WATER DISTRIBUTION PIPING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for domestic water and fire protection service. Refer to Town of Blacksburg Standards & Specifications Water Distribution System, current edition.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Contractor to provide Engineer field located as-built survey of water distribution piping as installed.

##### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:

- 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
- 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

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

- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

- D. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

- F. NSF Compliance:

- 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
- 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.
- 3. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

## 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

## 1.7 COORDINATION

- A. Coordinate connection to water main with utility company.

## PART 2 - PRODUCTS

- A. All products and materials shall comply with the standards and specifications of the Town of Blacksburg Standards & Specifications Water Distribution System, current edition, and product manufacturer.

### PART 3 - EXECUTION

- A. Installation of all water components shall comply with the regulations, standards, and specifications of the Town of Blacksburg Standards & Specifications Water Distribution System, current edition.

END OF SECTION 221113



## SECTION 221116

### DOMESTIC WATER PIPING AND VALVES

#### PART 1 GENERAL

##### 1.01 SYSTEM REQUIREMENTS

- A. Submit pipe, valves, and fittings and have approved before starting installation. Pipe, valves, and fittings to be new, and marked clearly with manufacturers' name, weight, and classification or working pressure.
- B. Piping to run approximately as shown on drawings or as structural and architectural conditions permit.
- C. Provide seismic support and bracing of all piping systems in accordance with Seismic Specification Section 220548 Vibration and Seismic Control for Plumbing Piping and Equipment.
- D. All products used for dispensing potable drinking water must be lead free and meet the requirements of NSF 61 and NSF 372 test standards via third party testing and certification.

#### PART 2 PRODUCTS

##### 2.01 COPPER PIPES

- A. Type "L" hard-drawn seamless copper tubing, ASTM B-88: Domestic hot and cold water.
- B. Type "K" hard-drawn seamless copper tubing:
  - 1. Domestic water lines located under slab.
  - 2. Exterior domestic water lines 2-1/2" and smaller underground.
  - 3. Provide rolled, soft drawn type "K" seamless copper tubing for under slab and below grade where length of run between fittings exceeds maximum hard-drawn lengths.
- C. Copper Pipe Fittings:
  - 1. Provide sweat fittings, ASTM B-62, dimensions conforming to ANSI B16.22, wrought copper, with sweep patterns for copper tubing smaller than 4".
  - 2. Provide brazed fittings, ASTM B-88, dimensions conforming to ANSI B16.50, wrought copper, with sweep patterns for copper tubing, 4" and larger.
  - 3. Dielectric connection: Provide Epco Sales, lead free dielectric couplers at junction of steel pipe and equipment with copper piping systems. Use of steel or cast iron fittings in copper piping systems prohibited. T-drill branch tee connections shall not be allowed for domestic water piping.
- D. Unions to be brass ground joint, 250-pound working pressure.
- E. Nipples used in conjunction with copper pipe to be brass.

##### 2.02 AQUATHERM GREEN PIPE

- A. Pipe shall be manufactured from a PR-R resin (Fusiolen) meeting the requirements of ASTM F 2389 as manufactured by Aquatherm. All pipe shall be made in an extrusion process. Domestic hot water shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure

requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

- B. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the requirements of ASTM F 2389 as manufactured by Aquatherm. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11. Install fittings and joints using socket fusion, electrofusion, or butt-fusion as applicable. All fusion-well joints shall be made in accordance with the pipe and fitting manufacture's specifications and product standards.
- C. Manufacturer shall warrant pipe and fittings for 10 years to be free of defects in materials or manufacturing.
- D. Warranty shall cover labor and material cost of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system do to defects in materials or manufacturing.
- E. Where indicated on the drawings that the pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, UV-resistant coating or alternative UV protection.

## 2.03 VALVES:

- A. Valves are specified by Manufacturer and Model Numbers to establish quality levels unless otherwise noted. Crane, Milwaukee, Hammond, Nibco, Stockham, Centerline, Apollo, Kitz, or Watts are considered equal manufacturers. Provide clamp lock hand lever operators on valves less than 8 inches. Provide hand wheel and closed housing worm gear on valves 8 inches and larger unless indicated otherwise below. Provide chain operators for all equipment room and powerhouse valves 4 inch and larger which are located over 6 feet 6 inches above the finish floor. All valves shall meet NSF-61 requirements.

### 1. Gate Valves:

- a. Gate valves for 2-1/2" and larger steel piping systems to be Class 125, cast iron body, bronze mounted, flanged ends, Nibco F-607-RW. Valves to have solid wedge disc, outside stem and yoke with rising stem, and bolted bonnet. Provide dielectric bolt protectors at all flanges when connecting dissimilar metals.
- b. Gate valves for copper piping 2" and smaller systems to be Class 125, bronze body, solder ends, Nibco S-113 LF. Valve to have either solid or split wedge disc, inside screw, non-rising stem, and screwed bonnet.

### 2. Globe Valves:

- a. Globe valves 2-1/2" and larger to be Class 150, cast iron body, bronze mounted, flanged ends, Watts M6115-74 lead free. Valves to have renewable seat and disc, outside stem and yoke with rising stem, and bolted bonnet.
- b. Globe valves 2" and smaller to be Class 150, bronze body, screwed ends, Apollo 121T-LF. Valve to be plug type with renewable seat and disc, rising stem, and union bonnet.

- 3. Ball Valves: Ball valves for copper water piping systems 2" O.D. and smaller to be equal to Apollo "3" S-585-66LF, solder ends, and for 2-5/8" thru 3-1/8" O.D. to be equal to Nibco T T-585-66LF, threaded ends. Valves to have bronze body, chromium plated bronze ball, PTFE seats, stuffing box ring and seals, and quarter turn on-off. Provide memory stops for valves used for balancing service. Valves to be rated for 400-psi WOG at 200 degrees F. Install threaded end valves with lead free brass adapters.
- 4. Butterfly Valves: Butterfly valves for steel water piping systems to be Crane Centerline Series 200, or approved equal industrial quality lug type with threaded holes. Valves to provide bubble-tight shut-

off at 150 psi working pressure and 200 degrees F. Valves to have ductile iron body, "EPT" seats and stem seals, 316 stainless steel or bronze disc, 316 or 304 stainless steel stems. Valves 4" and larger to have weatherproofed sealed gear operator consisting of fully enclosed worm, worm gear, and worm shaft with handwheel to provide necessary torque for close-off and infinite throttling positions. Valves 3" and smaller to have 10 position lever lock handle suitable for on-off and manual throttling service. All operators to have valve position indicator and memory stop.

5. Check Valves:

- a. Check valves for copper water piping systems to be swing type, Class 125, bronze body, screwed ends, Nibco T-413-Y-LF.
- b. Check valves for steel water piping systems to be Nibco-910 LF Silent Check Valve. Body to be iron with bronze disc plates. Stem to be 316 stainless steel, seat to be EPT. Valve to be suitable for 200 psi working pressure at 200 degrees F.

6. Flow balancing valves for domestic hot water service shall be Bell & Gossett lead free Circuit Setter Plus or approved equal. Valve shall provide flow balancing, flow measuring, and positive shutoff service. Provide valve with memory stop, capped differential pressure readout ports with internal check valves and preformed insulation. Valve construction to be bronze body and brass ball rated for 200 psig at 250 degrees F.

## 2.04 HANGERS

- A. Seismic application: The use of single-sided or friction type C-clamps with retention straps for hanging pipe is expressly prohibited on the project unless authorized by seismic bracing design engineer. Refer to Section 220547 for requirements.
- B. Copper piping 1/2" O.D. thru 4" O.D., with no longitudinal movement to be Grinnell Figure 260, MSS SP-69 Type 1, adjustable clevis hanger with Figure 167, MSS SP-69 TYPE 40, galvanized steel insulation protection shield sized for maximum 10' span on 4 psi compressive strength insulation.
- C. Non-insulated copper tubing 1/2" O.D. thru 4" O.D. with no longitudinal movement to be Grinnell Figure CT-99C, MSS SP-69 TYPE 9, plastic coated adjustable tubing ring hanger.
- D. Insulated steel piping 1" thru 30" with longitudinal movement to be Grinnell Figure 171, MSS SP-69 TYPE 41, pipe roll complete with Figure 160, MSS SP-69 TYPE 39A or 39B, pipe insulation protection saddle sized for proper pipe size and insulation thickness.
- E. Insulated copper piping 1/2" O.D. thru 2-1/8" O.D. with longitudinal movement to be Grinnell Figure 171, MSS SP-69 TYPE 41, pipe roll complete with Figure 167, MSS SP-69 TYPE 40, galvanized steel insulation protection shield sized for maximum 10' span on 4 psi compressive strength insulation.
- F. Support copper pipe risers by Grinnell Figure CT-121C, MSS SP-69 TYPE 8, plastic coated riser clamps at floor penetrations.
- G. Support three or more parallel lines by trapeze hangers utilizing Unistrut channel or equal in bottom mounting arrangement with rod hanging support.
- H. Adequately size hangers on insulated piping for insulation to pass continuously through hangers. Insulated piping to be supported outside insulation covering.
- I. Provide concrete inserts, Grinnell Figure 282, MSS SP-69 TYPE 18, universal concrete insert, for attaching hangers to building structure. Inserts to be adequately sized and correctly positioned to support piping, valves, etc., when full of water and system is in operation.

- J. Support all piping by heavy steel, adjustable hangers, or brackets suitably fastened to structural portion of building. Place hangers in accordance with following tables.

COPPER TUBING SUPPORTS	
SIZE (IN.)	DISTANCE BETWEEN SUPPORTS (FT.)
5/8	6
7/8 - 1-1/8	8
1-3/8 - 2-1/8	10
2-5/8 - 5-1/8	12
6-1/8 - 8-1/8	14

- K. Perforated metal, strap iron, or band iron hangers are not permitted. Offsets in hangers are not allowed. Pipe risers to be supported at regular intervals in pipe shafts within the limits of good practice.
- L. See Insulation Section for requirements at pipe hangers.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install piping not to interfere with opening of doors or other moving parts. Do not install piping near or directly over any portion of electrical equipment.

#### 3.02 FIRE-RATED PARTITIONS

- A. Provide permanent firestop system at all piping penetrations of fire-rated walls and floors. Review details on drawing as well as this specification for permissible firestop systems. The firestop system shall have been tested and approved in accordance with ASTM E119 and U.L. 1479 (ASTM E814) and classified for up to 2 hours fire rating. Firestop system shall be type detailed on drawings or intumescent type capable of expanding up to 8 times its original volume. Firestop system to be 3M, Hilti, Nelson, Johns Manville, or Specified Technologies. Firestop system shall be installed in strict accordance with published U.L. approved installation instructions. Piping to pass through the fire-rated partition insulated or non-insulated as specified and detailed. Submit U.L. approved installation drawing for each type of penetration prior to construction.

#### 3.03 NON-RATED PARTITIONS

- A. Piping to pass through the walls insulated or non-insulated as specified. Wall should be finished to fit neatly around the piping. Firestopping is not required at non-rated partitions.

#### 3.04 PIPE SLEEVES

- A. Pipe sleeves shall be provided at non-rated partitions and floor penetrations. Pipe sleeves to be Schedule 40 or 18 gage steel. Sleeves to extend 1-1/2" in excess of partition depth on each side. Sleeves penetrating floors in wet areas, including all mechanical rooms, shall extend a minimum of 1 inch above the floor.
1. Piping requiring sleeves: Copper pipes thru masonry walls
- B. Provide chromium-plated escutcheon plates for exposed uninsulated pipes projecting through floors or walls in finished spaces. Mechanical rooms and janitor closets are not considered "finished" spaces.

- C. Hang piping so equipment, flanges, and connections do not bear weight of piping.
- D. Adequately support vertical lines at their bases or by a suitable hanger placed in horizontal line near riser or by a base fitting set on pedestal.
- E. Pipes not to be hung or supported by pumps. No torque to be applied to pumps by connecting pipes. After final pipe adjustments and initial operation of the pumps, this Contractor to recheck alignment of pumps and realign as required.
- F. Run piping in straight lines; riser lines to be plumb with such offsets only as indicated or necessary. No sagging of lines permitted.
- G. Unless otherwise shown on drawings, lines to be installed to drain to sumps or sewer.
- H. Ream pipe after cutting to full bore. Remove foreign matter from inside of pipe before installing. Keep installed piping free from dirt and scale and protect open ends from foreign matter. Use temporary plugs or other approved methods of open end closure.
- I. Threads to be right-hand, pipe standard, clean cut, full depth, and tapered. Joints to be made tight without caulking. Approved pipe joint lubricant to be used, applied in thin layer to the male thread only.
- J. Install copper fittings with suitable flux and silver solder with a melting temperature of at least 1000 degrees F. and 95/5 lead free solder. Type K copper pipe to be joined by means of suitable flux and silver or phos-copper.
- K. Piping to have sufficient number of flanges or unions for convenient installation and removal of piping and equipment.
- L. Remake or replace defective, leaking, or otherwise unsatisfactory joints or material. Peening, caulking, or doping of piping is not permitted.
- M. Install piping to prevent stresses and strains to piping and hangers from expansion or contraction. Provision for proper loops, offsets, or expansion joints to be responsibility of Contractor. Make provision for servicing and removal of equipment without dismantling piping.

### 3.05 PIPING IN TRANSFORMER, ELECTRICAL, AND ELEVATOR EQUIPMENT ROOMS

- A. Refer to drawings. No water piping permitted in transformer, electrical, or elevator equipment rooms.

### 3.06 VALVE ACCESS

- A. Locate all shutoff and control valves for easy access and operation. Where valves must necessarily be located in enclosed spaces, they shall be provided with access panels of sufficient size for operation. Furnish these access panels to proper trades for installation.

END OF SECTION



## SECTION 221119

### DOMESTIC WATER PIPING SPECIALTIES

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. This section includes requirements for:
- B. Backflow preventers.
- C. Shock absorbers.
- D. Trap primers.
- E. Equipment connection backflow device.
- F. Vacuum breakers.

#### PART 2 PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. All products to be purchased from Ferguson Enterprises. Contact Bettina Dawson office (615) 316-1920 cell (931) 239-0466 or email HCA@Ferguson.com.
- B. All products used for dispensing potable drinking water must be lead free and meet the requirements of NSF 61 and NSF 372 test standards via third party testing and certification.

##### 2.02 BACKFLOW PREVENTERS

- A. Acceptable Manufacturer: Wilkins.
- B. Product must meet NSF-61.
- C. Provide completely automatic, unit, fitted with tight closing shut-off valves and test cocks at each end.
- D. Construct such that all parts are replaceable without removing unit from line.
- E. Design such that total pressure drop through complete backflow preventer does not exceed 12 PSI at rated flow. Certified U.S.C. flow curves shall be provided for each device as part of the submittal package.

##### 2.03 SHOCK ABSORBERS

- A. Acceptable Manufacturer: Sioux Chief.
- B. Refer to drawings for placement and size of shock absorbers.
- C. Access Covers: Minimum size 12" x 12" located for access to shock absorbers.

## 2.04 TRAP PRIMERS

- A. Acceptable Manufacturer: Precision Plumbing Products.
- B. Construct trap primer valve of all bronze, chrome plated with removable operating parts, integral vacuum breaker, and gasketed access cover.
- C. Access Covers: Minimum size 12" x 12" located for access to trap primers.

## 2.05 EQUIPMENT CONNECTION BACKFLOW DEVICE

- A. Acceptable manufactures: McCann Engineering ASSE 1022 Backflow Preventer.
- B. Must meet ASSE 1022
- C. Provide the above referenced backflow device if beverage equipment does not have integral backflow device.

## 2.06 VACUUM BREAKERS

- A. Wilkins model 420

# PART 3 EXECUTION

## 3.01 INSTALLATION AND TESTING

- A. Backflow Preventers:
  - 1. Pipe relief through fixed air gap and discharge to sewer.
  - 2. Install adjacent to wall and/or floor utilizing stand-off brackets, angle frame, and/or concrete piers.
  - 3. Test unit for leaks and pressure drop. Clean and/or replace soiled strainer media.
  - 4. Provide dual parallel reduced pressure backflow preventers on the main domestic water entrance to the facility.
  - 5. Provide backflow prevention vacuum breaker on any water line feeding any piece of equipment which could cause back siphonage such as mechanical equipment, trap primer lines, etc.
- B. Shock Absorbers:
  - 1. Install shock absorbers above ceiling, outside wall so access and maintenance can be performed without disturbing walls and non-liftouts ceilings.
  - 2. Install shock absorbers on all flush valves, solenoid valves and quick closing devices.
  - 3. Test and certify shock absorbers by plumbing and drainage institute.
  - 4. Trap Primers: Trap primers to have approval of plumbing and drainage institute.
- C. Equipment Connection Backflow device: Provide on all water lines feeding coffee makers, ice machines and beverage dispensers.
- D. Vacuum Breakers: Provide on water lines feeding equipment to protect against back siphonage of contaminated water.

END OF SECTION

## SECTION 221313

### FACILITY SANITARY SEWERS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Town of Blacksburg Sanitary Sewer System Standards & Specifications, current edition.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe and fittings.
  - 2. Nonpressure and pressure couplings.
  - 3. Expansion joints and deflection fittings.
  - 4. Backwater valves.
  - 5. Cleanouts.
  - 6. Encasement for piping.
  - 7. Manholes.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Special pipe fittings.
- B. Shop Drawings: For the following:
  - 1. Manholes: Include plans, elevations, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Field quality-control test reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Do not store plastic manholes, pipe, and fitting in direct sunlight.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

- A. All products and materials shall comply with the standards and specifications of the Town of Blacksburg Sanitary Sewer System Standards & Specifications, current edition, and product manufacturer.

PART 3 - EXECUTION

- A. Installation and testing of all sanitary sewer components shall comply with the regulations, standards, and specifications of the Town of Blacksburg Sanitary Sewer System Standards & Specifications, current edition.

END OF SECTION 221313

## SECTION 221316

### SANITARY WASTE AND VENT PIPING

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED



- A. Submit pipe and fittings and have approved before starting installation. Pipe and fittings to be new, and marked clearly with manufacturers' name, weight, and classification or working pressure.
- B. Piping to run approximately as shown on drawings or as structural and architectural conditions permit.
- C. Provide seismic support and bracing of all piping systems in accordance with Seismic Specification Section 220548 Vibration and Seismic Control for Plumbing Piping and Equipment.


#### PART 2 PRODUCTS

##### 2.01 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, draining tube, drawn temper. Waste, vent and drainage piping 1-1/2 and smaller.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B 16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASME B 88, Type L, water tube, drawn temper.
- D. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- E. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

##### 2.02 CAST IRON SOIL PIPE

- A. Standard weight cast iron soil pipe with drainage fittings:
  - 1. Waste, drainage, and vent lines 2" and larger. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute  and listed by NSF  International.

2. Drain lines under concrete or other paving and under buildings, including to a distance of not less than 5'-0" from building. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute  and listed by NSF® International.
3. Manufacturers: Charlotte Pipe and Foundry, Tyler Pipe, AB&I Foundry.
4. Joints in cast iron soil pipe may be hub and spigot with neoprene compression gaskets conforming to ASTM C564 or "No-hub". No-hub shall not be permitted on underground systems. No-hub couplings shall be standard CISPI 310 couplings manufactured with 300 series stainless steel and neoprene rubber sleeve.

## 2.03 PVC PIPE

- A. Schedule 40 PVC DWV pipe, ASTM D-2665 solid wall Type 1, Grade 1.
  1. Schedule 40 DWV waste and drainage piping below grade ONLY. PVC piping not permitted within Boiler Room or Kitchen.
- B. TYPE PSM SDR-35 PVC sewer pipe with gasket slip joints, ASTM D-3034.
  1. Outside gravity, underground sanitary sewer drainage, from 5'-0" outside building to connection to local sewer.
- C. Fittings to match piping system. Fittings to have manufacturer's trademark permanently identified in accordance with MSS-SP-25. Supplier to include with submittal data certification that fittings and flanges have met requirements.
- D. Joints for piping to be made with tetrahydrofuron solvent cement. Joints to be in accordance with manufacturer's recommendations.
- E. Pipe, fittings, and cement to all be supplied by single manufacturer for entire project.
- F. All solvent cements shall be low emitting VOC at 510 g/L or less.

## 2.04 HANGERS

- A. Seismic application: The use of single-sided or friction type C-clamps with retention straps for hanging pipe is expressly prohibited on the project unless authorized by the seismic bracing design engineer refer to Specification Section 220548 for requirements.
- B. Non-insulated cast iron soil pipe thru 8" to be Grinnell Figure 104, MSS SP-69 TYPE 6, adjustable swivel ring, split ring type, and pipe 10" thru 15" Grinnell Figure 260, MSS SP-69 TYPE 1, adjustable clevis hanger.
- C. Support three or more parallel lines by trapeze hangers utilizing Unistrut channel or equal in bottom mounting arrangement with rod hanging support.
- D. Adequately size hangers on insulated piping for insulation to pass continuously through hangers. Insulated piping to be supported outside insulation covering.
- E. Provide concrete inserts, Grinnell Figure 282, MSS SP-69 TYPE 18, universal concrete insert, for attaching hangers to building structure. Inserts to be adequately sized and correctly positioned to support piping, valves, etc., when full of water and system is in operation.
- F. Attention is called to pipe spring isolation specified to be furnished by this Contractor.

- G. Support all piping by heavy steel, adjustable hangers, or brackets suitably fastened to structural portion of building. Place hangers in accordance with Cast Iron Supports. Support each fitting, at intervals of not more than 5 feet, and at least at each joint.
- H. Perforated metal, strap iron, or band iron hangers are not permitted. Offsets in hangers are not allowed. Pipe risers to be supported at regular intervals in pipe shafts within the limits of good practice.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install piping not to interfere with opening of doors or other moving parts. Do not install piping near or directly over any portion of electrical equipment.

#### 3.02 FIRE-RATED PARTITIONS

- A. Provide permanent firestop system at all piping penetrations of fire-rated walls and floors. Review details on drawing as well as this specification for permissible firestop systems. The firestop system shall have been tested and approved in accordance with ASTM E119 and U.L. 1479 (ASTM E814) and classified for up to 2 hours fire rating. Firestop system shall be type detailed on drawings or intumescent type capable of expanding up to 8 times its original volume. Firestop system to be 3M, Hilti, Nelson, Johns Manville, or Specified Technologies. Firestop system shall be installed in strict accordance with published U.L. approved installation instructions. Piping to pass through the fire-rated partition insulated or non-insulated as specified and detailed. Submit U.L. approved installation drawing for each type of penetration prior to construction.

#### 3.03 NON-RATED PARTITIONS

- A. Piping to pass through the walls insulated or non-insulated as specified. Wall should be finished to fit neatly around the piping. Firestopping is not required at non-rated partitions.
- B. Provide chromium-plated escutcheon plates for exposed uninsulated pipes projecting through floors or walls in finished spaces. Mechanical rooms and janitor closets are not considered "finished" spaces.
- C. Hang piping so equipment, flanges, and connections do not bear weight of piping.
- D. Adequately support vertical lines at their bases or by a suitable hanger placed in horizontal line near riser or by a base fitting set on pedestal.
- E. Pipes not to be hung or supported by pumps. No torque to be applied to pumps by connecting pipes. After final pipe adjustments and initial operation of the pumps, this Contractor to recheck alignment of pumps and realign as required.
- F. Run piping in straight lines; riser lines to be plumb with such offsets only as indicated or necessary. No sagging of lines permitted.
- G. Unless otherwise shown on drawings, lines to be installed to drain to sumps or sewer.
- H. Ream pipe after cutting to full bore. Remove foreign matter from inside of pipe before installing. Keep installed piping free from dirt and scale and protect open ends from foreign matter. Use temporary plugs or other approved methods of open end closure.

- I. Threads to be right-hand, pipe standard, clean cut, full depth, and tapered. Joints to be made tight without caulking. Approved pipe joint lubricant to be used, applied in thin layer to the male thread only.
- J. Piping to have sufficient number of flanges or unions for convenient installation and removal of piping and equipment.
- K. Remake or replace defective, leaking, or otherwise unsatisfactory joints or material. Peening, caulking, or doping of piping is not permitted.
- L. Install piping to prevent stresses and strains to piping and hangers from expansion or contraction. Provision for proper loops, offsets, or expansion joints to be responsibility of Contractor. Make provision for servicing and removal of equipment without dismantling piping.

3.04 PIPING IN TRANSFORMER, ELECTRICAL, AND ELEVATOR EQUIPMENT ROOMS

- A. Refer to drawings. No water piping permitted in transformer, electrical, or elevator equipment rooms.

3.05 GRADES AND ELEVATIONS

- A. Uniformly grade sanitary drainage lines to elevations shown. If no elevations are given, pitch sewers not less than 1/8" per foot.

END OF SECTION

## SECTION 221319

### SANITARY WASTE PIPING SPECIALTIES

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. This section includes requirements for:
  - 1. Cleanouts.

#### PART 2 PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Cleanouts and grease interceptors to be purchased from Ferguson Enterprises. Contact Bettina Dawson office (615) 316-1920 cell (931) 239-0466 or email HCA@Ferguson.com.

##### 2.02 CLEANOUTS

- A. Acceptable Manufacturer: Zurn. The following model numbers listed are Zurn.
- B. Exterior: ZN-1402-HD cast iron cutoff ferrule with round nickel bronze scoriated frame and cover, secured.
- C. Finished Concrete Floor: ZN-1400-HD inside caulk round nickel bronze scoriated frame and cover.
- D. Resilient Tile Floor: ZN-1400-X inside caulk round nickel bronze scoriated frame and cover, secured.
- E. Carpet: ZN-1400-CM inside caulk round nickel bronze scoriated frame and cover; provide carpet marker and permanent marker in ceiling above.
- F. Wall: ZN-1440-1 cast iron caulking ferrule with Nikaloy smooth round frame and cover.
- G. Access Covers: Minimum size 12" x 12" located for access to valves, shock absorbers, trap primers, wall cleanouts, etc.
- H. Furnish cleanouts occurring in waterproof floors with clamping devices.

#### PART 3 EXECUTION

##### 3.01 INSTALLATION AND TESTING

- A. Cleanouts:
  - 1. Locate line size cleanouts, except 4" largest required, at base of all soil and waste stacks, at all changes in direction and in straight runs. Ensure spacing in straight runs does not exceed 50 feet inside building and 100 feet outside the building.

2. Extend inaccessible cleanouts up through floor and/or wall provided easy accessibility cannot be obtained otherwise.

END OF SECTION

## SECTION 221400

### STORM DRAINAGE


#### PART 1 GENERAL

##### 1.01 SYSTEM REQUIREMENTS

- A. Submit pipe and fittings and have approved before starting installation. Pipe, and fittings to be new, manufactured domestically, and marked clearly with manufacturers' name, weight, and classification or working pressure.
- B. Piping to run approximately as shown on drawings or as structural and architectural conditions permit.
- C. Provide seismic support and bracing of all piping systems in accordance with seismic details shown on drawings.

#### PART 2 PRODUCTS

##### 2.01 CAST IRON SOIL PIPE

- A. Standard weight cast iron soil pipe with drainage fittings:
  - 1. Storm water piping.
  - 2. Rainwater leaders inside building.
  - 3. Drain lines under concrete or other paving and under buildings, including to a distance of not less than 5'-0" from building.
  - 4. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute  and listed by NSF® International.
  - 5. Joints in cast iron soil pipe may be hub and spigot with neoprene compression gaskets or "No-hub". No-hub shall not be permitted on underground systems. No-hub couplings shall be standard CISPI 310 couplings manufactured with 300 series stainless steel and neoprene rubber sleeve.

##### 2.02 PVC PIPE

- A. Schedule 40 PVC pipe, ASTM D-1785 Type 1, Grade 1, 200-psi test:
  - 1. Storm water piping below grade.
  - 2. Foundation drainage: Perforated schedule 40 PVC laid in pea gravel may be used in lieu of perforated clay tile.
- B. Fittings to match piping system. Fittings to have manufacturer's trademark permanently identified in accordance with MSS-SP-25. Supplier to include with submittal data certification that fittings and flanges have met requirements.
- C. Joints for piping to be made with tetrahydrofuron solvent cement. Joints to be in accordance with manufacturer's recommendations.
- D. Pipe, fittings, and cement to all be supplied by single manufacturer for entire project.
- E. All solvent cements shall be low emitting VOC at 510 g/L or less.

## 2.03 HIGH DENSITY POLYETHYLENE PIPE

- A. High density, perforated polyethylene pipe shall be manufactured to AASHTO M252 and M294, ASTM F405 and F667:
  - 1. Underfloor slab drainage pipe.
  - 2. Retaining wall drainage pipe.
- B. Pipe shall be covered 100 percent polyester, knitted fabric to prevent infiltration of sand and soils.
- C. Contractor shall backfill around pipe with Class 1 materials per ASTM D2321. Minimum compaction of 85 percent shall be required.

## 2.04 HANGERS

- A. Seismic application: The use of C-clamps for hanging pipe is expressly prohibited on the project.
- B. Non-insulated cast iron soil pipe thru 8" to be Grinnell Figure 104, MSS SP-69 TYPE 6, adjustable swivel ring, split ring type, and pipe 10" thru 15" Grinnell Figure 260, MSS SP-69 TYPE 1, adjustable clevis hanger.
- C. Support three or more parallel lines by trapeze hangers utilizing Unistrut channel or equal in bottom mounting arrangement with rod hanging support.
- D. Adequately size hangers on insulated piping for insulation to pass continuously through hangers. Insulated piping to be supported outside insulation covering.
- E. Provide concrete inserts, Grinnell Figure 282, MSS SP-69 TYPE 18, universal concrete insert, for attaching hangers to building structure. Inserts to be adequately sized and correctly positioned to support piping, valves, etc., when full of water and system is in operation.
- F. Provide C-clamps with locknut, Grinnell Figure 86, MSS SP-69 TYPE 23, where piping is to be hung from steel beams. Welding hanger rods to steel members is not permitted. Provide malleable beam clamps, Grinnell Figure 218, MSS SP-69 TYPE 30, with extension piece, Grinnell Figure 157, where piping is hung from bar joist.
- G. Attention is called to pipe spring isolation specified to be furnished by this Contractor.
- H. Support all piping by heavy steel, adjustable hangers, or brackets suitably fastened to structural portion of building. Place hangers in accordance with Cast Iron Supports. Support each fitting, at intervals of not more than 5 feet, and at least at each joint.
- I. Perforated metal, strap iron, or band iron hangers are not permitted. Offsets in hangers are not allowed. Pipe risers to be supported at regular intervals in pipe shafts within the limits of good practice.
- J. See Insulation Section for requirements at pipe hangers.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install piping not to interfere with opening of doors or other moving parts. Do not install piping near or directly over any portion of electrical equipment.

- B. Provide chromium-plated escutcheon plates for exposed uninsulated pipes projecting through floors or walls in finished spaces. Mechanical rooms and janitor closets are not considered "finished" spaces.
- C. Hang piping so equipment, flanges, and connections do not bear weight of piping.
- D. Adequately support vertical lines at their bases or by a suitable hanger placed in horizontal line near riser or by a base fitting set on pedestal.
- E. Pipes not to be hung or supported by pumps. No torque to be applied to pumps by connecting pipes. After final pipe adjustments and initial operation of the pumps, this Contractor to recheck alignment of pumps and realign as required.
- F. Run piping in straight lines; riser lines to be plumb with such offsets only as indicated or necessary. No sagging of lines permitted.
- G. Unless otherwise shown on drawings, lines to be installed to drain to sumps or sewer.
- H. Ream pipe after cutting to full bore. Remove foreign matter from inside of pipe before installing. Keep installed piping free from dirt and scale and protect open ends from foreign matter. Use temporary plugs or other approved methods of open end closure.
- I. Threads to be right-hand, pipe standard, clean cut, full depth, and tapered. Joints to be made tight without caulking. Approved pipe joint lubricant to be used, applied in thin layer to the male thread only.
- J. Piping to have sufficient number of flanges or unions for convenient installation and removal of piping and equipment.
- K. Remake or replace defective, leaking, or otherwise unsatisfactory joints or material. Peening, caulking, or doping of piping is not permitted.
- L. Install piping to prevent stresses and strains to piping and hangers from expansion or contraction. Provision for proper loops, offsets, or expansion joints to be responsibility of Contractor. Make provision for servicing and removal of equipment without dismantling piping.

### 3.02 FIRE-RATED PARTITIONS

- A. Provide permanent firestop system at all piping penetrations of fire-rated walls and floors. Review details on drawing as well as this specification for permissible firestop systems. The firestop system shall have been tested and approved in accordance with ASTM E119 and U.L. 1479 (ASTM E814) and classified for up to 2 hours fire rating. Firestop system shall be type detailed on drawings or intumescent type capable of expanding up to 8 times its original volume. Firestop system to be 3M, Hilti, Nelson, Johns Manville, or Specified Technologies. Firestop system shall be installed in strict accordance with published U.L. approved installation instructions. Piping to pass through the fire-rated partition insulated or non-insulated as specified and detailed. Submit U.L. approved installation drawing for each type of penetration prior to construction.

### 3.03 NON-RATED PARTITIONS

- A. Piping to pass through the walls insulated or non-insulated as specified. Wall should be finished to fit neatly around the piping. Firestopping is not required at non-rated partitions.

### 3.04 PIPING IN TRANSFORMER, ELECTRICAL, AND ELEVATOR EQUIPMENT ROOMS

- A. Refer to drawings. No water piping permitted in transformer, electrical, or elevator equipment rooms.

3.05 GRADES AND ELEVATIONS

- A. Uniformly grade storm drainage lines to elevations shown. If no elevations are given, pitch sewers not less than 1/8" per foot.

END OF SECTION

## SECTION 224300

### HCA PLUMBING FIXTURES

#### PART 1 GENERAL

##### 1.01 MANUFACTURERS

- A. Provide plumbing fixtures and drains as listed on drawings and described herein. Fixture numbers are per HCA standard per purchase agreement for all products. All products to be purchased from Ferguson Enterprises. Contact Bettina Dawson office (615) 316-1920 cell (931) 239-0466 or email [HCA@ferguson.com](mailto:HCA@ferguson.com).
- B. All drainage products to be Zurn no exceptions. All drains installed above slab to be complete with clamping device.
- C. Stainless steel sinks shall be Elkay no exceptions.
- D. Flush valves shall be Zurn-AV no exceptions.
- E. Pressure balancing shower valves shall be Symmons
- F. Commercial or public faucets shall be Zurn no exceptions.
- G. Gooseneck faucets shall be Zurn no exceptions. All gooseneck water supply spouts for lavatories and sinks shall discharge a minimum of 5" above the rim of the specified fixture. All gooseneck faucets shall be furnished with plain end spouts; aerators shall not be accepted. An in-line flow control device to limit flow to 1.5 GPM maximum shall be installed on all gooseneck faucets, including gooseneck sensor faucets unless otherwise called for on specific fixtures.
- H. Fixture supplies, stops, and traps to be commercial grade Proflo. Traps to be 17 gauge with wall flange. Supplies to be flexible stainless steel supply lines and stops to be Proflo quarter turn compression stops.
- I. Water closet seats shall be Proflo, no exceptions.
- J. Thermostatic master mixing valves shall be Symmons, Powers, or Leonard.
- K. China or enamel fixtures to be white in color
- L. All wall-mounted lavatories shall be capable of supporting a minimum vertical load of 250 pounds. Install wall-mounted lavatories with floor-anchored carriers which fit in standard stud walls.
- M. All water supply spouts for lavatories and sinks shall discharge a minimum of 1" above the rim of the specified fixture.
- N. Where blade handles are specified, they shall not be less than 3-1/2", or more than 4-1/2" in length, except that handles of clinical sinks shall not be less than 6" long.
- O. All products used for dispensing potable drinking water must be lead free and meet the requirements of NSF 61 and NSF 372 test standards via third party testing and certification.

## PART 2 PRODUCTS

### 2.01 FIXTURES

- P101 Water Closet - Public, Floor Mounted, Barrier-Free, 1.28 Gallon:  
Zurn Z5665-BWL1 Floor Mt water closet 1.28gpf Bowl  
Zurn Z-6000-AV-HET 1.28gpf flush valve  
Proflo PFTSCOF2000WH Comm Elongated OF Closet seat
- P104 Water Closet - Patient, Floor Mounted, Barrier-Free, 1.6 Gallon:  
Zurn Z5666-BWL-AM 1.6gpf Bowl  
Zurn Z-6011-AV-BWN-WS1 bedpan flush valve  
Proflo PFTSCOF2000WH Comm Elongated OF Closet seat
- P303 Lavatory, Wall Hung, Sensor Gooseneck: Barrier free  
Zurn Z5344 White 20x18 4cc wall mount lavatory  
Zurn Z6920XL-CP4-FC1.5 CP 1.5gpm, GN sensor faucet with plain end spout  
Wilkins ZW3870XLTC 3/8" point of use therm mixing valve 3-PORT  
Proflo PFGD101 1-1/4x6 CP 17ga offset grid drain  
Proflo PFPTB400 1-1/4" 17ga P trap  
Proflo PFXQAC32C ¼ turn angle stop (2)  
Proflo PFX146324 20" Flex SS riser (2)  
Proflo PFE7 ½" CP escutcheon (2)  
Proflo PF202WH Trap wrap kit  
Zurn ZZ1231 wall carrier
- P304 Lavatory, Wall Hung, Patient, Barrier-Free, Gooseneck:  
Zurn Z5344 White 20x18 4cc wall mount lavatory  
Zurn Z812A4-XL-FC1.5 CP 1.5gpm, GN wrist blade hdl, plain end spout  
Proflo PFGD101 1-1/4x6 CP 17ga offset grid drain  
Proflo PFPTB400 1-1/4" 17ga P trap  
Proflo PFXQAC32C ¼ turn angle stop (2)  
Proflo PFX146324 20" Flex SS riser (2)  
Proflo PFE7 ½" CP escutcheon (2)  
Proflo PF203WH Trap wrap kit  
Zurn ZZ1231 wall carrier
- P409 Single Compartment, Solid Surface:  
Zurn Z831B4-XL-FC gooseneck, wrist blades  
Proflo PFWTST wide top grid drain  
Proflo PFPTB403 1-1/2 17 ga P trap  
Proflo PFXQAC32C ¼ turn angle valve (2)  
Proflo PFX146324 20" flex riser (2)  
Proflo PFE7 ½" CP escutcheon (2)
- P411 Single Compartment Sink, Utility / Soiled Linen:  
Elkay DLR 1919-10-3 stainless sink  
Zurn Z831B4-XL-FC gooseneck, wrist blades  
Proflo PFWTST wide top grid drain  
Proflo PFXQAC32C ¼ turn angle valve (2)  
Proflo PFX146324 20" flex riser (2)  
Proflo PFE7 ½" CP escutcheon (2)  
Proflo PFPTB403 P trap
- P501 Clinical Sink, Wall Mounted:  
Zurn Z5410 with rim guards  
Zurn Z6017-AV-H  
Zurn Z843D4-LVB-PE-2XT-FT-YJ  
Zurn Z85500WM-XL-EVB-HK-SE-SH2-VC bedpan washer with elevated vacuum breaker

	Zurn Z-1217 carrier
	Install 30" from rim to finished floor
P505	Janitor sink, Faucet/Eyewash Combination: SSB902 24x24 Terazzo mop basin, SS rim guards Speakman SEF9000-TW eyewash faucet & mixing valve STC3NH mop sink gasket for cast iron pipi Proflo PFWG24S SS wall guards for 24x24 mop basin
P701	Floor Drain, Regular: Zurn ZN-415-P-Y type B strainer, nickel bronze top, trap primer, sediment bucket
P702	Floor Drain, 12" Mechanical Room: Zurn ZN-541-P, nickel bronze top, sediment bucket, trap primer
P710	Roof Drain, 15" Diameter: Zurn ZA-100-DR, aluminum dome, adjustable drain riser extension assembly
P711	Roof Drain, Overflow: Zurn ZA-100-W2-DR, aluminum dome, adjustable drain riser extension assembly, internal 2" dam
P724	Downspout Nozzle Zurn ZARB199-IP-SS
P801	Wall Hydrant, Exterior: Zurn Z-1310, non-freeze with vacuum breaker and stainless steel face Install 18" above finished grade
P802	Hose Bibb, Interior: Zurn Z1341-P34-PC polished chrome finish with vacuum breaker Install 18" above finished floor
P804	Ice Machine Connection: Oatey No. 39140 metal ice maker box with metal face plate. Box with valve and water hammer arrestor
P815	Ice Machine/ Vending Connection with drain: IPS Corp 88436 metal drain box with metal face plate. Box with 3/8" supply valve and water hammer arrestor
P900	Scrub Sink Kohler K-12793 scrub sink Kohler K-1814 wall mounted supports Zurn Z8Z1AO-XLGooseneck Spout Zurn Z85500-XL-WM Foot Pedestal Zurn Z8739-SW-PC CP strainer with tailpiece Proflo PFXQAC32C ¼ turn angle valve (2) Proflo PFX146324 20" flex riser (2) Proflo PFE7 ½" CP escutcheon (2)
P901	Floor Sink: 16" square-1/2 grate Zurn ZN 1920 KC-2 nickel bronze half grate Flange are coating, 8" sump depth

### PART 3 EXECUTION

#### 3.01 REQUIREMENTS

- A. Water closets shall be installed complete with wall carriers, wax rings, bolt caps, and flush valves (or float valves).
- B. Elevated vacuum breakers, where specified, shall be installed 7'-6" above the finished floor.

- C. Countertop sinks shall be installed complete with required mounting rim or clips.
- D. After installation, all fixtures shall be cleaned and labels removed. Where fixtures are in contact with walls, floors, or countertops, caulking shall be applied. Caulking shall be General Electric white silicon sanitary sealant.
- E. Water closets identified on plans as barrier free fixtures shall have the flush valves installed per American Disabilities Act. Flush valves shall have the handle installed on the wide side of the stall. Coordinate with the architectural drawings.
- F. At each floor drain installed above slab on grade, install a 36" x 36" apron equal to chloraloy 240 brand non-plasticized chlorinated polyethylene concealed waterproofing membrane, .040 inch thick, waterproofing membrane to be installed per manufacturers recommendations.
- G. At each flush valve, solenoid valve and other quick closing devices provide shock absorber.

END OF SECTION

## SECTION 226006

### CERTIFICATION PROCEDURE FOR MEDICAL GAS PIPELINES

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. This section is to outline the responsibilities and procedures to be followed in final certification of the medical gas pipelines and included as a supplement to Section 226013 Medical Gas Piping System.
- B. When new piping is "cut-in" to previously installed piping, it is possible that previously installed piping could be disturbed so as to cause crossed piping in previously installed systems. It is imperative that previously installed systems be inspected for crossed piping in conjunction with new system medical gas pipeline inspection and certification to the point of source.
- C. The certification procedure shall comply with all requirements of NFPA 99, latest published edition and as stated herein.
- D. Pipeline certification shall be performed by an independent third party Certification Agency. The Certification Agency qualifications data to be submitted and approved before any work to certify the systems has been performed.

#### PART 2 PRODUCTS

##### 2.01 EQUIPMENT REQUIREMENTS

- A. Refer to Section 226013 Medical Gas Piping System.

#### PART 3 EXECUTION

##### 3.01 INSTALLATION

- A. The General Contractor shall furnish a verified list designating number and location of all medical gas outlets to the Certification Agent. The General Contractor shall review and check this list with the appropriate subcontractors and the medical gas system personnel performing the medical gas pipeline inspection.
- B. The Plumbing Contractor is to perform mechanical check of all medical gas outlets prior to the certification inspection. Any necessary repairs or rework to be done prior to system suppliers inspection. Check to include:
  - 1. Outlets properly supported.
  - 2. Installation complete.
  - 3. Appropriate adapters fit and securely lock in place.
- C. The Owner is responsible for ensuring that bulk tank and/or cylinder supplies are installed, connected, and filled (or partially filled) prior to system suppliers inspection.
- D. All medical gas outlets shall be tested by the Certification Agent, excluding none.

- E. Certification Agent shall provide factory trained, qualified representatives to perform pipeline inspection and to provide report and certification in accordance with NFPA 99, latest published edition.
  1. Any discrepancies discovered during the inspection shall be noted, corrected, and any and all portions of the system affected by corrective action shall be retested and findings recorded after retest.
- F. Plumbing Contractor to provide representative who shall serve as customer contact person and who shall witness the inspection and certify that all outlets on the list furnished by the General Contractor have been checked and is in accord with inspection procedure and findings as witnessed.
- G. Hospital Engineering Department shall provide a representative who shall witness the inspection and certify that all spaces and the outlets therein listed on the list furnished by the General Contractor have been checked in accordance with inspection procedure.
- H. Certification Agent shall perform a cross connection test on all medical gas outlets using oil-free nitrogen as described in NFPA 99, latest published edition. Each pipe system shall be reduced to atmospheric pressure. Certification Agent shall then pressurize and test each piping system, one system at a time.
- I. Contractor shall connect all designated gas systems and purge the systems, completely. Certification Agent shall then analyze each medical gas outlet for proper oxygen content.
- J. The Certification Agent to furnish copies of Medical Gas Pipeline Inspection Report and Medical Gas Pipeline Certification to General Contractor to be distributed as follows:
  1. Plumbing Contractor
  2. Owner's Construction Manager
  3. Consulting Engineer
  4. Hospital
- K. The following procedure should be followed in addition to the above on extensions to existing systems:
  1. Owner's Representative shall, with adequate advance notice, request that system supplier's inspector or inspection team be on-site when old piping is cut-in for installation of new lines.
  2. Owner's Representative and system supplier's representative shall arrange to have inspector or inspection team on-site when the existing piping is cut into for installation of new lines.
  3. Main line shut-off vales shall be installed in new piping as close as possible to point of cut-in to previously installed piping.
  4. NOTE: Following verification of proper labeling or proper gas distribution of previously installed piping after cut-in procedure, the aforementioned valves (Item 3) shall be considered the "source" of supply for the new piping.

GAS ANALYSIS		
Gas	Concentration (%)	Pressure (psig)
Oxygen	99-100	50 +/- 5
N <sub>2</sub> O	99+	50 +/- 5
N <sub>2</sub>	99+	Normal regulated pressure Plus/Minus 5 (usually set from 160 to 200)
Vacuum	–	Negative
Air	19.5 - 23.5 O <sub>2</sub> content	50 +/- 5
CO <sub>2</sub>	0	Temporarily reduced pressure at source to 30. Outlet pressure shall be 30 +/- 5

END OF SECTION

## SECTION 226013

### MEDICAL GAS PIPING SYSTEM

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Furnish and test the following systems:
  - 1. Oxygen (O<sub>2</sub>).
  - 2. Vacuum (V).
  - 3. Nitrous oxide (N<sub>2</sub>O).
  - 4. Medical/clinical compressed air (A).
  - 5. Nitrogen (N<sub>2</sub>).
  - 6. Carbon Dioxide (CO).
- B. Outlets, valve boxes, valves, alarm systems, pressure and vacuum switches, and miscellaneous accessories for complete systems.
- C. Reserve oxygen manifold system.
- D. Emergency oxygen supply connection.
- E. Nitrous oxide manifold system.
- F. Nitrogen manifold system.
- G. Carbon dioxide manifold system.
- H. Pressure testing, cross connection testing and final testing, including purging and analyzing.
- I. Electrical power wiring for ceiling columns/hose drops, alarms, vacuum pumps, medical air compressor, and other electrical accessories associated with the system shall be furnished and installed under Division 26.
- J. Medical gas contractor shall furnish and install all low voltage control raceways and wiring associated with alarms and controls.
- K. Anesthesia evacuation connectors.

##### 1.02 CODE COMPLIANCE/QUALITY ASSURANCE

- A. Install in compliance with the recommendations of the National Fire Protection Association (NFPA) as set forth in locally enforced editions of NFPA 99, Latest Edition, and NFPA 50.
- B. Comply with all local, state or federal codes applicable in this jurisdiction.
- C. Employ only qualified journeymen for this work. Employ a competent qualified mechanic/piping foreman, who has satisfactorily completed at least five other similar hospital installations, for this work. Provide brazers performance qualification test records for each brazer used on installation.

### 1.03 COORDINATION

- A. Coordinate with other trades to assure timely installations and to avoid conflicts and interference.
- B. Work closely with the metal stud partition installer and/or mason to assure that anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.
- C. Coordinate layout of medical gas systems in all spaces and identify all piping accurately.

## PART 2 PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Piping System Components:
  - 1. Allied Health Products, Chemtron Division.
  - 2. AMICO Corporation with Chemtron, Medaes compatible outlets.
  - 3. Puritan Bennett with Chemtron, Medaes compatible outlets.
  - 4. Beacon Medical Systems to match existing hospital outlets.
  - 5. Medical gas outlets shall match or be compatible with existing outlets, no exception.

### 2.02 QUALIFICATION OF MANUFACTURER

- A. Pipeline System Components:
  - 1. One manufacturer shall supply the medical gas piping system(s) equipment to include outlets, valves and gauges, valve boxes, alarm boxes, nitrous oxide manifold system, nitrogen manifold system, reserve oxygen manifold system, and nitrogen control cabinet.
  - 2. This manufacturer shall have a pipeline system engineer or product specialist available to periodically check with the contractor during installation of pipeline system equipment and provide a service organization to certify the system. The contractor may use a third party certification agency at his discretion.
  - 3. Provide ongoing service support to the hospital after turnover to the Owner.

### 2.03 PIPING MATERIALS AND HANGERS

- A. Piping: All piping including vacuum shall be seamless Type K or L (ASTM B819) copper tubing, pre-cleaned for oxygen use, in accordance with NFPA 9. Piping shall be pre-cleaned, marked and plugged by supplier before shipment to job site. Any system operating above 200 psi shall have Type K tubing.
- B. Fittings: Wrought copper, brass or bronze designed expressly for brazed connection. All fittings shall comply with ANSI B16.22. Cast fittings shall not be used. T-drill branch tee connections shall not be allowed for medical gas piping.
- C. Brazing alloy: Melting point of at least 1000 degrees F.
- D. Flux: Do not use for copper-to-copper joints. Use flux for joining copper to brass or bronze. In those cases where flux is used, exercise particular care in applying the flux to avoid leaving any excess inside the completed joints.
- E. Pipe hangers shall be copper coated adjustable swivel ring, typical of B-Line B3170CT. Strut systems may be incorporated with rubber isolators, typical of B-Line Vibra Cushion or Vibra Clamp pipe clamps. The taping of pipes for isolation shall not be permitted. Medical gas piping within metal stud walls shall be supported with plastic isolators such as Pipe-Tytes System or equivalent.

## 2.04 HIGH PRESSURE CYLINDER MANIFOLDS

- A. Provide automatic manifold control including self-shifting to reserve bank on exhaustion of the primary service bank and automatic reset of replaced bank to reserve status. Incorporate pressure switches for the purpose of actuating designated signals when the primary service bank is exhausted. Incorporate in control unit a visible means of determining when either bank is exhausted and operation has automatically switched to "reserve in use". Visible indication shall be by red light over exhausted bank and by gauges showing remainder pressure in each bank. Continuous visible indication of electrical circuits in effective operation shall be by means of green light. Line pressure shall be shown by separate visible gauge. Manifolds shall be installed as shown on drawings.
- B. Nitrous oxide (N2O) manifold: to accommodate 2 cylinders divided into 2 equal banks.
- C. Nitrogen (N2) manifold: to accommodate 2 cylinders divided into 2 equal banks.
- D. Install heater bars on both the primary and reserve bank headers for all gas manifolds.

## 2.05 MEDICAL GAS OUTLET STATIONS

- A. Quick-Connect Recessed Wall Outlets:
  - 1. Medical Gas Outlet Stations shall be modular, Quick-Disconnect recessed type. Modular outlet stations shall be field-assembled with sequences and services indicated on the plans. Centerline spacing of multiple outlets shall be 5 inches minimum.
  - 2. Outlet stations for medical gases shall have a stainless steel faceplate mounted on a chrome-plated, zinc die-cast cover plate. The cover plate assembly shall contain the quick-connect latch release mechanism, indexing pins for safety keying the gas-specific cover plate to the appropriate rough-in box, and color-coded gas service identification. The safety-keying index pins shall be permanently captured between the cover plate and latch assembly. Designs with index pins molded in plastic will not be accepted.
  - 3. The latch mechanisms shall be designed for one-handed, single thrust mounting and one-handed fingertip release of secondary equipment. The outlet stations shall be capable of supporting common secondary equipment, including suction regulator and half-gallon collection bottle, without the use of slide brackets.
  - 4. The cover plate shall attach to the primary valve assembly. The primary valve shall be threaded into the rough-in box separately from the cover plate to facilitate leak-testing around the valve. Designs which prevent this test will not be acceptable. The primary valve body shall be made of brass and shall be adjustable to compensate for variation in plaster thickness. Provide an O-ring within the valve to seal mating adapter plugs. Future replacement of the O-ring shall not require disassembly of the cover plate. The primary valve poppet shall be self-sealing in service, requiring no dust cap or cover.
  - 5. Each rough-in box shall contain a base and tube assembly consisting of a Type K copper pigtail, flared to accept 1/4" ID, 3/8" O.D. supply line, brass block and base housing a secondary check valve per NFPA 99 (not required in vacuum), primary valve O-ring seal, check valve deflator spring (except vacuum), pressure testing cap plug, and plaster shield. The copper inlet tube shall be capable of rotating 360 degrees to adjust for field piping conditions.
  - 6. Medical gas outlets shall be cleaned for oxygen service in accordance with CGA Pamphlet G-4.1. The assembly shall be capped and internal parts poly-bagged for shipment. The outlet assembly shall bear the label of listing under Re-examination Service of Underwriters' Laboratory.
  - 7. Quantity and gas type shall be provided as indicated on plans.
- B. Nitrogen (N2) Control Panel:

1. Nitrogen Control Panel shall be designed to deliver variable pressures to power pneumatic surgical tools. The unit shall have inlet supply gauge, 0-300 psig. (0 kPa to 2067 kPa), to indicate the supply line pressure.
2. Located immediately upstream of this gauge shall be a supply line shut-off valve, rated at not less than 250 psig, (1722.5 kPa) pressure. A quarter turn of the valve handle shall be required to obtain a fully "open" or "closed" position.
3. An adjustable relieving type pressure regulator, with an operating range of 0-250 psig. (0 kPa to 1722.5 kPa) shall provide required pressure to the nitrogen service outlet.
4. There shall be an outlet supply gauge, 0-300 psig. (0 kPa to 2067 kPa), to give indication of the outlet pressure being supplied to the outlet(s). The nitrogen control panel shall be pre-piped internally requiring only external supply line connection(s). Additional outlets in the same room may be connected to the remote outlet pigtail furnished in the control panel. Remote outlets shall be regulated by the adjustable pressure regulator within the panel and shall match the Nitrogen Control Panel outlet.
5. The control panel shall have a D.I.S.S. service outlet.

## 2.06 MEDICAL GAS CEILING OUTLET STATIONS

### A. D.I.S.S. Recessed Ceiling Outlets:

1. Medical Gas Outlet Stations located in ceilings shall be D.I.S.S. type. Modular outlet stations shall be field-assembled with sequences and services indicated on the plans. Centerline spacing of multiple outlets shall be 5 inches minimum.
2. Outlet stations for medical gases shall have a stainless steel faceplate mounted on a chrome-plated, zinc die-cast cover plate. The cover plate assembly shall contain indexing pins for safety keying the gas-specific cover plate to the appropriate rough-in box. The safety keying index pins shall be permanently captured between the cover plate and index pin retainer. Designs with index pins molded in plastic will not be acceptable. Provide a color-coded, molded plastic gas service identification label on each cover plate.
3. The outlet stations shall be capable of supporting common secondary equipment, including suction regulator and half-gallon collection bottle, without the use of slide brackets.
4. The cover plate shall attach to the primary valve assembly and rough-in box. The primary D.I.S.S. valve shall be independently safety-keyed to prevent cross-connection. In addition, the D.I.S.S. valve shall thread into the rough-in box separately from the cover plate to facilitate leak-testing around the valve. Designs which prevent this test will not be acceptable. The primary valve shall be made of brass, chrome plated and shall contain a poppet that is self-sealing in service, requiring no dust cap or cover. The primary valve shall be adjustable to compensate for variations in plaster thickness.
5. Quantity and gas type shall be provided as indicated on plans.
6. Each rough-in box shall contain a base and tube assembly consisting of a Type K copper pigtail, flared to accept a 1/4" ID, 3/8" O.D. supply line, brass block and base housing a secondary check valve per NFPA 99 (not required in vacuum), primary valve O-ring seal, check valve deflator spring (except vacuum), pressure testing cap plug, and plaster shield. The copper inlet tube shall be capable of rotating 360 degrees to adjust for field piping conditions.
7. Medical gas outlets shall be cleaned for oxygen service in accordance CGA Pamphlet G-4.1. The assembly shall be capped and internal parts poly-bagged for shipment. The outlet assembly shall bear the label of listing under Re-examination Service of Underwriters' Laboratory.

### B. Hose Drop Assemblies:

1. Hose assemblies shall utilize gas specific color coded hose that meet or exceed conductivity requirements as specified in NFPA 99. Hose assemblies shall consist of a D.I.S.S. female fitting for attaching to the ceiling outlet, a hose retractor and quick-connect coupler (D.I.S.S. for N2) with

- inherent primary and secondary check valves, for attaching to hoses connected to patient care equipment.
2. Hose assemblies are to be supplied for a finished ceiling height as shown on drawings. Quantities and gas services as indicated on drawings.
- C. Anesthesia Evacuation Connectors: Provide exhaust grille connector and flexible tubing to provide for anesthesia evacuation from anesthesia machine to anesthesia evacuation grille. Part Nos. as follows:
1. Exhaust grille connection, 19mm, Chemtron Part #83-16-0005.
  2. Corrugated tubing, 19 mm, 96" long.

## 2.07 MEDICAL GAS VALVING

- A. Main and Base of Riser Valves (Valves Not in Boxes):
1. All valves and tubing shall be specially prepared for oxygen service and shall conform in all particulars to NFPA 99. All valves shall be a lockable ball-type, with teflon seats and adjustable stem packing gland with teflon stem seal, through 2-inch sizes. 2-1/2" to 3" valves have teflon seats and double teflon stem seal. 4-inch valves shall have Buna-N ball seats.
  2. All ball valves rated at 400 psig, actuate from full "ON" to full "OFF" by 90 degrees turn of vinyl gripped valve handle. Factory installed copper tubing shall be extended sufficiently to help prevent valve seat damage during soldering.
  3. Unless specifically noted or obviously required, main and riser valves located in other than public areas are not required to be installed in box.
  4. Lock valves in the open position, and turn keys over to hospital maintenance upon completion of the project.
- B. Area/Zone Valves (Valves in Boxes):
1. Zone valve boxes shall be constructed of extruded aluminum or 18 gauge sheet steel with air dried lacquer finish. The cover frame shall be made of an anodized aluminum and attached to the box by concealed screws. The finished assembly shall be substantially dust-tight. The frame assembly shall be capable of adjusting for variances in wall thickness up to one inch. The frame assembly shall contain an easily removable cover window with pull ring. The window shall conceal exposed piping and valves within the box and shall be labeled "Caution - Medical Gas Shut-Off Valves - Close Only in Emergency". Clean viewing space shall be provided in the window to display the gas service, the area controlled by the valve, and pressure gauges on units so equipped.
  2. Frames for all valve boxes shall have uniform width for balanced appearance. Manufacturer shall provide color-coded self-adhesive gas service labels for compliance with NFPA 99 labeling requirements. Apply labels to each valve within the assembly for proper gas service identification according to the manufacturer's instructions.
  3. Placement of the valve within the zone valve box shall be such that the removable window cannot be replaced when any valve is closed. Factory installed Type K copper pipe extensions shall extend three (3) inches outside the valve box. Design of the valve box shall be such that valves may be removed prior to brazing, without disassembly of the box, to permit field rearrangement of valves if necessary. Valves shall be ball type, cleaned for oxygen service, supplied with capped ends, and shall operate full open to closed position with 90 degree handle rotation. Provide chrome finish on valves and piping within valve boxes.
  4. Gauge model zone valve assemblies shall include 1-1/2" pressure gauges reading 0-100 psig for oxygen, nitrous oxide and air; 0-300 psi for nitrogen, and 0-30" Hg for vacuum or evacuation vacuum. The gauge port shall be equipped with removable plug for pressure testing prior to final assembly of gauge.
  5. All gauge model zone valve box assemblies shall read pressure downstream and vacuum upstream of the valve per NFPA 99. Valves shall be piped left to right.

## 2.08 MEDICAL GAS ALARM SYSTEMS

- A. Line pressure alarms shall be of modular construction where additional modules may be field expanded. The alarm assembly shall be U.L. listed requiring 115-volt supply. Internal voltage shall be stepped down to 24 or 12 volts for control circuit power. Each service (gas or vacuum) shall be provided with an audible alarm and visual red light flasher for abnormal pressure conditions. Audible alarm may be silenced by push-button, but visual alarm will continue to flash until abnormal condition is corrected. A green light for each service shall indicate normal pressure conditions. A pressure gauge or solid state readout shall display the pressure of each service.
1. The alarm assembly shall be recessed within standard 3-5/8" stud walls. Type "K" copper pipe (1/4" I.D.) shall be provided for connection to each service.
- B. Master alarm panel shall be of modular construction where additional modules may be field expanded. The alarm assembly shall be U.L. listed requiring 115-volt supply. Internal voltage supply shall be stepped down to 24 or 12 volts for control circuit power. Each service (gas or vacuum) shall be provided with an audible alarm and a visual red light flasher for abnormal pressure conditions. Audible alarm may be canceled but visual alarm will continue until abnormal condition is corrected. Alarm signals shall be received from master pressure switches located at the supply source downstream of the main line shutoff valves.
1. A minimum of two master alarm panels shall be installed. Reference the drawings for locations. Panels shall be wired in parallel to the pressure switches, not in series. Control wiring between switches and alarm panels shall be in 3/4" minimum EMT conduit. Wiring shall be 22-gauge shielded, twisted pair cable equal to Belden #8451 or West Penn #452 or per manufacturer requirements.
  2. Master alarm panel shall be recessed within standard 3-5/8" stud wall.
  3. The Multi-Signal Alarm Panel functions to be as follows:

FUNCTION	
O <sub>2</sub>	Changeover to reserve
O <sub>2</sub>	Liquid level low
O <sub>2</sub>	Reserve in use
O <sub>2</sub>	Reserve low
O <sub>2</sub>	Line pressure high
O <sub>2</sub>	Line pressure low
N <sub>2</sub> O	Reserve in use
N <sub>2</sub> O	Line pressure high
N <sub>2</sub> O	Line pressure low
N <sub>2</sub>	Reserve in use
N <sub>2</sub>	Line pressure high
N <sub>2</sub>	Line pressure low
Air	Line pressure high
Air	Line pressure low
Vacuum	Line pressure low
Vacuum	Reserve pump in use
Air	Reserve compressor in use
Air	High water (liquid ring)
Air	High air temperature (oil-free or oil-less compressors)
Air	High carbon monoxide levels

- C. Provide pressure and vacuum switches, as companion to each Master alarm of the Hi-Lo single-pole double-throw approved snap-acting type enclosed in a NEMA 4 watertight housing. Switches to be factory set to activate alarms as follows:

1. O2--40 psi-low and 60 psi-high
2. N2O--40 psi-low and 60 psi-high
3. N2--140 psi-low and 160 psi-high (two switches required)
4. Air--40 psi-low and 60 psi-high
5. Vacuum--12" Hg-low

- D. Provide monitoring gauges in accordance with NFPA 99 for nonflammable medical gases using lettered identification labels and color coding.

### PART 3 EXECUTION

#### 3.01 IDENTIFICATION

- A. All medical gas piping to be stenciled with name of gas, direction of flow, operating pressure, and pipe size. Stenciling to be spaced not more than 20 feet intervals and at least once in each room and each story traversed by the piping system.

#### 3.02 INSTALLATION

- A. Copper pipe, tubing, valves, and fittings shall be pre-cleaned and prepared for medical gas service in accordance with NFPA 99, except those supplied especially prepared for such service by the manufacturer and received sealed on the job.
- B. Joints in all the piping including vacuum piping, except those at equipment requiring screwed connections, shall be made with silver brazing alloy or similar high melting point (at least 1000 degrees F) brazing metal. Silver brazing material for pipes and fittings in the medical gas system shall be Stay-Silv-15 or equal to the following: Silvaloy-15, Aircosil No. 15, or Phos-Silver-15. The silver brazing alloy shall contain a minimum of 15% silver, 80% copper, and 5% phosphorus and shall not contain cadmium alloy. The silver brazing alloy shall have a minimum of 1000 degrees F. liquidus melting point and shall have an ASTM rating of "BCuP5". The use of flux is prohibited from the making of joints between copper to copper pipes and fittings. Appropriate flux similar to "Stay-Silv-Black Flux" or "Stay-Silv-White Flux" is required between dissimilar metals such as copper to brass or bronze material, when parts are heated over a prolonged period. DURING THE BRAZING OF PIPE CONNECTIONS, THE INTERIOR OF THE PIPE SHALL BE PURGED CONTINUOUSLY WITH NITROGEN. The outside of the tube and fittings shall be cleaned by washing with hot water after assembly.
- C. Threaded joints in piping systems shall be tinned or made up with polytetrafluorethylene (such as teflon) tape or other thread sealants suitable for oxygen service. Sealants shall be applied to the male threads only.
- D. All piping shall be supported with pipe hangers or strut systems at intervals per NFPA 99, and NOT supported by other piping. Isolation of all copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as isolation material. Hanger Spacing Shall be as Follows:

Pipe Size	Hanger Spacing
1/2 inch	6 feet
3/4 inch	7 feet
1 inch	8 feet
1-1/4 inch	9 feet
1-1/2 inch and larger	10 feet

- E. Install screw joints used in shutoff valves, including station outlet valves, by tinning the male thread with soft solder. Litharge and glycerin or an approved oxygen luting or sealing compound are acceptable.

- F. Use prepared flux manufactured by Handy and Harman which consists of dry boric and water boric for hard solder joints. Alcohol mixture is prohibited. Resin or petroleum base of similar paste flux may contain compounds objectionable for oxygen service and shall not be employed.
- G. All pipe, pipe fittings, and valves not furnished pre-washed and degreased shall be cleaned and degreased by washing in a hot solution of sodium carbonate or tri-sodium phosphate (Oakite #24) and then thoroughly rinsed with water. Oakite #24 solution of six to eight ounces of Oakite per gallon of water is prepared by mixing one-third the total quantity of water with the total amount of Oakite #24 required. When this has been dissolved, the remaining water shall be added. The pipe and fitting shall be immersed for five to fifteen minutes or until all deposits are removed. Scrubbing shall be employed where necessary to ensure complete cleaning. After washing, the material shall be rinsed thoroughly in clean, hot water. After cleaning particular care shall be exercised in the storage and handling of all pipe and fittings. Pipe and fittings shall be temporarily capped or plugged to prevent re-contamination before final assembly. Tools used in cutting or reaming shall be kept free from oil or grease. Where such contamination has occurred, the items affected shall be re-washed and rinsed. Pipe may be washed on the job site with written permission of the Owner only.
- H. After installation of the piping, but before installation of the outlet valves, blow lines clear by means of oil-free, dry air or nitrogen.
- I. Identification tape shall be buried approximately 18 inches above the piping, and immediately on top of the conduit.
- J. Piping exposed to physical damage shall be adequately protected.

### 3.03 ANESTHESIA EVACUATION CONNECTORS

- A. Connect anesthesia evacuation grille connector and corrugated evacuation hose to anesthesia exhaust grille's in each surgery and or delivery room. See mechanical and plumbing drawings for details.

### 3.04 PRESSURE TESTING

- A. After installation of the piping and valves, but before installation of the service outlets, alarm actuating switches and gauges, the line shall be blown clear by means of oil-free, dry air or nitrogen.
- B. Next, each section of the piping system shall be subjected to a test pressure of one and one-half (1-1/2) times the maximum working pressure, but not less than 150 psig, with oil-free, dry nitrogen. This test pressure shall be maintained for at least 24 hours. Then each joint shall be examined for leakage by means of soapy water or other effective means of leak detection safe for use with oxygen.
- C. All leaks shall be repaired and the section retested.
- D. After completing the testing of each individual piping system, all of the medical gas systems shall be subjected to a pressure test at one and one-half (1-1/2) times the maximum working pressure, but not less than 150 psig. The test gas shall be oil-free, dry nitrogen. The main line shut-off valve shall be closed during the test.
- E. After completion of the above test procedure the finishing assemblies of station outlets, alarms, and all components (e.g. pressure switches, gauges, relief valves, etc.) shall be installed and all medical gas piping systems shall be subjected to a 24 hour standing pressure test at 20% above the normal operating line pressure with oil-free, dry nitrogen. The main line shut-off valve shall be closed during this test.
- F. Leaks, if any, shall be located, repaired, and the system retested.

- G. To determine that no cross connection to other pipeline systems exists, reduce all systems to atmospheric pressure. Disconnect all sources to test gas from all of the systems with the exception of the one system to be checked. Pressure this system with oil-free, dry air or nitrogen to a pressure of 50 psig. With appropriate adapters matching outlet labels, check each individual station outlet of all systems installed to determine that test gas is being dispensed from only the outlets of this system.
- H. When all medical gas piping systems have been tested, the source of test gas shall be disconnected and the proper gas source of supply connected to each respective system. Following this connection and pressurization, all outlets shall be opened in a progressive order, starting nearest the source and completing the process of purge flushing at the outlet farthest from the source. Gas shall be permitted to flow from each outlet until each system is purged of test gas used during previous tests. After completion of purge flushing of the pipeline system, the outflow from each designated and labeled oxygen outlet station, anesthesia machine, and other oxygen dispensing equipment shall be tested (using an oxygen analyzer) to confirm the presence of the desired purity of oxygen.

### 3.05 CROSS CONNECTION TESTING AND CERTIFICATION

- A. General Requirements:
  - 1. This section is to outline the responsibilities and procedures to be followed in final certification of the medical gas pipelines and outlets.
  - 2. When new piping is "cut-in" to previously installed piping, it is possible that previously installed piping could be disturbed so as to cause cross connections. It is imperative that previously installed systems be inspected for crossed piping in conjunction with new system medical gas pipeline inspection and certification to the point of source.
  - 3. The certification procedure shall comply with all requirements of NFPA 99, Latest Edition and as stated herein.
  - 4. Pipeline certification shall be performed by an independent subcontractor (certification agent) not associated with the medical gas equipment supplier.
- B. Certification Procedure:
  - 1. The Contractor shall furnish a verified list designating number and location of all medical gas outlets to the Certification Agent. The Contractor shall review and check this list with the medical gas system personnel performing the medical gas pipeline inspection.
  - 2. The Contractor is to perform mechanical check of all medical gas outlets prior to the certification inspection. Any necessary repairs or rework to be done prior to system suppliers inspection. Check to include:
    - a. Outlets properly supported.
    - b. Installation complete.
    - c. Appropriate adapters fit and securely lock in place.
  - 3. The Owner is responsible for ensuring that bulk tank and/or cylinder supplies are installed, connected, and filled (or partially filled) prior to system suppliers inspection.
  - 4. All medical gas outlets shall be tested by the Certification Agent, excluding none.
  - 5. Certification Agent shall provide factory trained, qualified representatives to perform pipeline inspection and to provide report and certification in accordance with NFPA 99, Latest Edition.
    - a. Any discrepancies discovered during the inspection shall be noted, corrected, and any and all portions of the system affected by corrective action shall be retested and findings recorded after retest.

6. Contractor to provide representative who shall serve as customer contact person and who shall witness the inspection and certify that all outlets on the list furnished by the Contractor have been checked and is in accord with inspection procedure and findings as witnessed.
7. Hospital Engineering Department shall provide a representative who shall witness the inspection and certify that all spaces and the outlets therein listed on the list furnished by the Contractor have been checked in accordance with inspection procedure.
8. Certification Agent shall perform a cross connection test on all medical gas outlets using oil-free nitrogen as described in NFPA 99, Latest Edition. Each pipe system shall be reduced to atmospheric pressure. Certification Agent shall then pressurize and test each piping system, one system at a time.
9. Contractor shall connect all designated gas systems and purge the systems, completely. Certification Agent shall then analyze each medical gas outlet for proper oxygen content.
10. The Certification Agent to furnish copies of Medical Gas Pipeline Inspection Report and Medical Gas Pipeline Certification to General Contractor to be distributed as follows:
  - a. Plumbing Contractor
  - b. Owner's Construction Manager
  - c. Consulting Engineer
  - d. Hospital
11. The following procedure should be followed in addition to the above on extensions to existing systems:
  - a. Owner's Representative shall, with adequate advance notice, request that system supplier's inspector or inspection team be on-site when old piping is cut-in for installation of new lines.
  - b. Owner's Representative and system supplier's representative shall arrange to have inspector or inspection team on-site when the existing piping is cut into for installation of new lines.
  - c. Main line shut-off vales shall be installed in new piping as close as possible to the point of cut-in to existing piping.
  - d. NOTE: Following verification of proper labeling or proper gas distribution of previously installed piping after cut-in procedure, the aforementioned valves (Item 3) shall be considered the "source" of supply for the new piping.

GAS ANALYSIS		
Gas	Concentration (%)	Pressure (psig)
Oxygen	99-100	50 +/- 5
N <sub>2</sub> O	99+	50 +/- 5
N <sub>2</sub>	99+	Normal regulated pressure +/-5 (usually set from 160 to 200)
Vacuum	–	Negative
Air	19.5 - 23.5 O <sub>2</sub> content	50 +/- 5

END OF SECTION

## SECTION 226119

### MEDICAL COMPRESSED-AIR EQUIPMENT

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Furnish and test the Medical/clinical compressed air (A).
- B. Pressure and vacuum switches, air compressor, and miscellaneous accessories for complete systems.
- C. Pressure testing, cross connection testing and final testing, including purging and analyzing.
- D. Electrical power wiring for medical air compressor, and other electrical accessories associated with the system shall be furnished and installed under Division 26.
- E. Medical gas contractor shall furnish and install all low voltage control raceways and wiring associated with alarms and controls.

##### 1.02 CODE COMPLIANCE/QUALITY ASSURANCE

- A. Install in compliance with the recommendations of the National Fire Protection Association (NFPA) as set forth in locally enforced editions of NFPA 99, Latest Edition, and NFPA 50.
- B. Comply with all local, state or federal codes applicable in this jurisdiction.
- C. Employ only qualified journeymen for this work. Employ a competent qualified mechanic/piping foreman, who has satisfactorily completed at least five other similar hospital installations, for this work. Provide brazers performance qualification test records for each brazer used on installation.

##### 1.03 COORDINATION

- A. Coordinate with other trades to assure timely installations and to avoid conflicts and interference.
- B. Work closely with the metal stud partition installer and/or mason to assure that anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.
- C. Coordinate layout of medical gas systems in all spaces and identify all piping accurately.

#### PART 2 PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Medical Air Compressors Systems:
  - 1. Allied Health Products, Chemtron Division
  - 2. Beacon Medaes
  - 3. Powerex
  - 4. Amico Products

##### 2.02 QUALIFICATION OF MANUFACTURER

- A. Medical Air Compressor:
  - 1. Manufacturer/supplier shall have had at least fifteen (15) years experience in the manufacture of scroll medical (clinical) air compressors.
  - 2. Provide a service organization with staffing during working days, and repair parts, within 200 miles of the facility.
  - 3. The supplier shall supply drawings for installation operating and maintenance instructions manuals, and parts lists. The supplier shall provide both warranty and after warranty service for the total package. The service representative shall not be third party and shall be factory trained.

## 2.03 MEDICAL AIR COMPRESSOR SYSTEM

- A. The medical air compressor system shall be a duplex system mounted, wired and piped as a factory assembled and tested unit on a fabricated structural steel skid. The system shall have one point connections for electrical power, compressed air outlet and intake.
- B. Model number, SCFM capacity, horsepower and electrical characteristics shall be as scheduled on the drawings.
- C. The package shall be piped and wired such that either compressor, dryer, or filter bank can be isolated for service while permitting the other to operate normally.
- D. The control cabinet shall be a U.L. listed, dust-proof NEMA 12 enclosure. The cabinet shall contain the following:
  - 1. Fusible disconnects for each pump.
  - 2. Magnetic motor starters with thermal overload protection for each pump.
  - 3. Redundant control circuit transformers with fused primary and secondary.
  - 4. Hand-Off-Automatic selector switch for each pump.
  - 5. Automatic alternation between pumps.
  - 6. Minimum run timers.
  - 7. Pressure gauges.
  - 8. Pressure control switches.
- E. The control panel shall provide local alarms for the following conditions:
  - 1. Reserve compressor operation.
  - 2. Thermal overload protection.
- F. The control panel shall provide both local and remote (master alarm panel) alarms for the following conditions:
  - 1. High discharge air temperature.
  - 2. High dewpoint levels.
  - 3. High carbon monoxide levels.
  - 4. Reserve compressor in use.
- G. Furnish and install all required accessories for installing the system such as vibration dampeners, isolation pads or springs, flexible connectors on incoming and discharge piping, isolation and check valves, etc.
- H. Manifold piping shall be copper pipe per NFPA 99.
- I. Medical air compressor shall be an air-cooled single-stage **OIL-LESS**, reciprocating compressor. Piston rings and guides shall be self-lubricating with no oil present in the crankcase. The motor shall be a drip-proof, continuous duty, 40 degree C, NEMA Design B. Intake and discharge valves shall be stainless steel.
- J. All motor drives, whether direct coupled or belt-driven, shall be enclosed with a metal guard.
- K. The compressed air system shall have an 18-month warranty from start-up or 24 months from date of shipment, whichever comes first.
- L. The system intake piping shall contain dual in-line filters rated for 3 micron particles.
- M. Dryers and After-coolers:
  - 1. Duplex desiccant dryers shall be provided with the system. Each dryer shall be sized for the design capacity of the system. Automatic drains and water traps shall be provided on each dryer. Each dryer shall remove water moisture from the compressed air to a 35 degree F dewpoint. Provide safety disconnects for each dryer.
  - 2. After-coolers, where required, shall be duplexed and sized for the design capacity of the system. After-coolers shall be air-cooled.
- N. Duplex final filters shall remove liquids, particulate matter, and hydrocarbon odors. Each bank of filters shall have a pre-filter, aerosolizer oil filter, charcoal and final filters. Final filters shall be rated for a minimum of 98 percent efficiency at 1 micron. Differential pressure switches shall indicate when filters need replacing. Each filter shall be sized for the system design capacity.
- O. Supply line from the system shall contain duplex pressure regulators set for a maximum of 55 PSI.

- P. All duplexed accessories provided with the system shall have isolation valves. The valving shall permit the removal of one accessory while not shutting down the entire system.
- Q. Air receiver shall be ASME constructed with galvanized steel. The receiver shall contain a pressure relief valve, automatic drain and water trap, isolation valves and pressure gauge.
- R. Air Purity:
1. The medical compressed air package shall deliver, as a minimum, Grade D air as defined in Compressed Gas Association pamphlet G07.1 "Commodity Specification for Air" when installed and maintained in accordance with the manufacturer's recommendations. Ambient air temperature shall be 60 degrees F minimum, 100 degrees F. maximum. Cooling water shall be 40 degrees F minimum, 95 degrees F. maximum.
  2. Provide a Deltech Pyramid 8000 air purifier, or approved equal. The unit to be complete with refrigerated air dryer, coalescing-separator filter, absorption filter, particulate filter and catalyst to convert carbon monoxide into carbon dioxide. The unit to have a control panel capable of continuous electronic monitoring, digital display and indicating lights.
- S. Safety Monitors:
1. The medical compressed air system shall contain a dewpoint monitor. The dewpoint monitor shall alarm locally and remote at the master alarm panels. Alarm shall occur at 39 degree F dewpoint.
  2. The medical compressed air system shall contain a carbon monoxide monitor. The CO monitor shall alarm locally and remote at the master alarm panel.

PART 3 EXECUTION – NOT APPLICABLE

END OF SECTION



## SECTION 226719.19

### DEIONIZED WATER PIPING

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

###### A. General:

1. Furnish all labor, materials, tools, equipment, and services for distilled and deionized water piping system, as indicated, in accordance with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Section 230500 for special mechanical requirements.
5. See Division 01 for General Requirements.

##### 1.02 QUALITY ASSURANCE

- ###### A. Standard for Sterilization: AWWA C601.

##### 1.03 SUBMITTALS

- ###### A. Submit product for owner approval for water purification equipment. Submittal data not required for piping, fittings, support, etc.
- ###### B. Submit test reports to Owner at completion of job.
1. Pressure tests.
  2. Sterilization tests.

#### PART 2 PRODUCTS

##### 2.01 GENERAL

- ###### A. Acceptable Manufacturers: As indicated for individual items.

##### 2.02 VALVES

- ###### A. All valves: Rated for 125 PSIG working pressure, non-shock.
1. Acceptable manufacturer: Enfield.
  2. Use valves of same material as piping system in which they are installed.
- ###### B. Shut-off valves: Ball type, socket or threaded ends, and teflon seating.
- ###### C. Check valves: Ball type for either vertical or horizontal mounting, with threaded or socket ends.
- ###### D. Provide reduced pressure backflow preventer in piping serving equipment producing distilled or deionized water.

##### 2.03 PIPE AND FITTINGS

- ###### A. Deionized water piping: Polypropylene pipe and fittings, with electrically welded or threaded joints.
- ###### B. Fire-Rated Pipe Enclosures: Provide noncombustible, inorganic fireproofing jacketed wrap for fire-rated pipe enclosures equivalent to Thermal Ceramics Fire Firemaster, CertainTeed Flamecheck, Johns Manville Firetemp, or Nelso FlameShield. The system shall be designed for 2300 degrees F. continuous service and meet the following testing standards: ASTM E-84 and E-119; U.L. 263, 1479, and 1709; and U.L. Classification for fire-rated plastic pipe enclosures. A total 2-hour fire-rated assembly shall be created.
- ###### C. Install fireproof pipe enclosure in accordance with U.L. classification and manufacturer's published U.L. installation instructions.

## 2.04 CENTRAL PROCESSING DEIONIZER SYSTEM

- A. Approved Manufacturers: Culligan; Millipore; Millipore; Permutit. Specification based on Culligan Exchange Service mixed bed, 3-tank system.
- B. Description: Designed to provide 18 megohm water; less than 0.5 ppm as calcium carbonate.
  - 1. Peak flow rate of 5.0 gpm with pressure drop of 10 psi.
  - 2. Tanks constructed of steel; 100 psi working pressure; internal vinyl liner. All fittings plated for corrosion resistance. Tank diameter to be 9 IN.
  - 3. Heater assembly to accept 3 tanks in series.
  - 4. Water quality indicator light calibrated to indicate when tanks are exhausted and need to be exchanged.

## PART 3 EXECUTION

### 3.01 PIPING INSTALLATION

- A. Install piping and fittings as indicated in 22 1116 DOMESTIC WATER PIPING AND VALVES, 22 1316 SANITARY WASTE AND VENT PIPING, 22 1400 STORM DRAINAGE, 22 1516 GENERAL SERVICE COMPRESSED AIR PIPING AND VALVES, 23 2113 HYDRONIC PIPING, 23 2213 STEAM AND CONDENSATE HEATING PIPING].
- B. Install piping to provide every fixture and item of equipment requiring deionized water with suitable supply connection.
- C. Consult manufacturers' data and large scale details of rooms containing plumbing fixtures on architectural drawings before roughing in piping. Plug or cap piping immediately after installation.
- D. Connect equipment furnished by others in accordance with 230100 GENERAL PROVISIONS OF HVAC SYSTEMS and 220100 PLUMBING GENERAL PROVISIONS.
  - 1. For each water supply piping connection to equipment by others, furnish and install a union and a gate or angle valve. Provide a wheel handle stop valve at each sink water supply. Minimum line size 1/2 IN.
  - 2. Cap and protect until such time as installation is performed.

### 3.02 STERILIZATION OF SYSTEMS

- A. Sterilize system as indicated, or in accordance with AWWA C601.
- B. Thoroughly flush system.
- C. After flushing, introduce chlorine or chlorine compound into system with dosage sufficient to give an initial residual chlorine content of 50 ppm.
- D. Collect samples from various taps and fixtures throughout buildings during introduction of chlorine to assure uniform distribution. Open and close valves several times.
- E. After 24-hour contact period, flush all traces of heavily chlorinated water from systems.
- F. After flushing is complete, provide evidence of effectiveness of disinfection by filing with Designer, laboratory reports of bacteriological tests on samples taken from system.
  - 1. Number and locations of taking samples as specified by Designer.
- G. If satisfactory results are not obtained, repeat above disinfection process until satisfactory results are obtained.
- H. Do not put system into service until satisfactory tests are reviewed by Designer.

### 3.03 TESTING

- A. Do not insulate, conceal or furr in pipe until it has been tested to satisfaction of Designer.
- B. Upon completion of a section of system, test hydrostatically to pressure not less than 50 percent in excess of maximum pressure to which pipe will ordinarily be subjected, but in no case less than 100 PSI.
- C. If test shows defects, replace such defective work or material and repeat tests.
  - 1. Make repair to piping with new material.

2. No caulking of screwed joints or holes will be acceptable.

#### 3.04 RO SYSTEM

- A. Install in accordance with manufacturers recommendations.
- B. Connect storage tank with RO unit using plastic pipe material approved for use by RO unit manufacturer.

END OF SECTION