



ENGINEERING CLARIFICATION

EC TITLE: V-Bio Enhanced Polyethylene Encasement
PROJECT: 3 Kings Water Treatment Plant

EC NO.: 7
DATE: 3/13/2020
STATUS: Open

SECTION 1: BY CONTRACTOR

QUESTION:

Owner requested that V-Bio enhanced polyethylene encasement replace the polyethylene encasement (bagging) specified in Section 40 27 00, 2.06 and 3.10.

DRAWING NO.:

POTENTIAL COST IMPACT:

SPECIFICATION SECTION: 40 27 00 Process Piping—General **POTENTIAL SCHEDULE IMPACT:**

PROPOSED SOLUTION:

See attached revisions to Section 40 27 00, 2.06 and 3.10, that includes V-Bio enhanced polyethylene encasement.

COMMENTS:

INITIATOR: Zalla, Joseph/SLC

PRIORITY: Normal

ANTICIPATED RESPONSE DATE:

SECTION 2: BY REVIEWER

RESPONSE:

COMMENTS:

REVIEWED BY:

REVIEWED DATE:

SECTION 40 27 00
PROCESS PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
1. American Association of State Highway and Transportation Officials (AASHTO): HB-17, Standard Specifications for Highway Bridges.
 2. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
 3. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - b. B1.20.1, Pipe Threads, General Purpose (Inch).
 - c. B16.1, Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
 - d. B16.3, Malleable Iron Threaded Fittings Classes 150 and 300.
 - e. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
 - f. B16.9, Factory-Made Wrought Buttwelding Fittings.
 - g. B16.11, Forged Fittings, Socket-Welding and Threaded.
 - h. B16.15, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
 - i. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
 - j. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - k. B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings Classes 150, 300, 600, 900, 1500, and 2500.
 - l. B16.25, Buttwelding Ends.
 - m. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
 - n. B31.1, Power Piping.
 - o. B31.3, Process Piping.
 - p. B31.9, Building Services Piping.
 - q. B36.10M, Welded and Seamless Wrought Steel Pipe.
 4. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Recommended Practice for Personal Qualification and Certification in Nondestructive Testing.

5. American Water Works Association (AWWA):
 - a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
 - d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - f. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast.
 - g. C153/A21.53, Ductile-Iron Compact Fittings.
 - h. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
 - i. C606, Grooved and Shouldered Joints.
6. American Welding Society (AWS):
 - a. Brazing Handbook.
 - b. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
 - c. D1.1/D1.1M, Structural Welding Code - Steel.
 - d. QC1, Standard for AWS Certification of Welding Inspectors.
7. ASTM International (ASTM):
 - a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
 - d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - f. A135/A135M, Standard Specification for Electric-Resistance-Welder Steel Pipe.
 - g. A139/A139M, Standard Specification for Electro-Fusion (Arc)-Welded Steel Pipe (NPS 4 Inches and Over).
 - h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - i. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
 - j. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
 - k. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

- l. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- m. A197/A197M, Standard Specification for Cupola Malleable Iron.
- n. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- o. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- p. A276, Standard Specification for Stainless Steel Bars and Shapes.
- q. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- r. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- s. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- t. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
- u. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- v. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- w. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
- x. A536, Standard Specification for Ductile Iron Castings.
- y. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- z. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
- aa. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
- bb. A744/A744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
- cc. A774/A774M, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
- dd. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
- ee. B32, Standard Specification for Solder Metal.
- ff. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- gg. B61, Standard Specification for Steam or Valve Bronze Castings.
- hh. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- ii. B75/B75M, Standard Specification for Seamless Copper Tube.

- jj. B88, Standard Specification for Seamless Copper Water Tube.
- kk. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
- ll. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
- mm. B464, Standard Specification for Welded UNS N08020 Alloy Pipe.
- nn. B474, Standard Specification for Electric Fusion Welded Nickel and Nickel Alloy Pipe.
- oo. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- pp. D413, Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate.
- qq. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
- rr. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- ss. D1330, Standard Specification for Rubber Sheet Gaskets.
- tt. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- uu. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- vv. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- ww. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- xx. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- yy. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- zz. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- aaa. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
- bbb. D3222, Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
- ccc. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

- ddd. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
- eee. D4894, Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.
- fff. D4895, Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion.
- ggg. F423, Standard Specification for Polytetrafluoroethylene (PTFE) Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges.
- hhh. F436, Standard Specification for Hardened Steel Washers.
- iii. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- jjj. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- kkk. F441/F441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- lll. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- mmm. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- nnn. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 8. FM Global (FM).
- 9. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought and Fabricated Butt-Welding Fittings for Low-Pressure, Corrosion Resistant Applications.
- 10. NSF International (NSF):
 - a. ANSI 61: Drinking Water System Components - Health Effects.
 - b. ANSI 372: Drinking Water System Components - Lead Content.
- 11. National Electrical Manufacturers Association (NEMA): LI 1, Industrial Laminating Thermosetting Products.
- 12. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.02 DEFINITIONS

A. Submerged or Wetted:

- 1. Zone below elevation of:
 - a. Liquid surface or within 2 feet above top of liquid surface.

1.03 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
1. Process Piping: ASME B31.3, normal fluid service unless otherwise specified.
 2. Building Service Piping: ASME B31.9, as applicable.
 - a. Sanitary Building Drainage and Vent Systems: ICC International Plumbing Code.
 3. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.
 4. Thrust Restraints:
 - a. Design for test pressure shown in Piping Schedule.
 - b. Allowable Soil Pressure: 1,000 pounds per square foot.
 - c. Low Pressure Pipelines:
 - 1) When bearing surface of the fitting against soil provides an area equal to or greater than area required for thrust restraint, concrete thrust blocks will not be required.
 - 2) Determine bearing area for fittings without thrust blocks by projected area of 70 percent of internal diameter multiplied by chord length for fitting centerline curve.

1.04 SUBMITTALS

- A. Action Submittals:
1. Shop Fabricated Piping:
 - a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
 - b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
 2. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
 3. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
 4. Thrust Blocks: Concrete quantity, bearing area on pipe, and fitting joint locations.
 5. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
 6. Pipe Corrosion Protection: Product data.

3KINGS WTP PHASE III DESIGN

7. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer's Certification of Compliance, in accordance with Section 01 61 00, Common Product Requirements:
 - a. Pipe and fittings.
 - b. Factory applied resins and coatings.
2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Flanged Pipe and Fittings: Manufacturer's product data sheets for gaskets including torquing requirements and bolt tightening procedures.
4. Qualifications:
 - a. Nondestructive Testing Personnel: SNT-TC-1A Level II certification and qualifications.
 - b. AWS QC1 Certified Welding Inspector: Submit evidence of current certification prior to commencement of welding activities.
 - c. Welders:
 - 1) Continuity log for welders and welding operators.
 - 2) Welder qualification test records conducted by Contractor or manufacturer.
5. Welding Procedures: Qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
6. Nondestructive inspection and testing procedures.
7. Test logs.
8. Pipe coating applicator certification.
9. Laboratory Testing Equipment: Certified calibrations, manufacturer's product data, and test procedures.
10. CWI inspection records and NDE test records.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Independent Inspection and Testing Agency:
 - a. Ten years' experience in field of welding and welded pipe and fittings' testing required for this Project.
 - b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
 - c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.

- d. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.
 - e. Verification Welding Inspector: AWS QC1 Certified.
 - 2. Welding Procedures: In accordance with ASME BPVC SEC IX (Forms QW-482 and QW-483) or AWS D1.1/D1.1M (Annex N Forms).
 - 3. Welder Qualifications: In accordance ASME BPVC SEC IX (Form QW-484) or AWS D1.1/D1.1M (Annex N Forms).
 - 4. Contractor’s CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Engineer.
 - 5. Solvent Welder For Double Wall Containment Piping: Qualified in accordance with Chapter VII of the ASME B31.3 Code, Part 9, Paragraph A328.
- B. Quality Assurance: Special inspection to be provided by Owner and performed by independent inspection and testing agency for welding operations.
- 1. Note, the presence of Owner’s Special Inspector or Verification CWI does not relieve Contractor from performing own quality control, including 100 percent visual inspection of welds.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements, and:
- 1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
 - 2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
 - 3. Linings and Coatings: Prevent excessive drying.
 - 4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
 - 5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

3KINGS WTP PHASE III DESIGN

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

- A. As specified on Piping Data Sheet(s) and on Piping Schedule located on Drawings.
- B. Diameters Shown:
 1. Standardized Products: Nominal size.
 2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.
 3. Cement-Lined Steel Pipe: Lining inside diameter.

2.03 JOINTS

- A. Grooved End System:
 1. Rigid type.
 2. Use of flexible grooved joints allowed where shown on Drawings or with prior approval by Engineer.
 3. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.
- B. Flanged Joints:
 1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
 2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.
- C. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.
- D. Mechanical Joint Anchor Gland Follower:
 1. Ductile iron anchor type, wedge action, with break-off tightening bolts.
 2. Thrust rated to 250 psi minimum.
 3. Rated operating deflection not less than:
 - a. 3 degrees for sizes through 12 inches.
 - b. 2 degrees for sizes 14 inches through 16 inches.
 - c. 1.5 degrees for sizes 18 inches through 24 inches.
 - d. 1 degree for sizes 30 inches through 48 inches.
 4. UL and FM approved.

E. Flexible Mechanical Compression Joint Coupling:

1. Stainless steel, ASTM A276, Type 305 bands.
2. Manufacturers:
 - a. Pipeline Products Corp.
 - b. Fernco Joint Sealer Co.

2.04 GASKET LUBRICANT

- A. Lubricant shall be supplied by pipe manufacturer and no substitute or “or-equal” will be allowed.

2.05 DOUBLE WALL CONTAINMENT PIPING SYSTEM

- A. System components shall be pre-engineered, factory fabricated, tested, and assembled such that field assembly is minimized to primarily that of straight joints.

2.06 PIPE CORROSION PROTECTION

A. Heat Shrink Wrap:

1. Type: Cross-linked polyolefin wrap or sleeve with mastic sealant.
2. Manufacturer and Product: Raychem: WPC or TPS.

EC #7

B. Polyethylene Encasement (~~Bagging~~ V-Bio Enhanced):

1. ~~Encasement Tube: Three layer, co-extruded linear low density polyethylene (LLDPE) encasement tube, 8 mils minimum thickness after layers are fused together, impregnated with an antimicrobial and a volatile corrosion inhibitor, conforming to AWWA C105/A21.5, free of gels, streaks, pinholes, foreign matter, undispersed raw materials, and visible defects such as tears, blisters, and thinning at folds.~~ All buried ductile iron pipe shall be polyethylene encased.
2. ~~Securing Tape: Thermoplastic tape, 8 mils minimum thickness, 1 inch wide, pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene encasement tube.~~ Encasement for buried pipe shall be 8 mil linear low density (LLD), V-Bio enhanced polyethylene conforming to AWWA/ANSI C105/A21.5.
3. Marking: At a minimum of every 2 feet along its length, mark the polyethylene film with the following information:
 - a. Manufacturer's name or trademark.
 - b. Year of manufacture.
 - c. AWWA/ANSI C105/A21.5.
 - d. Minimum film thickness and material type.

- e. Applicable range of nominal diameter sizes.
f. “Warning - Corrosion Protection - Repair Any Damage”.
2.4. Plastic Adhesive Tape: Use 2-inch-wide plastic adhesive tape that meets requirements of AWWA C105.
- C. Insulating Flanges, Couplings, and Unions:
1. Materials:
 - a. In accordance with applicable piping material specified in Pipe Data Sheet. Complete assembly shall have ASME B31.3 working pressure rating equal to or higher than that of joint and pipeline.
 - b. Galvanically compatible with piping.
 - c. Resistant for intended exposure, operating temperatures, and products in pipeline.
 2. Union Type, 2 Inches and Smaller:
 - a. Screwed or solder-joint.
 - b. O-ring sealed with molded and bonded insulation to body.
 3. Flange Type, 2-1/2 Inches and Larger:
 - a. Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts.
 - b. Bolt insulating sleeves shall be provided full length between insulating washers.
 - c. Ensure fit-up of components of insulated flange assembly to provide a complete functioning installation.
 - d. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves.
 - e. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of required washers, flanges, and gasket.
 4. Flange Insulating Kits:
 - a. Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.
 - b. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA LI-1, G-10 grade).
 - c. Insulating Washers: Fiberglass-reinforced epoxy (NEMA LI-1, G-10 grade).
 - d. Steel Washers: Plated, hot-rolled steel, 1/8 inch thick.
 - 1) Flange Diameters 36 Inches or Less: Provide two washers per bolt.
 - 2) Flange Diameters Larger Than 36 Inches: Provide four washers per bolt.

5. Manufacturers and Products:
 - a. Dielectric Flanges and Unions:
 - 1) PSI, Houston, TX.
 - 2) Advance Products and Systems, Lafayette, LA.
 - b. Insulating Couplings:
 - 1) Baker Coupling Company, Inc.; Series 216.

2.07 THRUST BLOCKS

- A. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

2.08 THRUST TIES

- A. Steel Pipe: Fabricated lugs and rods in accordance with details shown on Drawings. Joint harness as specified in Section 40 27 01, Process Piping Specialties.
- B. Buried Ductile Iron Pipe and Fittings: Unless restraint is otherwise specified or shown, conform to NFPA 24. Tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

2.09 VENT AND DRAIN VALVES

- A. Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.
- B. Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

2.10 FABRICATION

- A. Mark each pipe length on outside with the following:
 1. Size or diameter and class.
 2. Manufacturer's identification and pipe serial number.
 3. Location number on laying drawing.
 4. Date of manufacture.
- B. Code markings according to approved Shop Drawings.
- C. Shop fabricate flanged pipe in shop, not in field, and delivered to Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer.

3KINGS WTP PHASE III DESIGN

2.11 FINISHES

- A. Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.
- B. Galvanizing:
 - 1. Hot-dip applied, meeting requirements of ASTM A153/A153M.
 - 2. Electroplated zinc or cadmium plating is unacceptable.
 - 3. Stainless steel components may be substituted where galvanizing is specified.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.02 PREPARATION

- A. See Piping Schedule and Section 09 90 00, Painting and Coating, for additional requirements.
- B. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.
- C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions, except for damaged glass-lined pipe that is to be promptly removed from Site.

3.03 WELDING

- A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.3 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting manufacturer.
- B. Weld Identification: Keep paper record of which welder welded each joint.

- C. Pipe End Preparation:
 1. Machine Shaping: Preferred.
 2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
 3. Beveled Ends for Butt Welding: ASME B16.25.

- D. Surfaces:
 1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
 2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
 3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

- E. Alignment and Spacing:
 1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
 2. Root Opening of Joint: As stated in qualified welding procedure.
 3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

- F. Climatic Conditions:
 1. Do not perform welding if there is impingement of any rain, snow, sleet, or wind exceeding 5 mph on the weld area, or if ambient temperature is below 32 degrees F.
 2. Stainless Steel and Alloy Piping: If ambient is less than 32 degrees F, local preheating to a temperature warm to the hand is required.

- G. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

- H. Surface Defects: Chip or grind out those affecting soundness of weld.

- I. Weld Quality: Meet requirements of governing welding codes.

3.04 INSTALLATION—GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

- B. Remove foreign objects prior to assembly and installation.
- C. Flanged Joints:
 - 1. Install perpendicular to pipe centerline.
 - 2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
 - 3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
 - 4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
 - 5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
 - 6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
 - 7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
 - 8. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
 - 9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
 - 10. Manufacturer: Same as pipe manufacturer or grooved joint flange adapter manufacturer.
- D. Threaded and Coupled Joints:
 - 1. Conform to ASME B1.20.1.
 - 2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
 - 3. Countersink pipe ends, ream and clean chips and burrs after threading.
 - 4. Make connections with not more than three threads exposed.
 - 5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.
- E. Grooved-End Joints:
 - 1. Piping shall be grooved in accordance with manufacturer's latest published instructions and shall be accurately cut with tools conforming to coupling manufacturer's standards and to AWWA C606.
 - 2. Install grooved joint couplings and gaskets in accordance with manufacturer's latest published installation instructions.

F. Soldered Joints:

1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

G. Brazed Joints for Refrigerant Piping:

1. Braze copper piping with silver solder complying with AWS A5.8/A5.8M.
2. Construct joints according to AWS Brazing Handbook, Chapter Pipe and Tube.
3. Inside of tubing and fittings shall be free of flux.
4. Clean parts to be joined with emery cloth and keep hot until solder has penetrated the full depth of the fitting and extra flux has been expelled.
5. Cool joints in air and remove flame marks and traces of flux.
6. During brazing operation, prevent an oxide film from forming on inside of tubing by slowly flowing dry nitrogen to expel the air.
7. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

H. Pipe Connections at Concrete Structures: As specified in Article Piping Flexibility Provisions in Section 40 27 01, Process Piping Specialties.

I. PVC and CPVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

J. Ductile Iron Piping:

1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
2. Dressing Cut Ends:
 - a. General: As required for the type of joint to be made.
 - b. Rubber Gasketed Joints: Remove sharp edges or projections.
 - c. Push-On Joints: Bevel, as recommended by pipe manufacturer.

- d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.

3.05 INSTALLATION—EXPOSED PIPING

- A. Piping Runs:
 1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
 2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.
- B. Supports: As specified in Section 40 05 15, Piping Support Systems.
- C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.
- D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
- E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
- F. Piping clearance, unless otherwise shown:
 1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 3. From Adjacent Work: Minimum 2 inch(es) from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
 5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
 6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.

7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.
8. If exposed to the outdoors, close and block open end of pipe section when placement operations are not in progress and at close of day's work.

3.06 INSTALLATION—BURIED PIPE

A. Joints:

1. Dissimilar Buried Pipes:
 - a. Provide flexible mechanical compression joints for pressure pipe.
 - b. Provide concrete closure collar for gravity and low pressure (maximum 10 psi) piping or as shown.
2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown.

B. Placement:

1. Keep trench dry until pipe laying and joining are completed.
2. Pipe Base and Pipe Zone: As specified in Section 31 23 23.15, Trench Backfill.
3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
4. Measure for grade at pipe invert, not at top of pipe.
5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
8. Lay pipe upgrade with bell ends pointing in direction of laying.
9. Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.
10. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
 - a. Shorter pipe lengths.
 - b. Special mitered joints.
 - c. Standard or special fabricated bends.
11. After joint has been made, check pipe alignment and grade.
12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
13. Prevent uplift and floating of pipe prior to backfilling.

C. PVC and CPVC Pipe Placement:

1. Lay pipe snaking from one side of trench to other.
2. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
3. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
4. Shield ends to be joined from direct sunlight prior to and during the laying operation.

D. Tolerances:

1. Deflection from Horizontal Line, Except PVC or CPVC: Maximum 1 inch.
2. Deflection From Vertical Grade: Maximum 1/8 inch.
3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.
5. Pipe Cover: Minimum 5 feet, unless otherwise shown.

3.07 INSTALLATION—CONCRETE ENCASED

- A. Provide reinforced concrete pipe encasement where shown on Drawings and where otherwise required. Some piping may be required to be concrete encased for pipe strength requirements that are included in the Specifications. Piping under and within the influence of buildings, utility trenches, vaults, slabs, and other structures shall be concrete encased. See details on Drawings for encasement requirements.
- B. Where concrete encased piping crosses structure construction and expansion joints, provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.08 INSTALLATION—DOUBLE WALL CONTAINMENT PIPING SYSTEM

- A. Install according to manufacturer's instructions.
- B. Valves and equipment shall be supported independently from pipe. Anchor valves such that turning moment resulting from their operation will not be transmitted to pipe.

C. Centering Devices for Double Wall Containment Piping:

1. Center and support carrier pipe within the containment pipe with centering devices. Locate not less than every 9 feet, or within 24 inches of the termination of containment pipe on fabricated pieces.
2. Install centering devices such that leak detection cable (if specified) will be unrestricted and such that system maintains free drainage.

D. Following Installation and Testing:

1. Flush clean carrier and containment piping system.
2. Purge annular space of moisture with clean, dry air.

3.09 LEAK DETECTION SYSTEM FOR DOUBLE WALL CONTAINMENT PIPING

- A. Install in accordance with system manufacturer’s instructions and recommendations.

3.10 PIPE CORROSION PROTECTION

EC #7

A. Ductile Iron Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating, and as shown in Piping Schedule.
2. ~~Buried: Wrap with polyethylene bagging.~~ Buried (Applying Polyethylene Tube Encasement to Pipe):
 - a. Cut polyethylene tube 2 feet longer than the length of pipe to receive the encasement. Prior to placing the length of pipe into the trench, raise the pipe section and slip the polyethylene tube over the spigot end of the pipe. Bunch up the tube in accordion fashion between the spigot end and the supporting sling.
 - b. Lower the pipe section into the trench and seat the spigot end into the bell of the previously installed pipe. Provide a shallow hole at the bell to facilitate the joint overlap.
 - c. Remove the sling from the pipe. Raise the pipe from the bell end and slip the bunched-up polyethylene tube along the full length of pipe. Leave 1 foot of bunched up polyethylene tube at each end of the pipe for joint overlap.
 - d. To make the joint overlap, pull the polyethylene tube from the bell end over the pipe joint to the spigot end by 1 foot. Fold the tube (wrap the tube around itself) around the pipe and secure the three circumferential wraps of plastic adhesive tape or a plastic tie strap. Repeat at spigot end. Fold tube and secure with tape or a plastic tie strap.
 - e. Pull the loose polyethylene tube on the pipe snugly around the pipe barrel. Fold the excess material over at the top of pipe and

- secure the fold with 6-inch-long strips of plastic adhesive tape at 3 feet on center.
- f. Polyethylene sheet will not be allowed as a substitute for tube when required for installation on buried pipe.
3. Buried (Applying Polyethylene Sheet Encasement to Valves):
- a. Wrap valves by pulling the bunched-up polyethylene tube from the adjacent pipe over the bells or flanges of the valve. Secure the tube to the valve body with plastic adhesive tape wrapped around the valve body. Then wrap the valve with a flat sheet of polyethylene. Extend the sheet to the valve stem and secure the sheet in place with plastic adhesive tape. Apply the second layer and secure with tape. Secure the sheets with tape around the valve stem below the operating nut and around the barrel of the connecting pipe to prevent the entrance of soil. Pour concrete anchor and support blocks after the wrap has been properly placed.
- b. Sheet encasement to be installed over the top of coating specified in Section 09 91 00, Painting and Protective Coatings.
4. Buried (Applying Polyethylene Sheet Encasement to Fittings, Couplings, and Appurtenances):
- a. Wrap buried ferrous metal pipe fittings, couplings, adapters, and appurtenances with polyethylene sheet. Overlap the adjoining pipe or fitting a minimum of 1 foot and secure in place with plastic adhesive tape. Apply a second layer and secure with tape around the barrel of the connecting pipe to prevent the entrance of soil. Pour concrete anchor and thrust blocks after the wrap has been placed.
5. Repair of Polyethylene Tube and Sheet Encasement Material:
- ~~2~~a. Repair polyethylene material that is damaged during construction. Use polyethylene sheet, place over damaged or torn area, and secure in place with plastic adhesive tape.
- ~~3~~6. Submerged or Embedded: Coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating. If in potable water service, use NSF/ANSI 61 approved epoxy.

B. Copper Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating.

C. PVC and CPVC Pipe, Exposed: As specified in Section 09 90 00, Painting and Coating.

- D. Piping Accessories:
1. Exposed:
 - a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 90 00, Painting and Coating, as applicable to base metal material.
 - b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
 2. Buried:
 - a. Ferrous Metal and Stainless Steel Components: Coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating.
 - b. Bolts, Nuts, and Similar Items: Coat with bituminous paint.
 - c. Flexible Couplings and Similar Items: Wrap with heat shrink wrap.
 - d. Buried Valves and Similar Elements on Wrapped Pipelines: Coat with bituminous paint and wrap entire valve in polyethylene encasement.
- E. Polyethylene Encasement: Install in accordance with AWWA C105/A21.5 and manufacturer's instructions.
- F. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.
- G. Insulating Flanges, Couplings, and Unions:
1. Applications:
 - a. Dissimilar metal piping connections.
 - b. Cathodically protected piping penetration to buildings and watertight structures.
 - c. Submerged to unsubmerged metallic piping connections.
 - d. Connections to existing metallic pipe.
 - e. Where required for electrically insulated connection.
 2. Pipe Installation:
 - a. Insulating joints connecting immersed piping to nonimmersed piping shall be installed above maximum water surface elevation.
 - b. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
 - c. Align and install insulating joints as shown on the Drawings and according to manufacturer's recommendations. Bolt lubricants that contain graphite or other metallic or electrically conductive components that can interfere with the insulating capabilities of the completed flange shall not be used.

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- H. Pipe Bonding for Buried Piping: As specified in Section 26 42 01, Pipe Bonding and Test Stations.
- I. Cathodic Protection for Buried Piping: As specified in Section 26 42 02, Cathodic Anode Protection System, and as shown.

3.11 THRUST RESTRAINT

A. Location:

1. Buried Piping: Where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist because of hydrostatic testing and normal operating pressure.
2. Exposed Piping: At all joints in piping.

B. Thrust Ties:

1. Steel Pipe: Attach with lugs fabricated in accordance with details shown on Drawings.
2. Ductile Iron Pipe: Attach with socket clamps anchored against grooved joint coupling or flange.
3. Flanged Coupling Adapters: For exposed installations, install manufacturer's anchor studs through coupling sleeve or use dismantling joints.

C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Install pipe joint manufacturer's adapter gland follower and pipe end retainer, or mechanical joint anchor gland follower.

D. Thrust Blocking:

1. Place between undisturbed ground and fitting to be anchored.
2. Quantity of Concrete: Sufficient to cover bearing area on pipe and provide required soil bearing area as shown.
3. Place blocking so that pipe and fitting joints will be accessible for repairs.
4. Place concrete in accordance with Section 03 30 00, Cast-in-Place Concrete.

3.12 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

- A. Application and Installation: As specified in Section 40 27 01, Process Piping Specialties.

3.13 BRANCH CONNECTIONS

- A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.
- B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including first block valve in the line carrying the lower pressure, unless otherwise shown.
- C. Threaded Pipe Tap Connections:
 - 1. Ductile Iron Piping: Connect only with service saddle or at tapping boss of a fitting, valve body, or equipment casting.
 - 2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
 - 3. Limitations: Threaded taps in pipe barrel are unacceptable.

3.14 INSULATION

- A. See Section 40 42 13, Process Piping Insulation.

3.15 HEAT TRACING

- A. See Section 40 05 33, Pipe Heat Tracing.

3.16 DISINFECTION

- A. See Section 33 13 00, Disinfecting of Water Utility Distribution.

3.17 FIELD FINISHING

- A. Notify Engineer at least 3 days prior to start of surface preparation or coating application work.
- B. As specified in Section 09 90 00, Painting and Coating.

3.18 PIPE IDENTIFICATION

- A. As specified in Section 10 14 00, Signage.

3.19 FIELD QUALITY CONTROL

- A. Pressure Leakage Testing: As specified in Section 40 80 01, Process Piping Leakage Testing.

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- B. Minimum Duties of Welding Inspector: as specified in Section 33 05 01.01, Welded Steel Pipe and Fittings.
- C. Required Weld Examinations: as specified in Section 33 05 01.01, Welded Steel Pipe and Fittings.
- D. Test containment piping leak detection system in accordance with system manufacturer's instructions and recommendations to verify proper operation.

3.20 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, to assist with unloading of the double wall containment piping system, system tests, containment pipe joint closure, installation and testing of leak detection system, and training of Owner's personnel in operation and maintenance of leak detection system. Manufacturer's representative shall complete a Manufacturer's Certificate of Proper Installation. Inspection and examination practices shall be according to ASME B31.3 for Normal Fluid Service.

3.21 CLEANING

- A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines, except as stated below, with water at 2.5 fps minimum flushing velocity until foreign matter is removed.
- B. Blow clean of loose debris plant process air, natural gas, and instrument air lines with compressed air at 4,000 fpm; do not flush with water.
- C. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.
- D. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.22 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Piping Schedule.
2. Data Sheets.

Number	Title
40 27 00.01	Cement-Mortar-Lined Ductile Iron Pipe and Fittings
40 27 00.07	Galvanized Steel Pipe and Malleable Iron Fittings
40 27 00.08	Stainless Steel Pipe and Fittings—General Service
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings
40 27 00.11	Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings
40 27 00.13	Copper and Copper Alloy Pipe, Tubing, and Fittings
40 27 00.15	Double Wall Containment Piping
40 27 00.18	Polyvinylidene Fluoride (PVDF) Pipe and Fittings.

END OF SECTION