# SECTION 22 05 00 COMMON WORK RESULTS FOR PLUMBING

# PART 1 GENERAL

# 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Identification for Plumbing Piping and Equipment
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Concrete bases.
  - 10. Supports and anchorages.
  - 11. Formed steel channel

# 1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

# 1.3 SUBMITTALS

- A. Shop Drawings: Submit for piping and equipment identification list of wording, symbols, letter size, and color coding for pipe identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- B. Product Data for Pipe and Equipment Identification: Submit for mechanical identification manufacturers catalog literature for each product required.
- C. All data for Division 22 must be submitted as a single package as the Engineer will commence review only when all data has been received. Submit shop drawings and product data in a 3-ring binder sub-tabbed and grouped to include complete submittals of related system, products, and accessories. Electronic submittals are acceptable in accordance with Paragraph D below. Engineer will commence review only when all data has been received in the format required. Incomplete submittals will be returned to sender.
- D. Electronic submittals will be reviewed when allowed by the Prime Design Professional (Architect or Other Engineer.) Electronic submittals will be reviewed provided the following conditions are met.

- 1. Complete submittals in pdf format will be reviewed by CSI Specification Division
- 2. All data for Division 22 must be submitted as a single package as the Engineer will commence review only when all data has been received.
- 3. Submittals linked to a manufacturer's web site will not be reviewed
- 4. Re-submittals must highlight changes from previous submittals.
- 5. Mixed submittals (part paper and part electronic) will not be reviewed
- E. The Contractor shall determine and verify field measurements and field construction criteria for conformance with Drawings and Specifications and for conflicts with other items of Construction past or present. He shall coordinate each submittal with the requirements of the Work and of the Contract Documents and notify the Engineer in writing, at the time of the submission, of any and all deviations in the submittals from requirements of the Work and Contract Documents.

No fabrication or work which requires submittals shall begin until submittals are returned with the Engineer's approval.

- F. Engineer's review does not constitute acceptance or responsibility for accuracy or dimensions, nor shall it relieve the Contractor from meeting any requirements of the Work and Contract Documents, nor shall it constitute approval for any deviation from the Contract Documents unless such deviations are specifically stated as such on the submittal and specifically allowed by the Engineer by specific written notification for each such variation. The Engineer's review will not relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.
- G. Submit copies of materials for submittal review as required by Division 1.

#### 1.4 **PERMITS**

A. Permits necessary for the performance of the work under this contract shall be secured and paid for by the Contractor. Final inspection by the Engineer will not be made or certificate of final payment issued until certificates of satisfactory inspection from the inspection authorities are delivered.

#### 1.5 SUBSTITUTIONS

- A. Prior approval required. When required by Division 1 of the Specifications, materials and equipment in Division 22 will be reviewed for prior approval. Bidder is required to document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- B. Basis of Design. Equipment/materials indicated in schedules and details shown on the plans form the Basis of Design for this project. Alternate equipment/materials proposed by the contractor must match the specified in dimension, configuration, weight, electrical requirements, etc. Any revision to plans necessary to accommodate the alternate equipment will be the responsibility of the contractor and be reflected in a shop drawing prepared by the contractor and approved by the Engineer.

#### 1.6 TRAINING

A. The mechanical contractor shall conduct a 4-hour minimum training session with owner designated staff to review all plumbing equipment installed under this contract. At a minimum, the session will include operation and maintenance, programming, and basic operation of the systems. Contractor shall physically demonstrate the operation of each piece of equipment. A sign in sheet and agenda indicating a list of all equipment reviewed shall be included in the close out documents.

#### PART 2 PRODUCTS

#### 2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

#### 2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.

#### 2.3 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- A. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light background color.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light background color, minimum 1-1/2 inches diameter.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener. Color and Lettering: Conform to ASME A13.1.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Color and Lettering: Conform to ASME A13.1.
- E. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

#### 2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

#### 2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### 2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Retain subparagraph below if required.
  - 2. Underdeck Clamp: Clamping ring with set screws.
- E. Plastic sleeves in first three paragraphs below are prohibited in Return Air Plenums.
- F. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- G. PVC Pipe: ASTM D 1785, Schedule 40.
- H. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

# 2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chromeplated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated or rough brass.

#### 2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

#### 2.9 FORMED STEEL CHANNEL

A. Manufacturers:

- 1. Allied Tube & Conduit Corp.
- 2. B-Line Systems.
- 3. Unistrut Corp.
- 4. Substitutions: Permitted.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

#### PART 3 EXECUTION

#### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs. Provide annular clear space between sleeve and pipe, one inch larger than pipe and scheduled insulation thickness.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.

Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- S. Label all piping with fluid type and flow direction. Locate labels within each room. Locate labels so they are readable from an access panel.

#### 3.2 PIPING JOINT CONSTRUCTION

J.

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
  - Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
    - 1. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

- 2. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
- K. Plain-End Pipe and Fittings: Use butt fusion.
- L. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

#### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

#### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Label all plumbing equipment including water heaters, pumps, etc. with laminated engraved nameplates.

# 3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

## 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

#### 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

#### 3.8 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

#### 3.9 EXISTING SERVICES

- A. The Contractor shall carefully examine the drawings and specifications, visit the site of the work, fully inform himself as to all existing conditions, dimensions and limitations before starting work.
- B. If existing active or non-active services (which are not shown on plans) are encountered that require relocation or disconnection, the Contractor shall notify the Engineer for a decision on proper handling of these services. The Contractor shall not proceed with the work until so authorized.

# SECTION 22 07 00 PLUMBING INSULATION

# PART 1 GENERAL

# 1.1 SUMMARY

- A. Section Includes:
  - 1. Plumbing piping insulation, jackets and accessories.

#### 1.2 SUBMITTALS

- A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

# 1.3 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, or NFPA 255.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

# 1.6 WARRANTY

A. Furnish one year manufacturer warranty for man made fiber.

# PART 2 PRODUCTS

# 2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
  - 1. CertainTeed.
  - 2. Knauf.
  - 3. Johns Manville.
  - 4. Owens-Corning.
  - 5. Substitutions: Permitted.
- B. Manufacturers for Closed Cell Elastomeric Insulation Products:
  - 1. Aeroflex. Aerocell.
  - 2. Armacell, LLC. Armaflex.
  - 3. Nomaco. K-flex.
  - 4. Substitutions: Permitted.

- C. Manufacturers for Polyisocyanurate Foam Insulation Products:
  - 1. Dow Chemical Company.
  - 2. Substitutions: Permitted.
- D. Manufacturers for Extruded Polystyrene Insulation Products:
  - 1. Dow Chemical Company.
  - 2. Substitutions: Permitted.

# 2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
  - 1. Thermal Conductivity: 0.23 at 75 degrees F.
  - 2. Operating Temperature Range: 0 to 850 degrees F.
  - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
  - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.

# 2.3 PIPE INSULATION JACKETS

- A. Vapor Retarder Jacket:
  - 1. ASTM C921 white Kraft paper with glass fiber yarn, bonded to aluminized film.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.
- B. PVC Plastic Pipe Jacket:
  - 1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
  - 2. Thickness: 15mil.
  - 3. Connections: Brush on welding adhesive or pressure sensitive color matching vinyl tape.

# 2.4 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping Shields: Galvanized steel saddle. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- D. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum or stainless steel jacket single piece construction with self adhesive closure. Thickness to match pipe insulation.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- G. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- H. Adhesives: Compatible with insulation.

# PART 3 EXECUTION

# 3.1 EXAMINATION

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

# 3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
  - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
  - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factoryapplied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
  - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
  - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
  - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
  - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Hot Piping Systems equal to or less than 140 degrees F:
  - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
  - 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- F. Inserts and Shields:
  - 1. Piping 1-1/2 inches Diameter and Smaller: Install [galvanized] steel shield between pipe hanger and insulation.
  - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
    - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
    - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
  - 3. Piping Supported by Roller Type Pipe Hangers: Install [galvanized] steel shield between roller and inserts.
- G. Insulation Terminating Points:
  - 1. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- I. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with

glass mesh reinforced vapor retarder cement. Cover with aluminum or stainless steel jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

- J. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- K. Prepare pipe insulation for finish painting. Refer to Division 09.

# 3.3 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

Domestic Hot Water Supply	P-1	1-1/4 inches and smaller	1.0
and Recirculation <141Deg.		1-1/2 inches and larger	1.5
Domestic Cold Water <40deg.F.	P-1	3/4 inches and smaller 1 inches and larger	0.5 1.0

# SECTION 22 10 00 PLUMBING PIPING AND PUMPS

# PART 1 GENERAL

# 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe hangers and supports.
  - 2. Pipe and pipe fittings.
  - 3. Valves.
  - 4. Piping specialties.
  - 5. Plumbing drainage specialties.

#### 1.2 SUBMITTALS

- A. Product Data:
  - 1. Pipe Hangers and Supports: Submit manufacturers catalog data including load carrying capacity.
  - 2. Pipe and pipe fittings: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes.
  - 3. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
  - 4. Plumbing drainage specialties: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes, and finishes.
  - 5. Plumbing supply specialties: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes, and finishes.
  - 6. Pumps: Include capacities, pump curves, equipment performance, and electrical characteristics.
- B. Pipe Hangers and Supports: Design data, indicate pipe sizes, load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

# 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit spare parts lists and maintenance procedures.

# 1.4 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

#### 1.5 WARRANTY

A. Furnish one year manufacturer warranty for pumps.

# PART 2 PRODUCTS

# 2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
  - 1. Carpenter & Paterson Inc.
  - 2. DecoShield Systems Inc.
  - 3. Globe Pipe Hanger Products Inc.
  - 4. Substitutions: Permitted.
- B. Conform to ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69 or MSS SP 89.

- C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
- D. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- E. Hangers for Pipe Sizes 6 inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- G. Multiple or Trapeze Hangers for Pipe Sizes 6 inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
- H. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- I. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- J. Vertical Support: Steel riser clamp.
- K. Floor Support for Pipe up to 6 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- L. Floor Support for Pipe Sizes 6 inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- M. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

# 2.2 PIPES AND TUBES

- A. Below grade Sanitary Sewer/Vent Piping, Buried Within 5 Feet of Building. All piping and fittings shall be marked with manufacturer's name, listing agency and size.
  - 1. Cast Iron Pipe: ASTM A74, service weight, with neoprene gaskets or lead and oakum joints.
  - 2. PVC Pipe: ASTM D2665 with PVC fittings and solvent weld joints.
  - 3. PVC Pipe: ASTM D2665 or ASTM F679 with PVC fittings and elastomeric gasket joints.
- B. Above grade Sanitary Sewer/Vent Piping, Buried Within 5 Feet of Building. All piping and fittings shall be marked with manufacturer's name, listing agency and size.
  - 1. Cast Iron Pipe: ASTM A74, service weight, with neoprene gaskets or lead and oakum joints.
  - 2. Cast Iron Pipe: CISPI 301, hubless, service weight, with neoprene gaskets and stainless steel clamps.
  - 3. PVC Pipe: ASTM D2665 with PVC fittings and solvent weld joints. Exception: piping shall not be exposed in a return air plenum.
- C. Water Piping, Buried Within 5 Feet of Building:
  - 1. Copper Tubing: ASTM B42, annealed without fittings.
  - 2. Ductile Iron Pipe: AWWA C151 with ductile iron fittings rubber gasket joints and 3/4 inch diameter rods.
  - 3. PEX Tubing: ASTM F877 Cross-Linked Polyethylene, ASTM F1807 for metal insert fittings, ASTM F2159 for copper crimp rings. NSF 14 & 61 compliant.
- D. Water Piping, above Grade:
  - 1. Copper Tubing: ASTM B88, Type L, hard drawn, with cast brass or wrought copper fittings and Grade 95TA solder joints. All materials shall be certified by NSF to ANSI/NSF Standard 61 meeting US EPA Lead and Copper Rule.
  - 2. PEX Tubing: ASTM F877 Cross-Linked Polyethylene, ASTM F1807 for metal insert fittings, ASTM F2159 for copper crimp rings. NSF 14 & 61 compliant. Rated for 200 degrees F. and 80psig working pressure.

- E. Equipment Drains and Overflows:
  - 1. Steel Pipe: ASTM A53/A53M, Grade B, Schedule 40 black steel, malleable iron or forged steel fittings, threaded or welded joints.
  - 2. Copper Tubing: ASTM B88, Type M, hard drawn, cast brass, wrought copper fittings, lead free solder joints.
  - 3. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26, PVC fittings, solvent weld joints.

# 2.3 VALVES

- A. Manufacturers:
  - 1. American Valve
  - 2. Red-White Valve Corp.
  - 3. Milwaukee Valve
  - 4. Substitutions: Permitted.
- B. Gate Valves:
  - 1. Up to 2 inches: Bronze body, bronze trim, non-rising stem, hand wheel, inside screw, double wedge disc, soldered or threaded.
  - 2. Over 2 inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, solid wedge, flanged or grooved ends.
- C. Ball Valves:
  - 1. Up to 2 inches: Bronze or stainless steel one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.
  - 2. Over 2 inches: Cast steel flanged body, chrome plated steel ball, Teflon seat and stuffing box seals and lever handle.
- D. Plug Valves:
  - 1. Up to 2 inches: Bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends.
  - 2. Over 2 inches: Cast iron body and plug, pressure lubricated, Teflon packing, flanged ends.
- E. Butterfly Valves:
  - 1. Up To 2 inches: Bronze body, stainless steel disc, resilient replaceable seat, threaded ends, extended neck, 10-position lever handle.
  - 2. Over 2 inches: Iron body, chrome plated iron disc, resilient replaceable seat, wafer or lug ends, extended neck, 10 position lever handle.
- F. Swing Check Valves:
  - 1. Up to 2 inches: Bronze body and swing disc, solder or threaded ends.
  - 2. Over 2 inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.
- G. Spring Loaded Check Valves:
  - 1. Iron body, bronze trim with threaded, wafer or flanged ends and stainless steel spring with renewable composition disc.
- H. Relief Valves:
  - 1. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

# 2.4 PIPING SPECIALTIES

A. Flanges, Unions, and Couplings:

- 1. Pipe Size 2 inches and Under: Malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- 2. Pipe Size Over 2 inches: Forged steel flanges for ferrous piping; bronze flanges for copper piping; preformed neoprene gaskets.
- 3. Grooved and Shouldered Pipe End Couplings: Malleable iron housing, C-shape elastomer composition sealing gasket, steel bolts, nuts, and washers.
- 4. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Strainers:
  - 1. Size 2 inches and Under: Threaded brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
  - 2. Size 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
  - 3. Size 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

# 2.5 PLUMBING DRAINAGE SPECIALTIES

- A. Cleanouts:
  - 1. Manufacturers:
    - a. Zurn
    - b. Wade
    - c. J.R. Smith
    - d. MiFab
    - e. Watts
    - f. Substitutions: Permitted.
  - 2. Finished Floor: Lacquered cast iron body with anchor flange, reversible clamping collar, and adjustable nickel-bronze round scored cover in service areas and round depressed cover to accept floor finish in finished floor areas.
  - 3. Wall type: lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

#### **PART 3 EXECUTION**

#### 3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavate.

#### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside piping before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

#### 3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

#### 3.4 INSTALLATION - PIPING SYSTEMS

- A. Install dielectric connections wherever jointing dissimilar metals.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Route piping parallel to building structure and maintain gradient.
- D. Install piping to maintain headroom. Group piping to conserve space. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Sleeve pipe passing through partitions, walls and floors.
- H. Install piping system allowing clearance for installation of insulation and access to valves and fittings.
- I. Install identification on piping systems including underground piping. Refer to Section 22 05 00.
- J. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- K. Install all sanitary vent piping so that all portions of the vent piping will drain by gravity back to the drainage system.
- L. Install sway bracing at all changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.

#### 3.5 INSTALLATION - VALVES

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install ball valves for throttling, bypass, or manual flow control services.
- D. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.
- E. Install check valves on discharge of pumps.
- F. Install plug valves for throttling service. Install non-lubricated plug valves only when shutoff or isolating valves are also installed.
- G. Install 3/4 inch ball drain valves at low points of piping, and at equipment. Pipe to nearest drain.
- H. Install independent ball valves at all hose bibbs.

#### 3.6 INSTALLATION - PIPING SPECIALTIES

- A. Install pressure gauges with pulsation dampers. Provide needle valve or ball valve to isolate each gauge. Extend nipples and siphons to allow clearance from insulation.
- B. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- C. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- E. Provide drain and hose connection with valve on strainer blow down connection.
- F. Test backflow preventers in accordance with ASSE.

# 3.7 INSTALLATION - PLUMBING SUPPLY PIPING

- A. Install water piping in accordance with ASME B31.9.
- B. Excavate and backfill in accordance with Section 31 20 00.
- C. Establish elevations of buried piping outside the building to 12 inches below frost line.
- D. Provide support for utility meters in accordance with requirements of utility companies.
- E. Slope water piping and arrange to drain at low points.
- F. Install piping from relief valves, back-flow preventers and drains to nearest floor drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets and flush valve assemblies.
- H. Install balancing valves in water circulating systems as indicated on Drawings.
- I. Disinfecting of Domestic Water Systems:
  - 1. Prior to starting, verify system is complete, flushed and clean.
  - 2. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
  - 3. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
  - 4. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.
  - 5. Maintain disinfectant in system for 24 hours.
  - 6. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
  - 7. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.
  - 8. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

#### 3.8 INSTALLATION - PLUMBING DRAINAGE PIPING

- A. Install bell and spigot pipe with bell end upstream.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Install with clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Establish elevations of buried piping outside building to provide not less than 3 ft of cover.
- F. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- G. Install bell and spigot pipe with bell end upstream.
- H. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Maintain gradients.
- I. Test drainage piping in accordance with local code requirements.

#### 3.9 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. [Refer to Section 09 90 00.] Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide sway bracing at changes in direction greater than 45 degrees for pipe sizes 4" and larger.
- M. Provide anchorage to restrain piping from axial movement.

#### 3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- B. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual. Bleed water from outlets to accomplish distribution.
- C. Maintain disinfectant in system for 24 hours. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
- D. Flush disinfectant from system. Take samples no sooner than 24 hours after flushing, and analyze in accordance with AWWA C601.

#### 3.11 SERVICE CONNECTIONS

- A. Install sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and verify proper slope for drainage and proper cover to avoid freezing.
- B. Install new water service complete with water meter with by-pass valves. Install sleeve and mechanical sleeve seal in wall for service main and supported at wall, caulked and made watertight. Install sleeve around service main to 6 inch above floor.

#### 3.12 SCHEDULES

A. Pipe Hanger Spacing:

PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
ABS (All sizes)	4	3/8
Aluminum (All sizes)	10	1/2
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10 foot length of pipe	10	5/8
CPVC, 1 inch and smaller	3	1/2
CPVC, 1-1/4 inches and larger	4	1/2

Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
Fiberglass	4	1/2
Glass	8	1/2
Polybutylene	2.67	3/8
Polypropylene	4	3/8
PVC (All Sizes)	4	3/8
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

# SECTION 22 30 00 PLUMBING EQUIPMENT

# PART 1 GENERAL

# 1.1 SUMMARY

- A. Section Includes:
  - 1. Water Heaters
  - 2. Thermal Expansion Tanks

## 1.2 SUBMITTALS

A. Product Data: Submit manufacturer's literature for humidifier

# 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit literature and parts list.

# 1.4 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

# 1.5 WARRANTY

A. Furnish one year manufacturer warranties for all equipment.

# PART 2 PRODUCTS

# 2.1 TANKLESS GAS WATER HEATERS

- A. Manufacturers
  - 1. Navien
  - 2. Substitutions: Permitted
- B. Automatic, natural gas-fired, tankless, instantaneous type.
  - 1. Maximum working pressure: 150 psi.
  - 2. Furnish with temperature and pressure relief valve.
  - 3. See Plumbing Schedule for further requirements.
- C. Direct vent, ANSI Standard Z21.10.3/CSA 4.3.
- D. Controls: Flame rod, APS, Ignition Operator Detector, Water Temperature High Limit Switch, Exhaust Temperature High Limit Sensor, Power Surge Fuse.
- E. Includes integral hot water recirculation pump.

# 2.2 THERMAL EXPANSION TANK

- A. Manufacturers:
  - 1. Taco
  - 2. Amtrol
  - 3. Bell & Gossett
  - 4. Substitutions: Permitted
- B. ASME, steel shell lined tank, for use in potable water systems, maximum working pressure 150 psi, maximum operating temperature 140 degrees F
- C. Heavy duty butyl diaphragm, NSF/ANSI 61.
- D. Factory precharged to 55 psig.
- E. Substitutions: Permitted.

# PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install water heaters in accordance to AGA, NSF and NFPA requirements. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve operating system.
- B. Clean and flush tanks after installation. Keep openings sealed until pipe connections are made.
- C. On tanks, install drain at water inlet and outlet, thermometer with range of 40 to 200 degrees F, and ASME pressure relief valve suitable for maximum working pressure.

# SECTION 22 40 00 PLUMBING FIXTURES

#### PART 1 GENERAL

# 1.1 SUMMARY

- A. Section Includes:
  - 1. Water closets.
  - 2. Urinals.
  - 3. Lavatories.
  - 4. Sinks.
  - 5. Electric water coolers.
    - Service sinks.

# 1.2 SUBMITTALS

A. Product Data: Submit manufacturer's literature for plumbing fixtures.

# 1.3 CLOSEOUT SUBMITTALS

6.

A. Operation and Maintenance Data: Submit literature and parts list.

# 1.4 WARRANTY

A. Furnish one year manufacturer warranties for all equipment.

# PART 2 PRODUCTS

# 2.1 FLUSH VALVE WATER CLOSETS

- A. Manufacturers:
  - 1. Kohler
  - 2. American Standard
  - 3. Zurn
  - 4. Sloan
  - 5. Gerber
  - 6. Toto
  - 7. Substitutions: [Permitted] [Not permitted].
- B. Bowl: Vitreous china closet, white with elongated rim, 1-1/2 inch spud, china bolt caps.
- C. Flush Valve: Exposed chrome plated, diaphragm type with oscillating handle, escutcheon, seat bumper, integral screwdriver stop and vacuum breaker.
  - 1. Manufacturers:
    - a. Zurn
    - b. Sloan
    - c. American Standard
    - d. Toto
- D. Seat: Solid white plastic, elongated, open front extended back, brass bolts, without cover.
- E. Mounting: Floor mounted

# 2.2 URINALS

- A. Manufacturers:
  - 1. Crane
  - 2. Kohler

- 3. American Standard
- 4. Zurn
- 5. Gerber
- 6. Toto
- 7. Substitutions: Permitted.
- B. Body: A.D.A. compliant, wall mounted vitreous china, flushing rim, siphon jet action and lever flushing valve.
- C. Wall Mounted Carrier: Floor fastened, adjustable cast iron frame, integral drain hub, lugs for floor and wall attachment.

# 2.3 LAVATORIES

- A. Manufacturers:
  - 1. Crane
  - 2. Kohler
  - 3. American Standard
  - 4. Zurn
  - 5. Gerber
  - 6. Toto
  - 7. Substitutions: Permitted.
- B. Body: A.D.A. compliant, wall mounted vitreous china, front overflow, self draining deck.
- C. Wall Mounted Carrier: Floor fastened, adjustable cast iron frame.
- D. Faucets
  - 1. Manufacturers:
  - 2. Moen
  - 3. Chicago Faucets
  - 4. Zurn
  - 5. Sloan
  - 6. T&S Brass

#### 2.4 SINKS

- A. Manufacturers:
  - 1. Elkay
  - 2. Just
  - 3. Advance Tabco
  - 4. Substitutions: Permitted
- B. Faucets
  - 1. Manufacturers:
    - a. Elkay
    - b. Moen
    - c. Delta
    - d. T & S Brass

#### 2.5 ELECTRIC WATER COOLERS

A. Manufacturers:

- 1. Elkay
- 2. Halsey Taylor
- 3. Oasis
- 4. Murdock
- 5. Substitutions: Permitted.

#### **PART 3 EXECUTION**

#### 3.1 EXAMINATION

- A. Verify adjacent construction is ready to receive rough-in work of this section.
- B. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough in and installation.

# 3.2 INSTALLATION

- A. Install each fixture with chrome plated rigid or flexible supplies with screwdriver stops, reducers, and escutcheons.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- C. Install all handicapped accessible water closet flush controls on the open side of the water closet enclosure.

#### SECTION 22 61 13 MEDICAL SIMULATION COMPRESSED-AIR PIPING

# PART 1 - GENERAL

# **1.1 DESCRIPTION**

A. This section describes the requirements for central compressed air piping, including all necessary piping, fittings, valves, cabinets, outlets, gauges, and low voltage wiring from pressure switch to alarm.

# **1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.
- E. Section 07 92 00, JOINT SEALANTS: Sealing around pipe penetrations through the floor to prevent moisture migration.
- F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

# **1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.
- B. American Society of Mechanical Engineers (ASME):

ASME Boiler and Pressure Vessel Code -

- BPVC Section IX-2019......Welding, Brazing, and Fusing Qualifications
- A13.1-2015......Scheme for the Identification of Piping Systems
- B16.3-2016......Malleable Iron Threaded Fittings: Classes 150 and 300
- B16.22-2018......Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
- B16.50-2018......Wrought Copper and Coper Alloy Braze-Joint Pressure Fittings
- B40.100-2013.....Pressure Gauges and Gauge Attachments
- C. American Society of Sanitary Engineering (ASSE):
  - 6000-2018 ......Professional Qualifications Standard for Medical Gas Systems Personnel
  - 6010-2018 ...... Medical Gas Systems Installers
  - 6020-2018 ......Medical Gas Systems Inspectors
  - 6030-2018 ..... Medical Gas Systems Verifiers
- D. American Society for Testing and Materials (ASTM):
   A47/A47M-1999(R2018)e1 ......Standard Specification for Ferritic Malleable Iron Castings

	A53/A53M-2018	Standard Specification for Pipe, Steel, Black and Hot–Dipped,	
		Zinc-Coated, Welded and Seamless	
	A536-1984(R2019)e1	Standard Specification for Ductile Iron Castings	
	B819-2019	Standard Specification for Seamless Copper Tube for Medical	
		Gas Systems	
	F2063-2018	Standard Specification for Wrought Nickel-Titanium Shape	
		Memory Alloys for Medical Devices and Surgical Implants	
E.	American Welding Society (AW	S):	
	A5.8M/A5.8-2019	Specification for Filler Metals for Brazing and Braze Welding	
	B2.2/B2.2M-2016	Specification for Brazing Procedure and Performance	
		Qualifications	
F.	F. Compressed Gas Association (CGA):		
	C-9-2019	Standard Color Marking of Compressed Gas Containers for	
		Medical Use	
	G-4.1-2018	Cleaning Equipment for Oxygen Service	
	G-10.1-2016	Commodity Specification for Nitrogen	
	P-9-2015	The Inert Gases: Argon, Nitrogen and Helium	
	V-1-2019	Standard for Compressed Gas Cylinder Valve Outlet and Inlet	
		Connections	
	V-5-2019	Standard for Diameter Index Safety System	
		(Noninterchangeable Low Pressure Connections for Medical Gas	
		Applications)	
G.	G. International Code Council (ICC):		
	IPC-2018	.International Plumbing Code	
Η.	Manufacturing Standardization Society: (MSS)		
	SP-72-2010a	Ball Valves with Flanged or Butt-Welding Ends for General	
		Service	
	SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved	
		and Flared Ends	
I.	National Fire Protection Association (NFPA):		
	70-2020	National Electrical Code (NEC)	
	99-2018	Health Care Facilities Code	
1.4 SU	BMITTALS		

- A. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
  - 1. Piping and fittings.

- 2. Valves.
- 3. Zone valve box.
- 4. Outlets.
- 5. Gauges.
- 6. Switches (pressure).
- 7. Alarm components.
- B. Station Outlets and Inlets: A letter shall be submitted from manufacturer stating that outlets and inlets are designed, manufactured, and shall comply with NFPA 99. Outlets and inlets shall bear label of approval as assembly of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer Representative (COR), certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.
- C. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
  - 1. Include complete list indicating all components of the systems.
  - 2. Include complete diagrams of the internal wiring for each item of equipment.
  - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

#### **1.5 AS-BUILT DOCUMENTATION**

A. Comply with requirements in Division 01.

# PART 2 - PRODUCTS

# 2.1 PIPING

- A. Copper medical gas tube shall be Type K or L, seamless, drawn temper meeting ASTM B819 that has been cleaned, purged, and sealed for medical gas service by the pipe manufacturer. Standard color markings "ACR/MED" shall be in green for Type K and in blue for Type L tubing.
- B. Wrought copper fittings shall be solder joint complying with ASME B16.22, dimensions for brazed joints complying with ASME B16.50.
- C. Brazing filler Metals shall be BCuP series, copper-phosphorus with a melting temperature greater than 538 deg C (1000 deg F) allows for general duty brazing conforming to AWS A5.8M/A5.8.Flux shall be strictly prohibited for copper-to-copper connections.
- D. Screw Joints shall be made with degreased polytetrafluoroethylene (Teflon) tape.
- E. Piping identification labels shall be applied at time of installation in accordance with NFPA 99. Supplementary color identification shall be in accordance with //CGA C-9// //or// //ASME A13.1//.
- F. Temperature and pressure ratings of memory metal couplings shall be not less than that of a brazed joint shall be permitted. The memory metal couplings shall be made of ASTM F2063, nickel titanium, shape memory alloy, cleaned, purged, and sealed for medical gas service.

#### 2.2 VALVES

- A. Ball valves: Ball valves shall be inline, other than zone valves in cabinets.
  - 100 mm or DN100 (NPS 4 inches) and smaller: Ball valves shall be bronze/brass body, MSS SP-72 and MSS SP-110, Type II, Class 150, Style 1, shall be full port, three-piece or double union end connection, double seal, chrome plated brass with PTFE or TGFE seats, lever type handle with locking device, blowout proof stem with PTFE or TFE seal and ends manufactured according to ASTM B819 with copper tube extensions for brazed connections. The ball valve shall have a pressure rating of 4138 kPa (600 psig) WOG maximum working pressure.
- B. Check valves:
  - 75 mm or DN80 (NPS 3 inches) and smaller: Check valves shall be brass /bronze body, straight through design for minimum pressure drop, spring loaded, self-aligning with Teflon cone seat, vibration free, silent operation, with ends manufactured according to ASTM B819 with copper tube extensions. Check valves shall have directional arrow permanently cast into body. The check valve shall have a pressure rating of 2758 kPa (400 psig) WOG maximum working pressure.

# 2.3 OUTLETS

- A. The outlet shall be for specific medical compressed air pressure and service listed. Rough-in assemblies shall be included. Recessed units shall be provided unless indicated. Outlets shall be UL listed; CSA certified.
- B. Finish assembly shall include primary check valve and secondary check valve rated at maximum 1380 kPa (200 psig), double seals to prevent air leakage and cover plate with service label.
- C. Quick coupler service connections shall include a pressure outlet with non-interchangeable keyed indexing and constructed to permit one-handed connection and removal of equipment using a positive locking ring that retains the equipment stem in valve during use.

#### 2.4 PRESSURE SWITCH

A. Pressure switches and sensors shall be UL listed and shall be NEMA Type 4 watertight housing field adjustable pressure settings. The switch shall be wired //normally open// //normally closed//, 6 mm (1/4 inch) FNPT connection and fitted with a quick connect to facilitate field service. Electrical rating 10 amperes at 120-volt AC.

#### **PART 3 - EXECUTION**

# **3.1 PREPARATION**

- A. All air tube and fittings, valves, gauges, and other components shall be free of oil, grease, and other readily oxidizable materials as required according to CGA G-4.1.
- B. All air tube and components shall be cleaned and capped for oxygen service in a facility equipped to clean, rinse, and purge the material in accordance with Category 3 piping per NFPA 99.

#### **3.2 INSTALLATION**

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Owner.
- B. New pipe to existing pipe connections shall be connected with memory metal couplings.
- C. Air piping shall use either Type L or K, copper medical gas tube, wrought copper fittings, and brazed joints.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, shall be used for pipe penetrations and sleeves.
- E. Pipe installation shall comply with ASSE 6010.
- F. All piping shall be installed parallel or at right angles to building walls.
- G. Piping above ceilings shall be installed to allow for the removal of ceiling tiles.
- H. Air and drain piping shall be installed at a one percent slope.
- I. Nipples, unions, special fittings shall be installed with pressure ratings same as or higher than system pressure rating.
- J. Eccentric reduces shall be used when air piping is reduced in the direction of flow with bottoms of both pipes and reduced fitting flush with bottom of pipe.
- K. Branch connections shall be installed from the top of the main.
- L. Pressure gauges shall be installed on discharge piping from each compressor and on each receiver.
- M. Open ends of tube shall be capped or plugged at all times or otherwise sealed until final assembly.
- N. Piping shall be cut square and accurately with a tube cutter (sawing is prohibited) to measurements determined at place of installation. Pipe shall be reamed to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Piping shall be worked into place without springing or forcing. Tube shall be bottomed in socket so there are no gaps between tube and fitting. Care shall be exercised in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material shall be no longer suitable for air service.
- O. Valves and other equipment shall be rigidly supported to prevent strain on tube or joints.
- P. Install unions in piping adjacent to each valve and connection to equipment and each specialty.
- Q. Pipe fittings shall be used for all changes in direction. Tube shall not be bent or forced into place.
- R. Support ceiling column assembly from heavy sub-mounting castings furnished with the unit as part of roughing-in. The ceiling column assembly shall be anchored with 13 mm (1/2 inch) diameter bolts attached to angle iron frame supported from structural ceiling, unless otherwise indicated.

- S. Pressures and vacuum switches, transmitters, and gauges shall be installed to be easily accessed, and provide access panel where installed above plaster ceiling. Pressure switches and sensors shall be installed for gas specified with gas specific demand check fittings.
- T. Pipe labeling shall be applied during installation process and not after installation is completed.
   The size of legend letters shall be in accordance with ASME A13.1.
- U. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.
- V. Install flexible pipe connector is discharge piping from each compressor.
- W. Install shut-off valve to each connection to and from air compressor and manifolds, and specialties.

# **3.3 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer's technical representative for 4 hours to instruct each maintenance personnel responsible for the operation and maintenance of the system.

#### SECTION 22 62 19 MEDICAL SIMULATION VACUUM AND EVACUATION EQUIPMENT

# PART 1 - GENERAL

# **1.1 DESCRIPTION**

A. This section specifies central piped high volume oral evacuation (HVE) system for operatories, including piping, valving, vacuum producers, separators, electric motors, starters, controls and installation and startup.

# **1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- E. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.
- F. Section 07 92 00, JOINT SEALANTS: Sealing around pipe penetrations through the floor to prevent moisture migration.
- G. Section 09 91 00, PAINTING: Piping system identification.
- I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General requirements and items common to more than one Section of Division 22.

# **1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
  - A13.1-2007 (R2013).....Scheme for the Identification of Piping System
  - B1.20.1-2013.....Pipe Threads, General Purpose, Inch
  - B16.3-2011......Malleable Iron Threaded Fittings: Classes 150 and 300
  - B16.22-2013......Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
  - B40.100-2013.....Pressure Gauges and Gauge Attachments
- C. American Society for Testing and Materials (ASTM):
  - A47/A47M-1999 (2014).....Standard Specification for Ferritic Malleable Iron Castings
  - A53/A53M-2012 .....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - A536-1984 (2014) .....Standard Specification for Ductile Iron Castings
  - B306-2013.....Standard Specification for Copper Drainage Tube (DWV)
  - D1785-2012.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic

Pipe, Schedule 40, 80, and 120

	D2564-2012	Standard Specification for Solvent Cements for Poly (Vinyl	
		Chloride) (PVC) Plastic Piping Systems	
	D2466-2013	.Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic	
		Pipe Fittings, Schedule 40	
	D3311-2011	.Standard Specification for Drain, Waste, and Vent (DWV) Plastic	
		Fittings Patterns	
D.	National Fire Protection Association (NFPA):		
	NFPA 99-2015	.Health Care Facilities Code	
E.	Underwriters' Laboratories, Inc.	(UL):	
	60601-1-2003 (R2006)	.Medical Electrical Equipment, Part 1: General Requirements for	

# 1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

Safety

- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 62 19, MEDICAL SIMULATION VACUUM AND EVACUATION EQUIPMENT", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
  - 1. Piping.
  - 2. Vacuum producer.
  - 3. Vacuum cleaning inlet.
  - 4. Vacuum gage.
  - 5. Separator.
  - 6. Vacuum relief valve.
  - 7. Butterfly valve.
  - 8. Directional flow valve.
  - 9. Anti-surge valve.
  - 10. Exhaust Silencer.
  - 11. Separator Drainage Pump.
  - 12. Control Panel.

#### **1.6 WARRANTY**

A. System shall have a ten-year warranty against pump wear-out or failure.

#### **1.7 AS-BUILT DOCUMENTATION**

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in an electronic pdf format. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and shall provide the complete set at the time of final systems certification testing.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

# PART 2 - PRODUCTS

# 2.1 PIPING

- A. PVC: ASTM D1785, Type 1 (normal impact), Grade 1 (chemical resistance), Schedule 40 pipe. Provide socket ASTM D2466 fittings and ASTM D2564 PVC solvent cement with PVC primer recommended by manufacturer. Provide DWV (drain-waste-vent) pipe fittings. Use long radius fittings for turns and wye fittings for branching, as defined in Section 22 13 00, FACILITY SANITARY AND VENT PIPING. Minimum pipe size for distributing piping in or below slab is 50 mm (2 inches).
- B. Galvanized Steel: Use only for discharge from vacuum producer, as per manufacturer's instructions.
  - 1. Pipe: ASTM A53/A53M, standard weight.
  - 2. Fittings:
    - a. Flexible groove type, malleable iron, ASTM A47/A47M, or Ductile iron, ASTM A536.
    - b. Malleable iron threaded, ASME B16.3, ASME B1.20.1.
- C. Cleanouts: Same size and material as pipe. Provide accessible and easily removable cleanouts as defined in Section 22 13 00, FACILITY SANITARY AND VENT PIPING.
- D. Apply piping identification per ASME A13.1.
- E. Wrap all PVC piping routed through the plenum in 3M plenum wrap.

## **2.2 EVACUATION VACUUM PUMPS**

A. Provide a completely packaged, continuous duty vacuum // duplex // multiplex // system as shown in the contract documents.

- B. Each vacuum producer shall be sized to produce 27 kPa (8 inches Hg) at an inlet airflow of 423 L/min. (15 SCFM).
- C. Duplex or multiplex systems shall consist of two or more separate high efficiency positive displacement oil sealed, rotary vane pumps with automatic continuous oil flow to all moving parts. Operation shall be waterfree.
- D. Duplex or multiplex systems shall be powered by two separate standard NEMA frame motors with V-belt drives enclosed in a UL approved guard.
- E. Provide two (2) 190 liters (50 gallons) fiberglass wet separator tanks. Tanks shall be pressure tested and certified for 61 kPa (18-inch Hg). Tanks shall be freestanding with legs. Provide tank drain with check valve to drain to sanitary sewer.
- F. Provide an electronic moisture alarm system capable of detecting liquid or foam overflows.
   Moisture sensors shall be located outside the wet tank. Connect moisture sensor(s) to BAS.
- G. 3 Phase motor control center shall be complete with motor starters, overload protection, single phasing protection and control transformers.
- H. Controls shall be DDC with LED status indicators for "power" and "motor on"; and solid state moisture alarm circuitry, moisture detector, wiring harness, manual start-stop switch, bypass for moisture alarm and remote on-off circuitry, and indicator for required maintenance.
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# 2.3 CENTRAL SEPARATOR (DUPLEX)

A. Freestanding, bottom pitched to drain at low end, hot-dipped galvanized steel or fiberglass construction with smooth interior walls, and able to withstand a constant negative pressure of 61 kPa (18 inch Hg). Provide optional 360-degree solid state auto flush assembly, with positive protection against flush operation with vacuum producer running, solid-state high-low liquid sensor and corrosion resistant effluent pump to drain the tank. Adjust one tank to sense 90 percent and the other tank to sense 100 percent of its water capacity, to allow for non-simultaneous discharge and, therefore, uninterrupted HVE function to the clinical facility. Provide a sensor operated (120 VAC) solenoid valve to control the outgoing airstream for adjustments between five and 180 seconds. Cold water supply to the autoflush unit shall contain an in-line filter equipped with 40-mesh stainless-steel screens 0.0425 cm (0.0165 inch) opening size. Provide a vacuum switch to prevent the wash down solenoid from operating when system is under a vacuum. Provide pressure reducing valve to maintain water pressure not to exceed 345 kPa (50 psig).

# 2.5 VACUUM RELIEF VALVE (PROVIDE FOR BACKWARD CURVE IMPELLER DESIGN EXHAUSTERS)

A. Mechanically operated, placed at the end of each trunkline, to automatically sense negative pressure in the system to maintain movement of liquids through the piping system to the

separator when inlet branches are closed. Valve connector shall be 15 mm (1/2-inch NPT). Equip with a silencer to reduce air noise to below 85 decibels.

# 2.6 PIPE ISOLATORS

A. Flexible rubber, couple band, sealed clamps to isolate the turbine from the piping. Size coupling in accordance with the turbine's intake and output connections and provide steel coupling guards.

# 2.7 BUTTERFLY VALVE

- A. Inlet: Built-in or located near the first stage of the turbine to prevent turbine overload through the operational range.
- B. Exhaust: Flanged, wafer-style, installed at exhauster output flange for equipment isolation.

#### 2.8 DIRECTIONAL FLOW VALVE

A. Non-restrictive on turbine inlet to prevent back-flow of air.

# 2.9 ANTI-SURGE VALVE

A. Mechanically or electrically operated valve that shall operate automatically throughout the turbine's designed range. Valve shall continually sense the negative pressure within the turbine and maintain a predetermined, operational level of x kPa (x inches Hg) draw. Equip with a silencer to reduce air noise to below 85 decibels.

#### 2.10 EXHAUST SILENCER

A. Open-bore expansion type to reduce air noise to below 85 decibels with interior baffling or shrouding.

# 2.11 REPLACEMENT PARTS

- A. Furnish a turbine bearings and coupling kit to include one set of turbine bearings and one complete motor/turbine flexible coupling, all of the same size and design as those supplied with the turbine.
- B. Provide complete installation instructions for repair kit items.

# 2.12 SEPARATOR DRAINAGE PUMP (OPTIONAL IF GRAVITY DRAIN NOT AVAILABLE)

A. Provide high-pressure corrosion resistant inline jet pump dedicated for the separator system. Install between separator and gate or swing-type check valve normally installed at separator drain outlet. Outlet air solenoid valve between separator and turbine is prohibited. Pumps shall be controlled by liquid level sensors in the separator.

# 2.13 SEPARATOR DRAIN AND VENT

A. Construct in accordance with NFPA 99, 5.3.3.10.1.3 for Drainage from Vacuum Equipment and 5.3.3.10.1.4 for Vacuum Exhaust.

# 2.15 VACUUM GAGE (DUAL SCALE)

A. In remote control panel: ASME B40.100, 40 mm (1-1/2 inch) dial with decorative ring and a dial range of 0 to 100 kPa (0 to 29.5 inches Hg).

B. In piping near separator: ASME B40.100, with metal case, 115 mm (4-1/2 inch) dial with a dial range of 0 to 100 kPa (0 to 29.5 inches Hg).

# 2.16 PVC BODY BALL VALVES

A. PVC Body double-seal ball valves with replaceable neoprene or TFE seat seals. Provide valves suitable for at least 690 kPa (100 psig), cold water, non-shock working pressure. Designed especially for vacuum service. Operating parts of valve shall be removable without removing from line.

# PART 3 - EXECUTION

# 3.1 INSTALLATION

- A. Place vacuum producers on insulating pads furnished with the equipment. Do not bolt or anchor equipment to the floor slab.
- B. Cut pipe square, with burrs removed and install with minimum obstructions to air flow. Use DWV (drain-waste-vent) long-radius fittings for turns and wye type for branches.
- C. Slope horizontal piping not less than 2 mm per 1 m (1/4 inch per 10 feet) toward the separator tanks.
- D. All fittings shall be DWV (drain-waste-vent) long-radius bend types for turns and wye types for branching. For small bore piping for which long-radius bends are not available, two 45-degree bends shall be substituted for 90-degree turning.
- E. All risers to all HVE inlet locations shall be 40 mm (1-1/2 inch NPS). Risers shall connect to trunklines whose nominal pipe sizes shall be determined by head loss calculations that yield a system designed for no more than 1.7 kPa (0.5 inches Hg) worse case head loss. Piping no smaller than 40 mm (1-1/2 inch NPS) shall be used.
- F. The cross-sectional area of all trunklines shall be graduated, increasing toward the vacuum source. The cross-sectional area at any point along the trunkline shall equate to the sum of the riser cross-sectional areas connected prior to that point. Individual trunklines shall terminate with connection to the manifold of the separators.
- G. If backward curve impeller design turbine is installed, terminate the most distant end from the separator of each trunk-line with a vacuum relief valve.
- H. Install separators level and anchored to the floor slab.
- I. Startup shall be by factory representative and observed by COR.

# **3.4 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer's technical representative for 4 hours to instruct Owner Personnel in operation and maintenance of the system.