SECTION 40 05 00

PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Process piping systems.
   2. Utility piping systems.
   3. Plumbing piping systems.
   4. Plastic pipe.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 10 14 00 - Identification Devices.
   4. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
   5. Section 40 05 07 - Pipe Support Systems.
   6. Section 40 05 51 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M36, Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760).
      b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
      c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
      d. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
   2. American Iron and Steel Institute (AISI).
   3. American Society of Mechanical Engineers (ASME):
      a. B16.3, Malleable Iron Threaded Fittings.
      b. B16.5, Pipe Flanges and Flanged Fittings.
      c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
      d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
      e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
      f. B36.19, Stainless Steel Pipe.
      g. B40.100, Pressure Gauges and Gauge Attachments.
   4. ASTM International (ASTM):
      a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
      c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
      d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

e. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
f. A197, Standard Specification for Cupola Malleable Iron.
g. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
i. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
j. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
k. A536, Standard Specification for Ductile Iron Castings.
l. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
m. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
n. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
o. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
p. B88, Standard Specification for Seamless Copper Water Tube.
q. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
r. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
s. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
t. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
u. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
v. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
w. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
x. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
y. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
z. D4101, Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.
aa. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
bb. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
cc. [F491, Standard Specification for Poly(Vinylidene Fluoride)(PVDF) Plastic-Lined Ferrous Metal Pipe and Fittings.] D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
dd. D1785, Standard Specification for Poly(Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.

ee. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ff. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
gg. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
hh. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
ii. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
jj. F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
kk. F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
ll. F949, Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.
mm. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

5. American Water Works Association (AWWA):
   a. B300, Standard for Hypochlorites.
   b. C200, Standard for Steel Water Pipe - 6 IN and Larger.
   c. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
   d. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
   e. C606, Standard for Grooved and Shouldered Joints.
   f. C651, Standard for Disinfecting Water Mains.
   g. C800, Standard for Underground Service Line Valves and Fittings.
   h. C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN through 12 IN, for Water Distribution.
6. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
   b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
   e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
7. Chlorine Institute, Inc. (CI):
   a. Pamphlet 6, Piping Systems for Dry Chlorine.
8. Cast Iron Soil Pipe Institute (CISPI):
   a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
9. International Plumbing Code (IPC).
10. National Fire Protection Association (NFPA):

a. 54, National Fuel Gas Code.
b. 69, Standard on Explosion Prevention Systems.
11. Underwriters Laboratories, Inc. (UL).
12. NSF International (NSF).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS

A. Hazardous Gas Systems: Digester gas, chlorine gas, sulfur dioxide gas, carbon dioxide gas, lab gases.

B. HPIC: High performance industrial coating.

C. PVDF: Polyvinylidene fluoride.

1.4 SYSTEM DESCRIPTION

A. Piping Systems Organization and Definition:
1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
2. See PIPING SPECIFICATION SCHEDULES in PART 3.

1.5 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
1) Attach technical product data on gaskets, pipe, fittings, and other components.
3. Fabrication and/or Layout Drawings:
a. Exterior yard piping drawings (minimum scale 1 IN equals 10 FT or as noted) with information including:
1) Dimensions of piping lengths.
2) Invert or centerline elevations of piping crossings.
3) Acknowledgement of bury depth requirements.
4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
6) Line slopes and vents.
b. Interior piping drawings (minimum scale 1/8 IN equals 1 FT or as noted) with information including:
1) Dimensions of piping from column lines or wall surfaces.
2) Invert dimensions of piping.

3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
4) Location and type of pipe supports and anchors.
5) Locations of valves and valve actuator type.
6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
7) Acknowledgement of valve, equipment and instrument tag numbers.
8) Provisions for expansion and contraction.
9) Line slopes and air release vents.
10) Rough-in data for plumbing fixtures.

c. Schedule of interconnections to existing piping and method of connection.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
1. Qualifications of lab performing disinfection analysis on water systems.
2. Test reports:
a. Copies of pressure test results on all piping systems.
b. Reports defining results of dielectric testing and corrective action taken.
c. Disinfection test report.
d. Notification of time and date of piping pressure tests.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer.
1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit.
1. Repair abrasions, scars, and blemishes.
2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General:
1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations shown on Drawings.
2. Furnish materials in full compliance to following material specifications:
a. Manufacture pipe, fittings and appurtenances from polyvinyl chloride (PVC) compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.

b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.

B. Pipe:
1. Furnish pipe meeting requirements of ASTM D1785.
2. Pipe 2 IN and less to be solvent welded.
3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.

C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Flanges/Unions:
1. Furnish flanges and unions at locations shown on Drawings.
2. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
3. For pipe larger than 2 IN, provide 150 LB socket type PVC flange.
4. For pipe 2 IN and less, provide socket type PVC union with Buna O-rings.
5. Use flat, full faced natural rubber gaskets at flanged connections.
   a. Furnish heavy hex head bolts, each with one (1) heavy hex nut, ASTM F593 Type 316 stainless steel.
6. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.

E. Installation:
1. Field threading PVC will not be permitted.
   a. Perform required threaded connections or attachments by the use of factory molded socket by threaded adapters.
   b. Female adapters are not acceptable.
2. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation.
   a. Continuously support PVC piping at liquid operating temperatures in excess of 100 DEGF.
   b. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load.
   c. Support riser clamps on spring hangers.
   d. Do not clamp PVC tightly or restrict movement for expansion and contraction.

F. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Insulating unions:
   a. "Dielectric" by Epco.
2. Dirt strainers (Y type):
   a. Mueller (#351).
   b. Sarco.
   c. Armstrong.
3. Chemical strainers (Y type):
   a. Chemtrol.
   b. Asahi.
4. Dry disconnect couplings:
   a. Kamlock.
5. Dielectric flange kit:

a. PSI.
b. Maloney.
c. Central Plastics.
6. Pipe saddles (for gage installation):
a. Dresser Style 91 (steel and ductile iron systems).
b. Dresser Style 194 (nonmetallic systems).
7. Expansion joint at FRP and poly tanks:
a. PROCO.
b. Garlock, Style 215.
8. Elastomeric bellows type expansion joints:
a. Garlock, Guardian 200/204.
b. PROCO, equivalent model.
c. Red Valve, equivalent model.
d. Or equal.
9. Dismantling Joint
a. Romac DJ400.
b. Smith Blair 972.

G. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PIPING SPECIFICATION SCHEDULES

A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping specification schedules located at the end of PART 3 of this Specification Section.

2.3 PRESSURE PIPING (UNDERGROUND)

A. General:
1. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.

B. Materials: Furnish materials in full compliance with following requirements:
1. 4-12 IN: AWWA C900 PVC with Pressure Class of 150 PSI.
2. Joints for PVC pipe shall be the elastomeric-gasket type with a pressure rating not less than pipe pressure rating meeting performance requirements of ASTM D3139.

C. Installation:
1. Field threading of PVC pipe will not be permitted.
2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.
3. Provide for a maximum deflection of not more than 3 percent.

2.4 COMPONENTS AND ACCESSORIES

A. Insulating Components:
1. Dielectric flange kits:
a. Flat faced.
b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
c. Suitable for 175 PSI, 210 DEGF.
d. 1/32 IN wall thickness bolt sleeves.
e. 1/8 IN thick phenolic insulating washers.
2. Dielectric unions:
a. Screwed end connections.

b. Rated at 175 PSI, 210 DEGF.
c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Dirt Strainers:
1. Y-type.
2. Composition bronze.
3. Rated for test pressure and temperature of system in which they are installed.
4. 20 mesh Monel screen.
5. Threaded bronze plug in the blowoff outlet.
6. Threaded NPT end connections.

C. Strainers for Chemical Applications:
1. Y-type.
2. Strainers of same material, test pressure, and temperature rating as system in which strainer is placed.

D. Reducers:
1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
2. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

E. Protective Coating and Lining:
1. Include pipe, fittings, and appurtenances where coatings, linings, coating, tests and other items are specified.
2. Field coating pipe in accordance with Specification Section 09 96 00.

F. Underground Warning Tape:
1. See Specification Section 10 14 00.

G. Dry Disconnect Couplings:
1. Adapters:
a. Male adapters: Size shown on Drawings.
b. Adapters:
1) Female NPT end connection for sludge and flush applications.
2) Male NPT end connection for chemical applications.
c. Construct adapters for sludge applications from cast iron or steel.
d. Construct adapters for chemical and PVC system applications 3 IN and below from polypropylene.
1) Above 3 IN size, provide stainless steel units.
2. Couplers:
a. Built-in valve and spring loaded poppet which close automatically when disconnected.
b. Designed to remain with only one (1) arm locked in closed position.
c. Construct couplers for sludge applications fabricated from material utilized for adapters.
d. Construct couplers for chemical and PVC system applications 3 IN and less from polypropylene with stainless steel arms and pins.
1) Above 3 IN, provide stainless steel units.
e. Gasket: Compatible with conveyed liquid.
3. Dust caps: For all adapters.

H. Sacrificial Anode Cathodic Protection:
   1. 3 LB magnesium sacrificial anodes, prepackaged in a cloth bag containing 75 PCT hydrated gypsum, 20 PCT bentonite and 5 PCT anhydrous sodium sulphate.
   2. TW 600 V or an HMWPE insulated copper lead attached to the anode.

I. Valves:
   1. See schematics and details for definition of manual valves used in each system under 4 IN in size.
      a. See Drawings for valve types 4 IN and above and for automatic valves used in each system.
   2. See Specification Section 40 05 51.

J. Expansion Joints at FRP and Poly Tanks:
   1. Materials:
      a. Bellows: PTFE-62.
      b. Flanges: PVC, ductile iron.
      c. Limit bolts and nuts: 316 stainless stee.
      d. Reinforcing rings: Stainless steel.
   2. Pressure rating at 70 DEGF: 70 PSIG.
   3. Minimum axial movement: 3/8 IN.

K. Elastomeric Bellows Type Expansion Joints:
   1. Provide reducing type where indicated on the Drawings.
   2. Air piping: Refer to stainless steel Specification 40 05 23.
   3. Flanges: ANSI 125/150.
   4. Materials:
      a. Bellows:
         1) Sludge service: Natural rubber.
         2) Hot Water (over 100 DEGF): EPDM.
         3) All other: Compatible with fluid.
      b. Restraint:
         1) Provide restraint limit bolts (control rods) and nuts to restrain joint at test pressure of piping.
         2) Control rod material: 316 stainless steel.
      c. Working pressure: Equal to or greater than test pressure of connecting piping.
      d. Minimum axial movement: 3/8 IN.
   5. Arches:
      a. Sludge service: Provide single filled arches.
      b. All other service: Provide double open arches.

PART 3 - EXECUTION

3.1 IDENTIFICATION

A. Identify each length of pipe clearly at intervals of 5 FT or less.
   1. Include manufacturer's name and trademark.
   2. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications and NSF approvals when applicable.

3.2 PRESSURE PIPING (UNDERGROUND)

A. Installation:
   1. Field threading of PVC pipe will not be permitted.

2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

3.3 EXTERIOR BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 3 FT of earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of point where pipe enters or leaves structure.
   1. Install second joint not more than 6 FT nor less than 4 FT from first joint.

C. Install expansion devices as necessary to allow expansion and contraction movement.

D. Laying Pipe In Trench:
   1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
   2. Clean each pipe length thoroughly and inspect for compliance to specifications.
   3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
   4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
   5. Except for first two (2) joints, before making final connections of joints, install two (2) full sections of pipe with earth tamped along side of pipe or final with bedding material placed.
   6. Lay pipe in only suitable weather with good trench conditions.
      a. Never lay pipe in water except where approved by Engineer.
   7. Seal open end of line with watertight plug if pipe laying stopped.
   8. Remove water in trench before removal of plug.

E. Lining Up Push-On Joint Piping:
   1. Lay piping on route lines shown on Drawings.
   2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
   3. Observe maximum deflection values stated in manufacturer's written literature.
   4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
   5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

F. Anchorage and Blocking:
   1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.

2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
   a. Concrete blocks shall not cover pipe joints.
3. Provide bearing area of concrete in accordance with drawing detail.

G. Install underground hazard warning tape per Specification Section 10 14 00.

H. Install insulating components where dissimilar metals are joined together.

3.4 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing intent and with clearance and allowance for:
   1. Expansion and contraction.
   2. Operation and access to equipment, doors, windows, hoists, moving equipment.
   3. Headroom and walking space for working areas and aisles.
   4. System drainage and air removal.

C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.

D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

E. Pipe Support:
   1. Use methods of piping support as shown on Drawings and as required in Specification Section 40 05 07.
   2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
      a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
   3. Size pipe supports with consideration to specific gravity of liquid being piped.

F. Locate and size sleeves and castings required for piping system.
   1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.

G. Use reducing fittings throughout piping systems.
   1. Bushings will not be allowed unless specifically approved.

H. Equipment Drainage and Miscellaneous Piping:
   1. Provide drip pans and piping at equipment where condensation may occur.
   2. Hard pipe stuffing box leakage to nearest floor drain.
   3. Avoid piping over electrical components such as motor control centers, panelboards, etc.

a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
b. Hard pipe drainage to nearest floor drain.

4. Collect system condensate at drip pockets, traps and blowoff valves.
5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
   a. Size to handle application with 3/4 IN being minimum size provided.

I. Unions:
1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

J. Install expansion devices as necessary to allow expansion/contraction movement.

K. Provide full face gaskets on all systems.

L. Anchorage and Blocking:
1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

M. Equipment Pipe Connections:
1. Equipment - General:
   a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
   b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
   c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
      1) Provide tightening torque in accordance with manufacturer's recommendations.
   d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
   e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
   f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
   g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.

h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.
   1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
   2) Realign as necessary, install flange bolts and make equipment connection.
i. Provide utility connections to equipment shown on Drawings, scheduled or specified.

N. Provide insulating components where dissimilar metals are joined together.

O. Instrument Connections:
   1. See drawing details.

3.5 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.

G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.6 CATHODIC PROTECTION

A. Isolate, dielectrically, all piping from all other metals including reinforcing bars in concrete slabs, other pipe lines, and miscellaneous metal.

B. Make all connections from wire or cable by Thermit Cadwelding accomplished by operators experienced in this process.

C. Install all cables with a loop and overhead knot around each pipe and slack equal to at least 50 PCT of the straight line length.

D. After cadwelding, coat all exposed metallic surfaces with hot applied tape.

3.7 FIELD QUALITY CONTROL

A. Pipe Testing - General:
   1. Test piping systems as follows:

a. Test exposed, non-insulated piping systems upon completion of system.
b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.

2. Utilize pressures, media and pressure test durations as specified in the PIPING SPECIFICATION SCHEDULES.
3. Isolate equipment which may be damaged by the specified pressure test conditions.
4. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
   a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
   b. Notify the Engineer 24 HRS prior to each test.
5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:
1. Testing medium: Unless otherwise specified in the PIPING SPECIFICATION SCHEDULES, utilize the following test media.
   a. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	25 PSIG or less	Water
Above 48 IN	Gravity	25 PSIG or less	Water
All sizes	Pumped	250 PSIG or less	Water

2. Allowable leakage rates:
   a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage at the specified test pressure throughout the duration of the test.
3. Hydrostatic pressure testing methodology:
   a. General:
      1) All joints, including welds, are to be left exposed for examination during the test.

2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
3) Provide temporary restraints for expansion joints for additional pressure load under test.
4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
5) Do not coat or insulate exposed piping until successful performance of pressure test.

C. Dielectric Testing Methods and Criteria:
1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

3.8 CLEANING, DISINFECTION AND PURGING

A. Cleaning:
1. Clean interior of piping systems thoroughly before installing.
2. Maintain pipe in clean condition during installation.
3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
   a. Pig high pressure air piping before connecting to valves or instruments.
4. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
   a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
   b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
5. Clean chlorine piping in accordance with CI Pamphlet 6.

B. Disinfection of Potable Water Systems:
1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.
3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
4. Flush each segment of system to provide flushing velocity of not less than 2.5 FT per second.
5. Drain flushing water to sanitary sewer.
   a. Do not drain flushing water to receiving stream.
6. Use continuous feed method of application.
   a. Tag system during disinfection procedure to prevent use.
7. After required contact period, flush system to remove traces of heavily chlorinated water.

8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality.
   a. Repeat entire disinfection procedures until satisfactory results are obtained.
9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from system.
   a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of State of Nevada.

3.9 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate information on "As-Recorded" Drawings.

E. SPECIFICATION SCHEDULE - SYSTEM 3
   1. General:
      a. Test requirements:
         1) Test medium: Water.
         2) Pressure: 125 PSIG.
         3) Duration: 6 HRS.
      b. Gaskets:
         1) O-rings: Neoprene or rubber.
         2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
         3) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
         4) Flanged joints (steel): AWWA C207.
   2. System components:
      a. Pipe size 3 IN through 24 IN:
         1) Exposed service:
            a) Material:
               (1) Flanged: Ductile iron, Class 350.
               (2) Grooved type joint system: Use pipe thickness per AWWA C606.
            b) Reference: AWWA/ANSI C115/A21.15.
            c) Lining: Cement.
            d) Coating: HPIC; See Specification Section 09 96 00.
            e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
            f) Joints:
               (1) Flanged or grooved type mechanical coupling (AWWA C606) joints.
               (2) With both systems, provide screwed-on flanges at equipment, valves and structure penetrations.
         2) Buried service:
            a) Materials: Ductile iron, Class 350.
            b) Reference: AWWA/ANSI C151/A21.51.
            c) Lining: Cement.

d) Coating: Bituminous.
e) Fittings:
f) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
(1) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 IN to 16 IN.
g) Joints: Push-on with mechanical (stuffing box type) joints at fittings and valves.

F. SPECIFICATION SCHEDULE - SYSTEM 10
1. General:
a. Piping symbol and service:
1) [Piping symbol] - [piping service].
b. Test requirements:
1) Test medium: Water.
2) Pressure: 12.5 PSIG.
3) Duration: 6 HRS.
c. Gaskets and O-rings:
1) O-rings: Neoprene or rubber.
2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
3) Flanged joints (steel): Rubber, AWWA C207.
4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
d. Pipe size 3 IN through 24 IN:
1) Exposed service:
a) Materials:
(1) Flanged: Ductile iron, Class 350.
(2) Grooved type joint system: Use pipe thickness per AWWA C606.
(3) With both systems, provide screwed on flanges at equipment, valves and structural penetrations.
b) Reference: AWWA/ANSI C115/A21.15.
c) Lining: Cement.
d) Coating: HPIC; See Specification Section 09 96 00.
e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
f) Joints:
(1) Flanged or grooved type mechanical coupling (AWWA C606) joints.
(2) With both systems, provide screwed-on flanges at valves, equipment, and structure penetration.
2) Buried service:
a) Materials: Ductile iron, Class 350.
b) Reference: AWWA/ANSI C151/A21.51.
c) Lining: Cement.
d) Coating: Bituminous.
e) Fittings:
(1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
(2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 to 16 IN.
f) Joints: Push-on with mechanical (stuffing box type) joints at fittings and valves.
2. Install drain tees with capped nipples of IPS brass 3 IN long at low points.

   a. If low point occurs in concealed piping, provide approved flush access panel.
   b. These drains are not shown on Drawings.
3. Slope water lines down to drain points not less than 1 IN in 60 FT.
4. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs.
   a. Pipe joint cement permitted only on external threads.
5. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
6. Install ball, butterfly and plug valves where indicated or required to adequately service all parts of system and equipment.
   a. Install valves on each branch serving restroom.
   b. Install valves on inlet and outlet connections of heat exchangers and on other equipment connected to water lines.
7. Install unions between valves and connections to each piece of equipment, and install sufficient number of unions throughout piping system to facilitate installation and servicing.
   a. On copper pipe lines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2-1/2 IN and over install brass flange unions.
8. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to entirely eliminate any danger of siphoning waste material into potable water supply system.
9. Where exposed pipes 6 IN in size and smaller pass through floors, finished walls, or finished ceilings, fit with nickel or chrome-plated plates large enough to completely close hole around pipes.
   a. Secure plates to pipe by set screw in approved manner.
10. Size supply branches to individual fixtures as scheduled or indicated on Drawings.
11. Install piping so as to be free to expand with proper loops, anchors and joints without injury to system or structure.
12. Provide branches to wall hydrants or hose bibbs in exterior locations with interior shutoff and drain valves.
13. Provide approved type vacuum breaker and backflow preventer installations indicated or as required by Code.
14. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

END OF SECTION