

Date: 03/08/2023

Project: Northwest Wichita Water Treatment Facility

Description: Availability of AIS compliant A312 304L Stainless Steel Seamless Tubing & Accessories.

Wichita Water Partners have been actively searching for American Iron & Steel (AIS) compliant 1-1/2" to 2" ASTM A312 Schedule 80 Type 304L Stainless Steel Seamless Tubing and fittings for the liquid Carbon Dioxide storage system at the new Northwest Wichita Water Treatment Facility without success. We have reached out to several major Pipe Distributors who have in turn canvassed their network of domestic manufacturers to confirm that a domestic manufacturer for this piping is not available. Included in this request for a waiver are the written confirmations from the distributors & manufacturers we received. Some of the manufacturers that the supplier reached out to are as listed below,

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

The list of materials for which we are requesting an AIS waiver is below. The costs & quantities of these materials are listed in detail in the manufacturers' quotes on the following pages. The overall cost of these materials is approximately [REDACTED] and covers approximately 420 linear feet of piping.

- 1-1/2" 304L Schedule 80 Stainless Steel Pipe
- 2" 304L Schedule 80 Stainless Steel Pipe
- 2" x 6" 304L Stainless Steel Seamless Nipple

Documentation to support this waiver request is enclosed, it appears that there have been several similar waiver requests approved by the EPA for Stainless Steel Tubing of similar sizes due to the lack of an AIS certifiable product. Three of those decision memorandums are included in this request for a waiver.

The documentation required in Appendix 1 AIS Waiver Checklist is as noted below.

1. Material – A312 Schedule 80 Type 304 Stainless Steel Seamless Tubing & Accessories
2. Unit of Measure - Lineal Feet of Tubing
3. Quantity – 420 LF
4. Value - [REDACTED]
5. Delivery Windows - Earliest delivery of the material would occur mid-April 2023 and the last of the material would be delivered in late-June 2023.
6. Location of the Project - The project is located in Wichita, Kansas
7. Proposed Supplier - The Proposed Supplier of the 1-1/2" and 2" stainless steel pipe is [REDACTED].  
The Proposed Supplier of the 2" x 6" 304L Stainless Steel Seamless Nipple is [REDACTED].
8. Reason for the Request - This is an Availability Waiver Request, as no AIS Compliant Manufacturer of this material could be found.

Your review of the request would be greatly appreciated. Please let me know if any additional information or documentation would be needed to address this waiver request.

Sincerely,

Cherith Parnell

This waiver request was submitted to the EPA by the state of Kansas. All supporting correspondence and/or documentation from contractors, suppliers or manufacturers included as a part of this waiver request was done so by the recipient to provide an appropriate level of detail and context for the submission. There may be documents with project diagrams, schedules, and supplier correspondence in formats that do not meet the Federal accessibility requirements for publication on the Agency's website. Hence, these exhibits have been omitted from this waiver publication. They are available upon request by emailing [DWSRFWaiver@epa.gov](mailto:DWSRFWaiver@epa.gov).



Stainless steel pipe with test pressure of 500 PSI must be provided from the fill point to the pressure regulating valves within the chemical building (5525-NWW-401-REG-0011, -0012, -0021, -0022). Beyond this point Copper piping with a test pressure of 180 PSI is acceptable to the Carbon dioxide pressurized feeders no. 1 thru 10. See attached file.

**Attachments:**

[RFI 521\\_001Y641\\_P&ID CARBON DIOXIDE SYSTEM 1 OF 4 Rev.2 markup.pdf](#)

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

PART 1 - GENERAL

1.1 SUMMARY:

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1. Process piping (less than 4 inches in diameter).
  - 2. Chemical feed piping.
  - 3. Chemical tubing.
  - 4. Sample piping.
- B. Supplier shall review and understand the American Iron and Steel (AIS) Requirements. Iron and steel products must be produced in the United States in a manner that complies with the AIS Requirement and certifications of such production must be provided to the Design-Builder prior to shipment.

1.2 RELATED REQUIREMENTS:

- A. Section 09 90 00 – Protective Coatings.
- B. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.
- C. Section 22 05 33 – Heat Tracing for Plumbing Piping.
- D. Section 22 05 53 – Identification for Plumbing Piping and Equipment.
- E. Section 22 07 19 – Plumbing Piping Insulation.
- F. Section 40 70 00 – Instrumentation for Process Systems.
- G. Division 46 – Water and Wastewater Equipment.

1.3 REFERENCES:

- A. Applicable Standards (Latest Edition):
  - 1. ASME International (ASME):
    - a. B1.20.1 - Pipe Threads, General Purpose, Inch.
    - b. B16.3 - Malleable Iron Threaded Fittings.
    - c. B16.5 - Pipe Flanges and Flanged Fittings, NPS 1/2 to NPS 24.
    - d. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
    - e. B16.34 - Valves-Flanged, Threaded, and Welding End.
    - f. B16.39 - Malleable Iron Threaded Pipe Unions.
    - g. B18.2.1 - Square and Hex Bolts and Screws - Inch Series.
    - h. B31.3 – Process Piping.
    - i. Boiler and Pressure Vessel Code: Section IV, "Heating Boilers;" Section VIII, "Pressure Vessels," Division 1; Section IX, "Welding and Brazing Qualifications."
  - 2. ASTM International (ASTM):
    - a. A4 - Ferritic Malleable Iron Castings.
    - b. A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - c. A105, Standard Specification for Carbon Steel Forgings for Piping Applications.
    - d. A106 - Seamless Carbon Steel Pipe for High-Temperature Service.
    - e. A193/A193M – Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
    - f. A194/A194M – Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
    - g. A234/A234M - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Services.
    - h. A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- i. A333, Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness.
  - j. A320, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low Temperature Service.
  - k. A350, Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components.
  - l. A733 - Welded and Seamless Carbon Steel and Austenitic Stainless-Steel Pipe Nipples.
  - m. D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - n. D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  - o. D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
  - p. D2467 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
  - q. D2564 - Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.
  - r. D2672 - Joints for IPS PVC Pipe Using Solvent Cement.
  - s. D2855 - Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
  - t. F402 - Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermostatic Pipe and Fittings.
  - u. F439 – Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
  - v. F493 – Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
  - w. F593 – Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - x. F656 - Primers for Use in Solvent Cement Joints of Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.
3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
    - a. SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
    - b. SP-69 - Pipe Hangers and Supports - Selection and Application.
    - c. SP-72 – Ball Valves with Flanged or Butt-Welding Ends for General Service.
    - d. SP-107 - Transition Union Fittings for Joining Metal and Plastic Products.
    - e. SP-122 - Plastic Industrial Ball Valves.
  4. Chlorine Institute, Inc.:
    - a. Chlorine Manual.
    - b. Pamphlet #6 – Piping System for Dry Chlorine.
    - c. Pamphlet #95 – Gaskets for Chlorine Service.
  5. National Sanitation Foundation (NSF):
    - a. NSF 61 - Drinking Water System Components - Health Effects.
    - b. NSF Standard 372 – Drinking Water System Components - Lead Content.
  6. General Requirements stipulated in the Procurement Documents.
- 1.4 SUBMITTALS:
- A. Submit as specified in procurement documents.
  - B. Submittals required shall include, but are not limited to, the following:
    1. Product Data:
      - a. Specifications, data sheets, and other descriptive information to establish compliance with these specifications.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
  - c. Solvent cement characteristics and chemical compatibility.
  - d. All manuals, drawings, parts lists, and special tools required for assembly, maintenance, and operation.
  - e. Operation and Maintenance Manuals in accordance with Section 01 33 00.
- C. Piping connection information showing:
- 1. Size, type, and location for each connection.
- D. Welding certificates.
- E. Testing documentation and records.
- 1. Manufacturer's installation instructions, and Inspection and Test Plan as required in the General Requirements.
- F. Certificates and Affidavits: Furnish prior to shipment. Include the following:
- 1. American Iron and Steel (AIS) Certifications.
    - a. If Supplier is unable to meet AIS requirements, Supplier shall disclose this information to Design Builder in their proposal.

1.5 QUALITY ASSURANCE:

- A. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.
- B. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. ASME Compliance: Comply with ASME B31.3, "Process Piping."

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Where possible, store pipe, fittings and equipment inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable waterproof wrapping. Protect material not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground.
- C. If special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.
- D. Protect all materials from dirt and dust, or other contaminants.
- E. Handle equipment in such a manner as to ensure delivery to final location in sound, undamaged condition. Make satisfactory repairs to damaged material(s) at no cost to Owner.
- F. Carry and do not drag materials.
- G. Inspect materials delivered to Site for damage; unload and store with minimum handling.

1.7 WARRANTY

- A. Supplier shall warrant that all equipment shall be free of defects caused by faulty material or workmanship for a minimum period of two (2) years from date of Substantial Completion for the entire project, unless otherwise specified.
- B. See procurement documents for full requirements.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Process piping components and installation shall be capable of withstanding the following minimum working pressure at the specified temperature:
  - 1. PVC/CPVC Piping: 150 psig at 73°F.
  - 2. Chlorine Service Carbon Steel Piping: Class IV or V service, 300 psig at -20 to 300 °F.
  - 3. General Service Carbon Steel Piping: 3600 psig at 400°F.
- B. Valve Actuator Types:
  - 1. Hand-lever: For quarter-turn valves NPS 4 and smaller.
  - 2. Solenoids: where indicated in Drawings. Refer to Section 40 70 00 for requirements.
- C. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Threaded: With threads according to ASME B1.20.1.
  - 3. Unions for PVC/CPVC valves.
- D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Extended operating handle of non-thermal-conductive material.
  - 2. Protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- E. Provide and install metallic tracer tape for all buried PVC/CPVC piping.
- F. All wetted components that contact process streams or chemicals/liquid to be added into the process stream shall be compliant with NSF 61.

2.2 STAINLESS STEEL BALL VALVES:

- A. Chemical Fill Stations (ONLY):
  - 1. Comply with MSS SP-110.
  - 2. Manufacturers:
    - a. Apollo.
    - b. Jamesbury.
    - c. Watts.
    - d. Stockham.
    - e. Nibco.
  - 3. Materials (All Stainless Steel):
    - a. Body: Three-part stainless steel, ASTM A351 CF8M.
    - b. Ball: Stainless steel ASTM A276.
    - c. Seats: Ensure material compatibility for each chemical system.
  - 4. Design Requirements:
    - a. Rated for a minimum of:
      - (1) 500 PSI CWP.
      - (2) 150 PSI of saturated steam.
      - (3) 29 IN vacuum.
    - b. Two-position lockable handle.
    - c. Stem with blowout-proof design.
    - d. Balancing stop for all applications.



SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

2.3 CARBON STEEL PIPE, VALVES, AND FITTINGS:

A. Chlorine Service

1. Pipe:
  - a. ANSI/ASME B36.10.
  - b. Up to 1.5-inch diameter, ASTM A106, Grade B, Type S, Schedule 80 seamless steel or ASTM A333, Grade 1 or Grade 6, Schedule 80 seamless steel.
2. Fittings:
  - a. ASMTM A105, 3,000 LB CWP forged carbon steel suitable for socket welding or butt welding (bore to match pipe).
  - b. Reducer bushings shall not be used, provide 3,000 LB reducers.
3. Hammer Unions:
  - a. General:
    - (1) Designed for chlorine service (tanker truck unloading connection)
    - (2) Handlebar style, 3000 LB.
    - (3) Provide threaded cap for each connection.
  - b. Materials:
    - (1) Plated forged steel.
    - (2) Viton O-rings.
  - c. Manufacturers:
    - (1) Huber-Yale.
    - (2) Powell Fabrication and Manufacturing, LLC.
4. Ammonia Unions:
  - a. General:
    - (1) Designed for chlorine service (tanker truck unloading connection)
    - (2) Handlebar style, 3000 LB.
    - (3) Provide threaded cap for each connection.
  - b. Materials:
    - (1) Plated forged steel.
    - (2) Viton O-rings.
  - c. Manufacturers:
    - (1) Henry-Tech.
    - (2) Engineer-approved equal.
5. Valves:
  - a. Materials:
    - (1) Body: Cast carbon steel, ASTM A216, Type WCB.
    - (2) Ball and stem: Hastelloy C.
    - (3) Seats: Xtreme® by Jamesbury.
    - (4) Seals: TFM.
    - (5) Miscellaneous valve hardware: 300 Series stainless steel.
  - b. Design Requirements:
    - (1) Seal welded ANSI body.
    - (2) Rated for a minimum of:
      - (a) 500 PSI CWP.
      - (b) 150 PSI of saturated steam.
      - (c) 29 IN vacuum.
    - (3) Two-piece body construction, full port design.
    - (4) Threaded connections.
    - (5) Two-position lockable handle.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- (6) Design shall ensure that excess pressure in the ball and body cavity of the closed valve will relieve spontaneously toward the direction of high pressure. Provide relief hole in the ball or body, by-paddling the upstream seat, or by use of a cavity pressure-relieving seat.
      - (7) Stem seals shall be externally adjustable.
    - c. Manufacturers:
      - (1) Metso Jamesbury, Eliminator Model 9FA.
      - (2) Approved equal.
- B. General Service
  - 1. Carbon Steel Pipe:
    - a. Coat carbon steel piping in accordance with Division 09.
    - b. Piping shall be Schedule 80, seamless carbon steel in conformance with ASTM A106.
    - c. Where indicated, insulation shall be provided. Refer to Section 22 07 19 for insulation requirements.
    - d. Joint compounds and gaskets shall be compatible with specific fluid/chemical application.
      - (1) Pressure piping for chlorine gas: Fittings shall be 3,000-lbs. cold working pressure forged carbon steel.
  - 2. Carbon Steel Valves:
    - a. Acceptable Manufacturers:
      - (1) Jamesbury, Inc.
      - (2) Apollo.
      - (3) Nibco.
      - (4) Stockham.
      - (5) Engineer-approved equal.
    - b. Compressed Air Gate Valves:
      - (1) Class 125 bronze gate valve.
      - (2) Comply with MSS SP-80.
      - (3) Materials:
        - (a) Body, bonnet, wedge: Bronze.
        - (b) Stem: Silicon bronze.
        - (c) Packing: Aramid fibers with graphite (Kevlar®).
      - (4) Design Requirements:
        - (a) 125 PSI air, 200 PSI non-shock WOG.
        - (b) Screw in bonnet, non-rising stem, solid wedge.
    - c. Valves shall be constructed of carbon steel, in conformance with ASTM A106. Ends shall be threaded or welded.
    - d. Ball valves shall have full-port ball and PTFE seals.
  - 3. Limit Switches:
    - a. Provide a closed limit switch on manual valves where required as noted on the drawings.
    - b. Support limit switch off of the pipe in which the valve is installed and be compatible with valves provided.
    - c. Electrical contacts shall be rated for 0.5 Amps at 120 VAC.
    - d. Limit switch shall be provided by same supplier as the valve that it is mounted on.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- 2.4 PLASTIC PIPE, VALVES, AND FITTINGS:
- A. Pipe and Fittings
1. Materials:
    - a. PVC plastic pipe and fittings shall be manufactured from PVC compounds as identified in ASTM D1784.
    - b. CPVC pipe per ASTM F441.
  2. Manufacturers:
    - a. Acceptable PVC Schedule 80 Manufacturers:
      - (1) Chemtrol/NIBCO.
      - (2) Colonial Engineering.
      - (3) George Fischer.
      - (4) IPEX.
      - (5) Engineer-approved equal. No other PVC manufacturers are acceptable for the Sodium Permanganate Chemical System.
    - b. Acceptable PVC Primer and Cement:
      - (1) Oatey.
      - (2) Engineer-approved equal. No other PVC primer and cement are acceptable for the Sodium Permanganate Chemical System.
    - c. Acceptable Valve Manufacturers:
      - (1) Chemtrol.
      - (2) +GF+ Signet.
      - (3) Engineer-approved equal. No other valve Manufacturers are acceptable for the Sodium Permanganate Chemical System.
  3. Fittings:
    - a. Exposed service:
      - (1) Solvent welded socket type complying with ASTM D2467.
    - b. Buried service:
      - (1) Solvent welded socket type complying with ASTM D2466.
- B. PVC Plastic Pipe: Schedule 80, ASTM D1785.
- C. PVC Plastic Pipe Fittings: Schedule 80, ASTM D2467.
1. Piping Insulation is specified in Section 22 07 19. Location of insulation shall be as indicated on the Contract Drawings.
  2. Pressure rating: Not less than 150 psig at 73°F.
    - a. Carbon dioxide system: Not less than 250 psig at 73°F.
- D. Plastic Ball Valves:
1. Materials:
    - a. Body: Two- or three-piece PVC to match piping.
    - b. Ball: Full-port PVC to match piping.
    - c. Seats: Suitable for fluid being handled and working temperatures and pressures.
    - d. Seals: Suitable for fluid being handled and working temperatures and pressures.
      - (1) Sodium permanganate:
        - (a) AFLAS.
        - (b) Santoprene.
        - (c) Silicone.
        - (d) Teflon.
        - (e) No other materials are acceptable.
  2. Design Requirements:
    - a. End Connections: Double union design with socket or flanged connections.
    - b. Handle Style: Tee shape.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- c. Cold Working Pressure Rating: Equal to piping service.
- d. Maximum Operating Temperature: Equal to piping service.
- e. Comply with MSS SP-122.
- f. PVC Ball Valves, NPS 2 (DN 50) and smaller: MSS-SP-122, union type with socket ends.
- g. PVC Valves shall vent toward the high-pressure side in event of pressure buildup inside the valve body while closed.
- 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hayward Industrial Products, Inc.
  - b. IPEX, Inc.
  - c. Spears
  - d. George Fisher Model 546.
  - e. Chemtrol.
  - f. Engineer-approved equal.
  - g. ONLY George Fisher and Chemtrol are acceptable for sodium permanganate system, no other manufacturers will be considered.
- E. Plastic Ball Electric Motor Actuators
  - 1. General:
    - a. Self-contained including motor, worm gearing, limit switches and cast housing.
    - b. Electrical enclosure: NEMA 4X/IP-67 to comply with area rating classification shown on Drawings.
    - c. Factory assembled requiring only field connection of power and control wires.
    - d. Continuous position indicator.
  - 2. Motors:
    - a. Produce 1.5 times the required torque.
    - b. Sized for two (2) complete open-close cycles without overheating.
    - c. Class F insulation.
    - d. Operate at plus or minus 10 % voltage.
    - e. 120 Volt, single phase, 60 Hz.
    - f. Provide thermal cutout switch for actuator enclosure.
    - g. Control wiring as shown on Drawings.
  - 3. Controls:
    - a. Integral control station
    - b. Local-Off-Remote Selector
    - c. Open-Stop-Close Selector
    - d. Limit switches for open and closed status, Form C.
    - e. Top mounted visual position indicator.
    - f. Manual declutching over-ride with handwheel.
  - 4. Manufacturers:
    - a. Hayward EJM.
    - b. RCEL.
    - c. Rotork RomPak.
    - d. Engineer-approved equal.
- F. Plastic Ball Check Valves:
  - 1. Materials:
    - a. Body: Two- or three-piece PVC to match piping.
    - b. Ends: Socket or flanged.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- c. Seats: suitable for fluid being handled and working temperatures and pressures.
    - (1) Sodium permanganate seats/seals/O-rings:
      - (a) AFLAS.
      - (b) Santoprene.
      - (c) Silicone.
      - (d) Teflon.
  - 2. Design Requirements:
    - a. Check Style: Spring loaded ball-cone inline check valve.
    - b. CWP Rating: Equal to piping service.
    - c. Maximum Operating Temperature: Equal to piping service.
    - d. Suitable for required chemical solution feed.
  - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Hayward Industrial Products, Inc.
    - c. IPEX, Inc.
    - d. Spears.
    - e. Engineer-approved equal.
    - f. ONLY George Fisher and Chemtrol are acceptable for sodium permanganate system, no other manufacturers will be considered.
- G. Plastic Swing Check Valves:
- 1. Materials:
    - a. Body: PVC to match piping.
    - b. Ends: Socket or flanged.
    - c. Seats: suitable for fluid being handled and working temperatures and pressures.
  - 2. Design Requirements:
    - a. Check Style: Swing.
    - b. CWP Rating: Equal to piping service.
    - c. Maximum Operating Temperature: Equal to piping service.
    - d. Suitable for required chemical solution feed.
  - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Asahi/America.
    - b. Hayward Industrial Products, Inc.
    - c. IPEX, Inc.
    - d. Spears.
    - e. Engineer-approved equal.
    - f. ONLY George Fisher and Chemtrol are acceptable for sodium permanganate system, no other manufacturers will be considered.
- H. Y-Strainers:
- 1. Strainer body and basket shall be fabricated from PVC material.
    - a. Sodium Permanganate strainer body and basket shall be fabricated from 316 stainless steel.
  - 2. Provide for cleaning without removal from pipe.
  - 3. Strainer basket mesh opening size shall be 1/32 inch.
  - 4. O-ring gasket material shall be EPDM as appropriate for all chemicals except sodium permanganate.
    - a. Sodium permanganate O-ring gasket material:
      - (1) AFLAS.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- (2) Santoprene.
      - (3) Silicone.
      - (4) Teflon.
      - (5) No other materials are acceptable.
    - 5. Full-port full-flow openings.
  - I. Overflow Check Valves:
    - 1. Slip on or flange connection.
    - 2. Less than 2" cracking pressure.
    - 3. Manufacturers:
      - a. Tideflex Series TF-1.
      - b. Engineer- approved equal.
  - J. Vacuum Breakers
    - 1. Materials:
      - a. Valve body: PVC or CPVC to match connecting piping.
      - b. Diaphragm: FKM all but sodium permanganate.
        - (1) Acceptable materials for sodium permanganate:
          - (a) PTFE.
          - (b) Polypropylene
          - (c) PVDF
          - (d) Engineer Approved equal.
    - 2. Design Requirements:
      - a. Opening vacuum: -1.0 psig
      - b. Designed for anti-siphon service
      - c. Provide ¾-inch valves unless otherwise noted on the Drawings.
      - d. Socket end connection
    - 3. Manufacturers:
      - a. Plast-o-matic Valves, Inc., Model VBM.
      - b. Engineer-approved equal.
- 2.5 POLYETHYLENE PIPE AND FITTINGS
  - A. Chlorine Solution Service (Buried)
    - 1. Pipe
      - a. Manufacturers
        - (1) Phillips Driscopipe.
        - (2) Plexco.
        - (3) Polypipe.
        - (4) Engineer-approved equal.
      - b. Materials
        - (1) High density polyethylene pipe (HDPE) shall be fabricated per ASTM 3408.
        - (2) Furnish materials in compliance with the following:
          - (a) Material description: ASTM D1248, Type III, Class C, Category 5, Grade P34.
          - (b) Cell classification: ASTM D3350.
          - (c) ESCR: ASTM D1693, condition C, Fo>5,000 HRS.
          - (d) Modulus of elasticity: ASTM D638, 130,000 PSI.
          - (e) Hardness: ASTM D2240, 65 Shore D.
          - (f) DR: 17.0 (125 psig).
          - (g) IPS for line size greater than 1 IN.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- (h) CTS for line size less than or equal to 1 IN.
  - 2. Fittings
    - a. ASTM D2513.
    - b. DR: 17.0 (125 psig).
    - c. 1/2 to 3 IN: ASTM D2683.
    - d. 4 to 10 IN: ASTM D3261.
    - e. End connections:
      - (1) Socket fused ends for fittings 1 IN and under.
      - (2) Butt-fused ends for fitting 1-1/2 IN and greater.
    - f. Mitered or field fabricated fittings are not allowed.
  - 3. Transition Fittings
    - a. Provide where indicated on the Drawings for transitions between PVC and HDPE.
    - b. Fittings shall have the same pressure rating as the connecting pipe.
- 2.6 CAM AND GROOVE COUPLERS FOR CHEMICAL SERVICE:
- A. Male Adapters
    - 1. Female NPT x male adapter.
    - 2. Type 316 stainless steel construction.
    - 3. Type 316 for sodium permanganate.
    - 4. Dixon Type A or equal.
  - B. Dust Caps
    - 1. Dual cam arm type with lanyard or chain.
    - 2. PTFE gasket.
    - 3. Type 316 stainless steel construction.
    - 4. Type 304 for sodium permanganate.
    - 5. Dixon Type DC or equal.
- 2.7 PLASTIC TUBING AND ENCASEMENT PIPE:
- A. Carrier Tubing Physical Properties:
    - 1. All inside tubing diameters to be greater than or equal to pipe size noted on Drawings.
  - B. Wire Reinforced PVC Tubing
    - 1. Plastic tubing for water sampling or chemical feed shall be NSF-61 approved PVC rated for a minimum of 30 psi or equal to two (2) times the system's pump discharge pressure (as specified in applicable pump specification), whichever is larger.
    - 2. Band clamps or other metallic hardware shall be stainless steel.
    - 3. Tubing manufactured for working temperatures from 5 to 180 DEGF.
  - C. Polyethylene
    - 1. Tubing for chlorine gas service shall be polyethylene, instrument grade, NSF-61 approved with a minimum pressure rating of 125 psig.
    - 2. Fittings shall be clamp-less, compression type thermoplastic type with O-rings suitable for chlorine service.
    - 3. Tubing and fittings shall be as manufactured by Parker Hannifin Corp. or approved equal.
  - D. High Density Polyethylene Tubing
    - 1. Tubing for sodium permanganate shall be a chemically compatible polyethylene, NSF-61 approved with a minimum pressure rating of 150 psig.
    - 2. Tubing manufactured for working temperatures from 5 to 180 DEGF.
  - E. Fittings:
    - 1. Install tubing with fittings and connectors compatible with the pumped medium.
    - 2. Use barbed type adapters with stainless steel clamps unless otherwise specified.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

3. Provide fittings capable of withstanding temperatures from –70 to 250 DEGF.
  4. Ensure fittings have the same pressure and temperature rating as the tubing.
  5. Ensure all wetted components are compatible with the pumped medium.
  - F. Encasement pipe (for flexible carrier tubing):
    1. Material: PVC, Type 1, Grade 1, Schedule 80.
    2. Reference: ASTM D1785.
    3. Fittings: Solvent welded socket type complying with ASTM 2466.
    4. Joints: Solvent welded.
- 2.8 METALLIC TUBING:
- A. Metallic tubing for water sampling shall be stainless steel rated for a minimum 30 psi or equal to the system’s pump shutoff head (as specified in applicable pump specification), whichever is larger.
- 2.9 COPPER PIPE, VALVES AND FITTINGS:
- A. Carbon Dioxide Gas Service:
    1. Pipe:
      - a. Exposed service:
        - (1) Copper tubing, Type L.
        - (2) Reference: ASTM B88.
        - (3) Fittings: Wrought copper or bronze fittings meeting ASME B16.22.
        - (4) Joints: Soldered or brazed with unions at valves and equipment.
      - b. Buried service:
        - (1) Material: Copper tubing, Type K.
        - (2) Reference: ASTM B88.
        - (3) Fittings AWWA C800.
        - (4) Joints: Flared.
    2. Gaskets and O-rings: Neoprene, 250 DegF.
    3. Pressure rated for minimum of 500 PSI working pressure.
    4. Slope all piping mains approximately 1:100 toward points of drainage.
    5. Provide drip legs at all low points:
      - a. Provide ball type isolation valve at an accessible location.
      - b. Route dripleg to nearest wall or column and terminate 4 FT above finished floor.
    6. Insulation: Install on liquid CO2 lines between the storage tank and vaporizers for operator safety.
    7. Ball Valves:
      - a. Materials:
        - (1) Body: Brass ASTM B283.
        - (2) Ball and stem: chrome plated lead free brass.
        - (3) Seats and seals: RPTFE or PTFE.
      - b. Design Requirements:
        - (1) Rated for minimum of 500 PSI working pressure.
        - (2) UL 1477Two-piece body construction, full port design.
        - (3) Threaded connections.
        - (4) Two-position lockable handle.
        - (5) Blow-out proof stem.
        - (6) Adjustable stem packing.
        - (7) Lead free.



SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- c. Manufacturers:
  - (1) Apollo Valves.
  - (2) Engineer-approved equal.
- 8. Motor Actuator:
  - a. General:
    - (1) Self-contained including motor, worm gearing, limit switches and cast housing.
    - (2) Electrical enclosure: NEMA 4X/IP-67 to comply with area rating classification shown on Drawings.
    - (3) Factory assembled requiring only field connection of power and control wires.
    - (4) Continuous position indicator.
  - b. Motors:
    - (1) Produce 1.5 times the required torque.
    - (2) Sized for two (2) complete open-close cycles without overheating.
    - (3) Class F insulation.
    - (4) Operate at plus or minus 10 PCT voltage.
    - (5) 120 Volt, single phase, 60 Hz.
    - (6) Provide thermal cutout switch and internal heater for actuator enclosure.
    - (7) Control wiring as shown on Drawings.
  - c. Controls:
    - (1) Integral control station
    - (2) Local-Off-Remote Selector
    - (3) Open-Stop-Close Selector
    - (4) Limit switches for open and closed status, Form C.
    - (5) Top mounted visual position indicator.
    - (6) Manual declutching over-ride with handwheel.
  - d. Manufacturers:
    - (1) Hayward EJM.
    - (2) RCEL.
    - (3) Rotork RomPak
- 9. Gas Pressure Regulators:
  - a. Acceptable manufacturers:
    - (1) Rego.
    - (2) Fisher.
    - (3) Engineer-approved equal.
  - b. Design requirements:
    - (1) Self-contained, diaphragm operated.
      - (a) Spring loaded.
      - (b) Field adjustable.
    - (2) Carbon dioxide gas service, CSA approved.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

(3) Valve schedule:

Valve Tag (5525-NWW-401-REG-____)	0011	0012	0021	0022
Maximum inlet pressure, psig	450	450	450	450
Minimum inlet pressure, psig	245	245	245	245
Reduced pressure setting, psig	40-110	40-110	40-110	40-110
Maximum flow, scfm	135	135	335	335
Ordinary flow, scfm	60	60	95	95
Minimum flow, scfm	1	1	2	2
Minimum permissible pressure at maximum flow, psig	TBD	TBD	TBD	TBD
Specific gravity of gas	1.52	1.52	1.52	1.52

2.10 DRY CHEMICAL FILL PIPES:

- A. Fill pipes for dry lime and soda ash silos.
- B. Fill Pipe:
  - 1. Material: Steel, Schedule 40, Grade B, black.
  - 2. Reference: ASTM A53.
  - 3. Coating: Paint per Specification 09 90 00.
  - 4. Lining: None.
  - 5. Fittings: Steel, Schedule 40, Grade B, black.
  - 6. Joints: Welded with flanges at fittings, equipment, and valves.
- C. Fill Pipe Flexible Piping:
  - 1. Acceptable Manufacturers:
    - a. Federal Hose, SuperFlex SF400.
    - b. Engineer-approved equal.
  - 2. Materials:
    - a. 0.018 IN thick 304 stainless steel flexible pipe with silicon packing rated to 300 Deg F.
    - b. 150# ANSI 304 stainless steel floating flanges on each end of spool.

2.11 JOINING MATERIALS:

- A. Carbon Steel Pipe for Chlorine Service
  - 1. Flanges:
    - a. ASTM A105, Class 150, ASME B16.5 forged steel, raised face, tongue and groove, threaded or ASTM A350 Grade LF2, Class 1, Class 300 forged steel raised face or tongue and groove socket weld, ASME B16.5.
  - 2. Flange Hardware
    - a. Bolts:
      - (1) Conform to ANSI/ASME B18.2.1, ASTM A193, Grade B7. Bolt threads in accordance with ANSI/ASME B1.1, Class 2A fit or ASTM A320 Grade L7 allow steel stud bolts and cap screws, ASME B18.2.1.
    - b. Nuts:
      - (1) Conform to ANSI/ASME B18.2.2, ASTM A194, Grade 2H, 4L or L7, heavy hex.
    - c. Gaskets:
      - (1) Non-asbestos type, barium sulfate or silicate filled PTFE in accordance with CI Pamphlet 95.
      - (2) Chemical lead (2 to 4 percent antimony) for tongue and groove flanges.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- (3) Manufacturers:
      - (a) Garlock Sealing Technologies, Gylon 3510.
      - (b) Gasket Resources Inc., Durlon 9000.
  - 3. Threaded Joint Accessories
    - a. Tape:
      - (1) 100 percent PTFE tape certified for chlorine service.
    - b. Thread Sealant:
      - (1) NSF/ANSI 61 certified.
      - (2) Suitable for pressures up to 3,000 psig.
  - 4. Ammonia Unions
    - a. General:
      - (1) Designed specifically for chlorine liquid and gas service.
      - (2) Two bolt design for ½ IN to 1 IN nominal.
      - (3) Four bolt design for 1 IN to 4 IN nominal.
    - b. Construction:
      - (1) Flange body of ASTM A105 forged steel.
      - (2) SAE Grade 5 steel bolts.
      - (3) Lead gaskets.
    - c. Manufacturers:
      - (1) Henry-Tech.
      - (2) Engineer-approved equal.
- B. Carbon Steel Pipe (Non-chlorine service)
  - 1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
    - a. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
      - (1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      - (2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. Flange Bolts and Nuts: ASTM 193/193M and ASTM 194/194M, stainless steel, unless otherwise indicated.
  - 3. Welding Filler Metals: Comply with ASME Section IX for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Plastic Piping
  - 1. Pipe-Flange Gaskets:
    - a. Suitable for chemical and thermal conditions of piping system contents.
    - b. Low torque type specifically designed for plastic pipe use.
    - c. Materials:
      - (1) Sodium hydroxide service: EPDM.
      - (2) Sodium Permanganate service: PTFE.
      - (3) All other chemical service: Viton, FKM.
    - d. Manufacturers:
      - (1) Proco 9013-ET (EPDM with PTFE Coating)
      - (2) Proco 9013-EP (EPDM with Peroxide Cure)
  - 2. Bolts, and Nuts:
    - a. ASTM 193/193M and ASTM 194/194M, stainless steel.
  - 3. Solvent Cements for Joining Plastic Piping:
    - a. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
      - (1) PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- (2) Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- b. All solvents shall be suitable for applicable chemical service.

2.12 TRANSITION FITTINGS:

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Charlotte Pipe and Foundry Company.
  - b. IPEX, Inc.
  - c. KBi.
  - d. Engineer Approved Equal.
2. PVC one-piece fitting with one threaded steel, brass or copper insert and one Schedule 80 solvent-cement-joint end. Material shall be compatible with chemical service.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Charlotte Pipe and Foundry Company.
  - b. IPEX, Inc.
  - c. KBi.
  - d. NIBCO INC.
  - e. Engineer Approved Equal.
2. MSS SP-107, PVC union. Include steel, brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union. Material shall be compatible with chemical service.

C. Plastic Pipe-to-Plastic Tubing Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Charlotte Pipe and Foundry Company.
  - b. IPEX, Inc.
  - c. KBi.
  - d. NIBCO INC.
  - e. Engineer Approved Equal.
2. PVC one-piece fitting with one threaded steel, brass or copper insert and one Schedule 80 solvent-cement-joint end. Material shall be compatible with chemical service.

2.13 PIPE HANGERS AND SUPPORTS:

- A. Pipe hangers, inserts, and supports shall conform to MSS SP-58, except as modified herein, and to Section 22 05 29. Pipe hanger types 5, 12, and 26 shall not be used.
- B. Refer to Drawings for maximum allowable unsupported spans.
- C. Horizontal Pipe Supports: Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping.
- D. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals as required.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

2.14 PRESSURE REGULATOR (INSTALLED ON SAMPLE LINE):

- A. Acceptable Manufacturers:
  - 1. Fisher Series MR95HP
  - 2. Engineer-approved equal.
- B. Design:
  - 1. Valve shall have a field adjustable outlet pressure rating through an adjusting screw/jam nut.
  - 2. Valve shall have an external pressure registration feature through a control line that taps on downstream end of the basket strainer.
  - 3. Valve shall have a size of 2 Inches
  - 4. The flow through the valve will not exceed 5 GPM.
  - 5. Valve is subject to inlet pressures ranging from 20 psi to 95 psi during normal operation and nearly 350 psi during pressure surges.
  - 6. Valve shall have an outlet pressure setting of about 15 psi.
  - 7. Valve should be provided with a 1/4" NPT vent connection.
- C. Materials and Construction:
  - 1. Body – Carbon Steel
  - 2. End Connection – NPT
  - 3. Trim – 416 Stainless Steel
  - 4. Actuator – Carbon Steel
  - 5. Diaphragm – Neoprene
  - 6. Disk – NBR
  - 7. Seat Ring – 416 Stainless Steel
- D. Operation:
  - 1. Downstream pressure is registered externally through a control line located on the underside of the diaphragm and that taps into the downstream end of the valve.
  - 2. Valve remains open as long as the downstream pressure is below the outlet pressure setting of the spring.
  - 3. Valve begins to close when the downstream pressure is equal to or exceeds the outlet pressure setting of the spring. The disk is held against the orifice, restricting fluid flow through the regulator.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS:

- A. As indicated on Process Drawings.

3.2 VALVE APPLICATIONS:

- A. As indicated on Process Drawings.

3.3 EXAMINATION:

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.4 PIPING INSTALLATION:

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. 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. Install piping to permit valve servicing.
- C. Install piping at indicated slopes.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Select system components with pressure rating equal to or greater than system operating pressure.
- G. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- H. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- I. Install sleeves and sleeve seals for piping penetrations of walls, ceilings, and floors as indicated in Drawings.
- J. Install piping adjacent to equipment and machines to allow service and maintenance.
- K. Support flexible hoses/tubing when there is a chance that the hoses may pulse or move specifically at changes in direction where tubing spans between two carrier pipes that are not connected.

3.5 HDPE PIPE JOINING:

- A. HDPE pipe joints shall be fused on the surface prior to installation into the trench.
- B. Alternative methods of fusing shall be approved by the Engineer.
- C. PE pipe 1 IN and under shall be socket fused.
- D. PE pipe joints 1-1/2 IN and over shall be buttfused.
- E. Fusion joiner must be qualified by type of fusion (i.e., butt fusion, socket fusion or sidewall fusion) and fuse pipe only as qualified.
- F. Each joint must be visually inspected inside and outside for damage, dirt, moisture, or any other abnormalities prior to fusing.
- G. All joint fusion shall be performed in strict accordance with the manufacturer's specifications.
- H. All fusion equipment must be approved by the manufacturer and operated by qualified and certified operators.

3.6 VALVE INSTALLATION:

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- E. Verify that all valves are installed in the correct direction with regards to flow and pressure.

3.7 PIPE JOINT CONSTRUCTION:

- 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. 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 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.
- E. Welded Joints:
  - 1. Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
  - 2. Chlorine Service Joints (Steel):
    - a. Do not weld pipe containing chlorine or chlorine residues.
    - b. All pipe-to-pipe welded connections shall be butt welded.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join ASTM D1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D2855.
  - 3. PVC Non-pressure Piping: Join according to ASTM D2855.

3.8 LABELING AND IDENTIFICATION:

- A. Install pipe markers and valve tags on piping. Distinguish between different systems and include direction of flow indication on each pipe. Comply with requirements for identification specified in Section 22 05 53.
- B. All lettering shall be ½-inch or larger.
- C. Provide arrows indicating direction of flow.
- D. Label design shall be per Kansas Department of Health standard.
  - 1. Permanganate piping: violet with white lettering.
  - 2. Ferric piping: orange with black lettering.
  - 3. Polymer piping: orange with green band and black lettering.
  - 4. Carbon dioxide piping: dark green with red band and white lettering.
  - 5. Polyphosphate piping: light green with red band and black lettering.
  - 6. Orthophosphate piping: light green with red band and black lettering.
  - 7. Lime piping: light green with black lettering.
  - 8. Soda ash piping: light green with white band and black lettering.
  - 9. Chlorine gas piping: yellow (under vacuum), yellow with red back (under pressure), and black lettering.

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

10. Chlorine solution piping: yellow with white band and black lettering.
  11. Liquid ammonium sulfate piping: white with black lettering.
  12. Sample piping: light gray with black lettering.
  13. Finished water piping: dark blue with white lettering.
  14. Filtered water piping: dark blue with white lettering
  15. Potable water piping: dark blue with white lettering
  16. Backwash supply piping: light blue with black lettering
- 3.9 CLEANING:
- A. Use procedures described below:
    1. Clean interior of piping. Remove dirt and debris as work progresses.
    2. Place plugs in ends of uncompleted piping at end of day and when work stops.
    3. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
    4. Clean piping by flushing with potable water.
  - B. Chlorine System Piping
    1. Clean chlorine piping in accordance with CI Pamphlet 6.
    2. Cleaning solvent shall be trichloroethylene, perchlorate, or hexane. Alcohols will not be allowed.
- 3.10 INSULATION:
- A. Piping insulation is specified in Section 22 07 19. Location of insulation shall be as indicated on the Contract Drawings.
- 3.11 FIELD QUALITY TESTING AND CONTROL:
- A. Prepare piping according to ASME B31.3 and as follows:
    1. Leave joints, including welds, uninsulated and exposed for examination during test.
    2. All joints, welds, and bonds shall be left uninsulated and exposed during test, except for the following:
      - a. Joints previously tested in accordance with ASME B31.3
      - b. At the Owner's option, joints subject to Category D Fluid Service of ASME B31.3 hydrostatic leak testing or initial service leaking test may be insulated and have protective coating weather sheathing installed prior to leak testing. These fluids are defined as:
        - (1) Fluid being handled is nonflammable, nontoxic, and not damaging to human tissues
        - (2) The design gauge pressure does not exceed 150 psig.
        - (3) The design temperature is not greater than 366°F.
    3. Joints in may be primed and painted prior to leak testing unless a sensitive leak test is required.
    4. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
    5. Flush piping systems with clean water; then remove and clean or replace strainer screens.
    6. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.



SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

- B. Non-Chlorine Liquid and Pressurized Gas Pipe Testing
  - 1. Perform hydrostatic pressure testing in accordance with ASME B31.3, “Process Piping”. Including, but not limited to:
    - a. Metallic Piping:
      - (1) At every point in the piping system, pressure testing shall not be less than 1.25 times the design pressure.
      - (2) When design temperature is greater than the test temperature:
        - (a) The minimum test pressure, at the point under consideration, shall be calculated using methodology described in ASME B31.3, “Process Piping”, Part 345.4.2.
    - b. Nonmetallic Piping:
      - (1) Hydrostatic test pressure shall not be less than 1.25 times the design pressure and shall not be greater than 1.5 times the maximum rated pressure of the lowest rated component in the system.
    - c. Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary, to support the weight of the test liquid.
    - d. Piping systems containing unrestrained expansion joints shall be leak tested without any temporary restraints up to 150% of the expansion joint design pressure.
    - e. Use ambient temperature water as a testing medium, unless there is risk of damage due to freezing or unless water will result in adverse effects on process. Another liquid that is safe for workers and compatible with piping may be used.
    - f. Where necessary for testing, install vents at high points and drains at low points in piping. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
    - g. After hydrostatic test pressure has been applied for at least 10 min., examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
    - h. Prepare written report of testing.
  - C. Liquid and Pressurized Gas Chlorine Service Pipe Testing
    - 1. General:
      - a. Testing includes cleaning, hydrostatic liquid or nitrogen pressure testing, and chlorine gas leak testing.
      - b. Test chlorine solution piping downstream of the injectors in accordance with Sections 40 05 00 and 40 05 31.
    - 2. Hydrostatic Pressure Testing
      - a. If drying after hydrostatic testing is impractical or cannot be accomplished, test steel piping by pneumatic testing as specified herein and per Chlorine Institute Pamphlet No. 6. When performing pneumatic testing, implement safety precautions to safeguard personnel and minimize risk.
      - b. Evaporator Piping:
        - (1) Disconnect vent from discharge side of pressure relief valve of each evaporator, plug resultant opening, inspect, and secure all joints, close valves that discharge to atmosphere, and open all inline valves. Open valve in bypass line around pressure reducing valve on downstream side of each evaporator to provide a through path around valve.
        - (2) Test system as specified.
        - (3) After testing, restore equipment, valves, and piping to pre-test positions and close inline valves. Reconnect vent line to downstream side of pressure

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

relief valve of each evaporator and close valve in bypass line around the pressure reducing valve on downstream side of each evaporator.

- c. Pressure Testing:
  - (1) Fill pipe with water and hydrostatically test in accordance with this Section.
  - (2) Hydrostatic test pressure shall be 1.5 times the maximum operating pressure to which the system may be subjected. Hydrostatically test vacuum piping to at least 25 psig.
  - (3) After hydrostatic testing, replace all moisture absorbing gaskets and valve packing.
- d. Drying:
  - (1) Chlorine piping systems shall be dried prior to testing and placing in service. Drying is required for all piping regardless of whether water has been purposely introduced to the system.
  - (2) Steel Pipe: drying shall be accomplished by passing steam through piping from high end of system until piping is heated to approximately 200 degrees F unless lower temperature is required to protect the system from damage. While steaming, allow condensate and foreign matter to drain from the pipe. Disconnect steam supply and drain pockets and low spots in the pipe. While the pipe is still warm, blow dry, oil-free air with a dew point of -40 degrees F or below, or nitrogen, through pipe until the exiting air dew point is equal to supply air dew point. Valves shall be at half-open position during drying. Valves removed temporarily from system during drying must be free of moisture before being re-installed.
  - (3) Plastic Pipe: dry gas piping only. Drain and remove all water and moisture from system. After draining, "pig" the pipe to remove excess water. Dry the system with air or nitrogen in accordance with requirements for steel pipe, except that steam shall not be used on plastic pipe.
- e. Nitrogen Pressure Testing:
  - (1) Perform nitrogen testing on steel chlorine liquid and vapor piping as an alternative to hydrostatic testing. Gradually introduce nitrogen pressure to 25 psig. Maintain this pressure while testing all joints along the pipe for leaks with soapy water solution. When system is free from leaks at this pressure, increase test pressure in increments of approximately 25 psig up to the highest of either 150 psig, the specified test pressure or 110 percent of the maximum system operating pressure. After each increase in pressure, check for leaks using soapy water solution and implement corrective action as necessary.
  - (2) When the system has no leaks at final test pressure, system shall be depressurized, the test source disconnected, and the system capped to prevent the entrance of water.
  - (3) Use cylinders of dry, high-purity nitrogen gas, nitrogen handling cylinder mounted pressure regulator with 0 to 300 psig range, and necessary fittings and adapters to connect the source to the pipe being tested. Pressure regulator shall be self-relieving type, venting to atmosphere, and include a throttling valve.
- f. Chlorine Gas Leak Testing:
  - (1) After pressure testing with water or nitrogen and pipe drying or nitrogen purging, gradually introduce chlorine gas from the bulk storage tank vapor

SECTION 46 31 12 – CHEMICAL SYSTEM PIPING AND COMPONENTS: continued

outlet to the piping. After gas has filled the pipe, increase the pressure to 5 psig and check all joints for leaks. Piping may be tested in sections.

- (2) Implement safety precautions to safeguard personnel and minimize risk when performing service gas leak test.
  - (3) Use a liquid ammonia solution or chlorine gas detector to check for chlorine leaks. When using liquid ammonia solution, spray solution at pipe joints and connections. Leaks in piping and equipment, if detected, shall not be repaired until all gas has been purged from the system being tested. Upon completion of repairs, repeat cleaning, drying, nitrogen testing, and service gas leak testing.
- D. Perform the following before operating the system:
1. Open manual valves fully.
  2. Test emergency shut-off valves.
  3. Inspect pumps for proper rotation.
  4. Inspect and set operating temperatures of equipment to specified values.
  5. Verify lubrication of motors and bearings.
- E. Test new piping and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.

END OF SECTION 46 31 12