

SECTION 15050

PIPING, FITTINGS, AND APPURTENANCES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Furnish and install all piping, including fittings, valves, and accessories as shown on the Drawings, described in the Specifications and as required to completely interconnect all piping for a complete and operable systems.
- B. Related Sections:
 - 1. Section 02301: Earthwork

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. American National Standards Institute (ANSI)
- C. American Society of Mechanical Engineers (ASME)
- D. American Society for Testing and Materials (ASTM)
- E. American Water Works Association (AWWA)
- F. California Department of Transportation Std. Specifications (Caltrans)

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Shop Drawings:
 - 1. Layouts and schematics: Submit detailed installation drawings of all piping and connected equipment. The drawings shall include each pipe, all fittings, valves, and other appurtenances (Product Review submittal).
 - 2. Verify by excavation, inspection and measurement all installation conditions for buried pipe before preparation of Shop Drawings. Submit field measurements with Shop Drawings where exposed conditions are significantly different than indicated on the Drawings.
 - 3. Submit data to show that the following items conform to the Specification requirements:
 - a. Pipe, fittings, and accessories.
 - b. Flexible couplings.
 - c. Restrained joints.
 - d. Valves.
 - e. Combination air/vacuum release valves.
 - f. Magmeters.
 - 4. Submit certified test reports as required herein and by the referenced Standard Specifications.
 - 5. Disinfection Plan including:
 - a. "Normal" disinfection procedure per AWWA C651.

- b. Emergency disinfection procedure for mains and services, which must be returned to service immediately.
 - c. Disinfection schedule including number and type of services and length of disruption of service.
 - d. Disinfecting agent(s).
 - e. Method of disposal of chlorinated water.
 - 6. Submit procedures for welding field joints of welded steel and stainless steel pipes and welder qualifications (Product Review).
 - 7. Cleaning and Hydrostatic Test Plans.
- C. Manuals: The Contractor shall furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for the following items:
 - 1. All valves over 4-inch size.
 - 2. Combination air/vacuum release valves.
 - 3. All magmeters.
 - 4. All automatic control valves.
- D. Affidavits: Submit affidavits from the manufacturer for the following items:
 - 1. All valves over 4-inch size.
 - 2. Combination air/vacuum release valves.
 - 3. All magmeters.
 - 4. All automatic control valves.
- E. The preceding submittals shall be in the Product Information Category except where noted.

1.04 QUALITY ASSURANCE

- A. All materials and equipment furnished under this Section shall: (1) be of a manufacturer who has been regularly engaged in the design and manufacture of the materials and equipment for at least five (5) years; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by those manufacturers specifically named herein, if an alternate product manufacturer is proposed.
- B. Factory Quality Control: The Contractor shall test all products as noted herein and by the referenced Specifications.
- C. Field Quality Control:
 - 1. The Contractor shall:
 - a. Perform leakage tests per AWWA C600 or AWWA C605.
 - b. Provide bacteriological sampling and testing, by an independent certified testing laboratory, to verify satisfactory disinfection of potable water piping and accessories.

1.05 POTHOLING (CHECK ON LOCATIONS)

- A. Refer to Section 02200, paragraph 3.02.

1.06 CONSTRUCTION SCHEDULING/SEQUENCING

- A. Construction under this Contract involves expansion and modification of the Owner's existing water system, which must continue to provide service during construction. Refer to Section 01010 and Section 01040.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Pipe and valve sizes are nominal diameter unless otherwise noted.
- B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.
- C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage and bacteriological tests as specified hereinafter.
- D. Products in contact with potable water shall be certified to NSF Standard 61.

2.02 PIPING MATERIALS

- A. Pipe Designation: Piping materials for miscellaneous small piping are designated on the Drawings. New water transmission mains shall be either ductile iron pipe or PVC C900, PVC C905, except that for water mains aboveground and connecting to the new water tank shall be welded steel pipe.
- B. Pipe Systems: Each designation identifies not only the pipe itself, but the entire system as well as including the associated fittings, appurtenances, and installation and test procedures.
- C. Ductile Iron (DI):
 - 1. Pipe: Ductile iron, AWWA C151. Unless otherwise specified, provide push-on joints and minimum Pressure Class 250.
 - a. Push-on joints and mechanical joints: AWWA C111.
 - b. Flanged joints: AWWA C115.
 - 2. Fittings: Ductile iron only, AWWA C110 or AWWA C153. Gray cast iron fittings are not acceptable. Fittings shall be furnished by, or under the direct supervision of, the pipe manufacturer. Unless otherwise specified, provide push-on or mechanical joint fittings.
 - 3. Joint restraint (pipe and fittings, where required):
 - a. Push-on joints: Capable of deflection after the restraint is installed.
 - 1) TR FLEX by United States Pipe & Foundry Company; Thrust-Lock by Pacific States Cast Iron Pipe Company; or equal.
 - 2) Connect pipe cut in the field, where necessary and when

favorably reviewed by the Engineer, by TR FLEX Gripper Ring System by United States Pipe & Foundry Company; or equal.

- b. Mechanical joints: Restraining gland; EBAA Megalug Series 1100; or equal.
 - c. Flanged joints only where otherwise specified.
 4. Lining (pipe and fittings): Unless otherwise specified, cement mortar lining, AWWA C104, standard thickness, with seal coat.
 5. Gaskets: Unless otherwise specified, vulcanized styrene butadiene rubber (SBR). Provide special gaskets, complying with the requirements of AWWA C111, Section 4.2.2, at flanged connections with pressures in excess of 250 psi.
 6. All Ductile Iron Pipe shall be polyethylene encased per AWWA C105.
- D. Galvanized Steel Pipe:
1. Pipe: Galvanized steel, ASTM A120, Schedule 80.
 2. Fittings: Galvanized malleable iron, screwed, ASTM A197 for materials, ANSI B16.3 150 psi for dimensions.
 3. Threads: ANSI B2.1.
 4. Unions: Galvanized malleable iron, ASTM A197 for materials and ANSI B16.39 for dimensions, with brass seats.
 5. Thread compound: Permatex No. 2, Crane equivalent, or equal, or teflon tape.
- E. Steel Pipe Assemblies:
1. Steel pipe assemblies consist of combinations of steel pipe, special sections (fittings) and flanges, as detailed on the Drawings.
 - a. Assemblies shall be shop welded, and all interior and exterior welds and edges ground smooth.
 - b. After all welding and grinding is complete, assemblies shall be fusion-bonded lined and coated per AWWA C213. Application shall be by the fluid bed method only unless the greatest dimension of the article to be coated exceeds ten feet, in which case electrostatic spray method may be used.
 - c. No field welding is permitted, except as specified in paragraph 3.01 of this section.
 2. Pipe and fittings: AWWA C200.
 - a. The minimum wall thickness of pipe and fittings shall be 0.1875 inch.
 - b. Unless otherwise noted or detailed on the Drawings, fitting dimensions shall conform to AWWA C208. Adding pipe to the fittings does not change the requirement that fittings conform to AWWA C208 dimensionally, nor does it reclassify the pipe portion as part of the fitting.
 - c. Provide reinforcement for fittings in the form of collars, wrappers or crotch plates, in accordance with AWWA M11 Table 13-2; use 150 psi for the design pressure P.
 - d. Mitered 90 Degree Elbows: Four pieces minimum.
 - e. Mitered 45 Degree Elbows: Three pieces minimum.

- f. The manufacturer shall maintain records that identify the cylinder used for all completed pipe and fittings.
 - 3. Flanges: AWWA C207 standard steel-ring flanges, Class B or D. Flanges shall be welded to the cylinder without warping and with flange face perpendicular to the longitudinal axis of the cylinder.
 - 4. Gaskets: AWWA C207, 1/8-inch thick.
 - 5. Provide certification of hydrostatic testing in accordance with AWWA C200.
- F. Polyvinyl Chloride Pipe (4-inch to 12-inch):
 - 1. Pipe: Polyvinyl Chloride (PVC), AWWA C900, Class 150
 - 2. Fittings: Ductile iron, in accordance with Paragraph 2.02C of this Section.
 - 3. Joint Restraint:
 - a. Push-on Joints: Restraining harness, Series 1600 by EBAA Iron; Style 611 by Romac; or equal.
 - b. Mechanical Joints: Restraining gland, Series 2000 PV by EBAA Iron; or equal.
- G. Polyvinyl Chloride Pipe (smaller than 4-inch):
 - 1. Pipe: Schedule 80 polyvinyl chloride (PVC), gray, normal impact, Type 12454 B, ASTM D1784 and ASTM D1785. Pipe shall bear the National Sanitation Foundation (NSF) label.
 - 2. Joints: Solvent weld, except flanged or threaded permitted where required at equipment connections and where required on the Drawings. Solvent weld and primer for PVC pipe and fittings used for sodium hypochlorite product and solution shall be as recommended by pipe manufacturer.
 - 3. Fittings: Solvent weld, socket type, of same material as the pipe, Schedule 80, ASTM D2467 or threaded PVC Plastic Pipe Fittings, ASTM D2464, Schedule 80.
 - 4. Cement: Solvent weld, ASTM D2564, as recommended by the pipe manufacturer for the schedule and size to be joined.
 - 5. Pipe Cleaner: As recommended by the pipe manufacturer for the schedule and size to be joined.
- H. Smooth-Interior Corrugated High-Density Polyethylene (HDPE) Pipe.
 - 1. Pipe and Fittings: AASHTO M294, Type S; Hancor Blue Seal, or equal.
 - 2. Joints: Watertight (10.8 psi) bell and spigot.
 - 3. Gaskets: ASTM F477.

2.03 PIPE COUPLINGS

- A. General: For typical pipe joints, refer to pipe material specifications. Other joint devices shall be furnished where called for as specified below.
- B. Flexible Couplings and Flange Coupling Adaptors:
 - 1. Sleeve: Cast iron or fabricated steel.
 - 2. Followers: Cast iron, ductile iron, or steel.
 - 3. Sleeve bolts: ASTM A325, Type 3; malleable iron; or equivalent.

4. Coating: Fusion epoxy line and coat sleeve and followers.
 5. Pressure rating: 250 psi.
 6. Buried flexible coupling sleeve: Long barrel
 7. Manufacturers:
 - a. Flexible couplings:
 - 1) Connecting pipe with identical outside diameters: Smith-Blair 411 or 431, Dresser Style 38 or 53, or equal.
 - 2) Connecting pipe with slightly different outside diameters: Smith-Blair 413 or R 441, Dresser Style 162, or equal.
 - b. Flange coupling adaptors:
 - 1) Connecting new pipe or new pipe to existing non-ferrous pipe: Smith-Blair 912 or 913, Dresser Style 127 or 128, or equal.
 - 2) Connecting new pipe to existing ferrous pipe: Insulating flange coupling adaptor with insulating boot: Smith-Blair 932 or 933, or equal.
 8. Gaskets: Oil and grease resistant; Smith-Blair Grade 60; or equal.
 9. Joint restraint: Provide joint harnesses (tie rod lug or attachment plate assemblies) across flexible couplings and flange coupling adaptors where indicated on the Drawings. For flanged coupling adaptors, anchor studs may be substituted for the harnesses on pipe up to 12-inch. Design restraint in accordance with AWWA M-11 for 250 psi if size of the rods is not indicated on the Drawings.
- C. Flexible Joint Restraint Couplings
1. The Casing, Ball, and Sleeve shall be of ductile iron meeting or exceeding ASTM A 536.
 2. The entire fitting shall be lined and coated with fusion bonded epoxy applied and tested in accordance with AWWA C213.
 3. Flexible Joint Restraint Couplings shall be Romac FlexiJoint or approved equal.
- D. Expansion Joint:
1. Spool-type non-metallic expansion joint; Proco Series 231 or Series 232; or equal.

2.04 VALVES AND ACCESSORIES

- A. General Requirements for Valves:
1. All valves of each type shall be the product of one manufacturer.
 2. All valves shall be furnished with control assembly, operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings.
 3. All threaded stem valves shall open by turning the valve stem counter-clockwise.
 4. The exterior of all buried valves and valve operators shall be painted with two coats of Tape Coat Mastic; Protecto Wrap CA1180 Mastic; or equal, except where otherwise indicated.
- B. Manual Valves and Accessories:
1. Butterfly valves:
 - a. Rating: 150 psi water. Leaktight in both directions.

- b. Type: Flanged body, or as shown on the Drawings, AWWA C504, geared operator, resilient seated, 90 degree seating.
 - c. Materials: Cast iron body; cast iron or ductile iron disc with Ni-Chrome or Type 316 stainless steel edge; Type 304 stainless steel shaft; disc to be secured to shaft with Type 304 stainless steel taper pins.
 - d. Operator: Traveling-nut type, 2-inch standard AWWA nut, designed for buried service, watertight to 10 psi with extension stem as detailed on the Drawings.
 - e. Valve seat: Buna-N seat shall be applied to the valve body. Bearings: Self-lubricating and corrosion resistant.
 - g. Finish: Internal, asphalt varnish in accordance with AWWA C504; external, factory applied coal tar epoxy, 16 mils minimum thickness.
 - h. Manufacturers: Pratt Groundhog, equivalent by DeZurik, or equal.
2. Gate Valves:
- a. Rating: 200 psi water.
 - b. Type: Resilient wedge, non-rising stem, full diameter waterway, AWWA C509.
 - c. Connection: As shown on the Drawings.
 - d. Stem seal: O-ring.
 - e. Finish: Fusion epoxy.
 - f. Manufacturers: American Darling; Clow; Kennedy; Mueller; or equal.
3. Canal Gate Valves:
- a. Construction shall be of grey iron with an all-bolted steel frame with 1/4" minimum thickness. Valve shall include a cast-bronze lift nut and a cast iron wheel. Canal gates shall be Waterman C-10 or approved equal.
4. Combination Air Vacuum Valve:
- a. Air and vacuum release valves shall be combination air and vacuum release valves as manufactured by the Valve and Primer Corporation (APCO) 143-C, 145-C, etc, Crispin U-10, U-20, etc.
- C. Automatic Control Valves:
- 1. Automatic control valves include pressure reducing, pressure relief, rate of flow, surge anticipation, pump control, and altitude valves. Unless otherwise approved by the District Engineer, all automatic control valves shall be diaphragm actuated pilot controlled type and shall have a globe style body, stainless steel trim, V-port seating, and be fusion bonded epoxy lined and coated. The pilot system shall include pilot line wye-strainers with blow-offs, opening and closing speed controls, position indicator, and pilot system isolation cocks.
 - 2. Pressure Reducing Valves:
 - a. Pressure reducing valves 2-inches and smaller shall be bronze body with stainless steel trim, self-contained, direct acting high capacity type with a built-in stainless steel strainer, have an adjustable outlet pressure setting, and be fully repairable in line. Valves shall be Watts Model U5B or Cla-Val Model 990.

- b. Pressure reducing valves larger than 2 inches shall be combination reducing/sustaining and diaphragm actuated pilot
 - 3. Pressure Relief Valves:
 - a. Pressure relief valves shall be diaphragm actuated pilot controlled type designed to maintain a steady upstream pressure by relieving excess pressure without causing pipeline surges. Valves shall be Watts Model 116 or Cla-Val Model 50-01.
 - 4. Altitude Valves:
 - a. Altitude valves shall be diaphragm actuated pilot controlled type with a single seat and a resilient disc for tight closure. If required by system hydraulics, the valve shall be the two way flow type. For applications of altitude valves in which the differential pressure exceeds the manufacturer's cavitation chart limit, and orifice plate shall be installed downstream of the valve to dampen the cavitation per the manufacturer's recommendations. Valves shall be Watts Model 127 or Cla-Val Model 210.
 - D. Solenoid Valves:
 - 1. Solenoid valves shall be two-way, full line size, normally closed, diaphragm type, 125 psi minimum body pressure, 5 psi minimum operating differential, for use with cold water or air. Valve shall be suitable for 115 volt, 60 Hz AC power supply.
 - 2. All solenoid valves shall have manual operators, encapsulated coils and shall have electrical characteristics as indicated on the drawings. All valves shall be mounted horizontally.
 - E. Swing Check Valves:
 - 1. Swing check valves 1.5 inches and smaller shall be all bronze, regrinding type designed for a working pressure of 150 psi.
 - 2. Swing check valves for waterlines 2 inches and larger shall be iron body, brass trimmed, designed for a working pressure not less than 350 psi. They shall be of the balanced, swing gate type with a clear opening at least equal to that of the connecting pipe and shall have an external lever and counter weight.
 - 3. Swing check valves shall be rubber flapper type, APCO Valve and Primer Corporation, Mueller, or Crane.
 - F. Rubber Check Valves:
 - 4. Tideflex by Red Valve Company; or equal.

2.05 FLOW METERS

- A. Magnetic Flow Meters:
 - 1. Flow meters shall be the magnetic type that utilizes the principle of electromagnetic induction to produce an output proportional to the rate of fluid flow. A set of pulsed, electrically powered coils shall generate a magnetic field that in turn induces a voltage in the flowing fluid that is sensed by a pair of electrodes in contact with the fluid.
 - 2. Provide flow tube with sensor element, cables, remote converter/transmitter with empty pipe detection option. The system shall be suitable for water with conductivity as low as 5.0 micromho/cm and shall have an accuracy of +/- 0.5% of rate.
 - 3. Flow tube material:

- a. 12-inch (nominal) diameter and less: Polyvinyl chloride (PVC).
 - b. Larger than 12-inch (nominal) diameter: Carbon steel with polyurethane lining and fusion epoxy coating.
4. Connection: ANSI Class 150 flanges.
 5. Electrodes: Type 316 stainless steel. Protect coils from contact with the fluid.
 6. NEMA 6 (submersible to 30 feet).
 7. Manufacturer: ISCO UniMag, McCrometer UltraMag, or approved equal.
 8. Special Tools: Furnish special tools that are necessary for the replacement of parts and the adjustment of the equipment.
- B. Turbine Meters:
1. Water meters 3 inches and larger shall be in conformance with AWWA C702. Meters shall be manufactured by Neptune or approved equal. Meters shall be a flanged single register high performance compound meter. The meter shall have a test plug on the downstream end of the meter.

2.06 APPURTENANCES

- A. Tapping Sleeves and Saddles:
1. Tapping sleeves shall be entirely Type 304 Stainless Steel, including the flange, nuts and bolts, and must have a tapped test outlet and plug as manufactured by JCM, Ford, or Romac. Mueller ductile iron tapping saddles shall be permitted.
- B. Polyethylene Encasement:
1. Polyethylene Encasement: AWWA C105, black, 8 mils. Joint tape shall be self-sticking, PVC or polyethylene, 10 mils thick; Chase "Chasekote 750"; Kendall "Polyken 900"; 3M "Scotchrap 50"; or equal.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. General:
1. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Pipe shall not be stored on rough ground and rolling of the pipe on the coating will not be permitted. Repair any damaged pipe sections, specials, or fittings or replace at the direction of the Engineer.
 2. Inspect each pipe fitting, valve and accessory carefully before installation. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replaced at the direction of the Engineer.
 3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
 4. Use reducing fittings where any change in pipe size occurs. Bushings shall not be used, unless specifically noted on the Drawings. Use

eccentric reducing fittings wherever necessary to provide free drainage of lines.

5. Connections between ferrous and non-ferrous metallic piping and accessories shall be made using a dielectric coupling, union, or flange.
6. Install piping without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.
7. Set all pipe flanges level, plumb, and aligned. Flanged fittings shall be true and perpendicular to the axis of the pipe. Bolt holes in flanges shall straddle vertical centerline of pipes.
8. Flanged Joints: Flanged joints shall be made up tight with care being taken to avoid undue strain in the flanges, fittings, and other accessories. Bolt holes shall be aligned for each flanged joint. Bolts shall be full-size for bolt holes; use of undersize bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Adjoining flange faces shall not be out of parallel to such a degree that the flanged joint cannot be made watertight without overstraining the flange. Replace any flanged pipe or fitting whose dimensions do not allow the making of a proper flanged joint, as specified herein by one of proper dimensions. Clean flanges prior to making joints.
9. Restrained Joints: Install in accordance with manufacturer's instructions. Pull slack out of joint after makeup.
10. Provide all necessary assembly bolts, washers and nuts, thrust blocks, supports, gaskets, flanges, and all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping, and devices included in or on the piping, equipment, and piping accessories.

B. General Buried Piping Installation:

1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section 02200.
2. Where no grade elevations are shown on the Drawings, buried piping shall have at least 3 feet of cover.
3. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
4. Protect buried piping against thrust by use of restrained pipe joints or thrust blocks as shown on the Drawings. Securely brace all exposed free pipe ends.
5. Do not deflect joints more than 75% of the maximum deflection permitted by the pipe manufacturer.
6. Provide polyethylene encasement of buried ductile iron components as follows:
 - a. Ductile iron pipe – single wrap.
 - b. Fittings, valves and pipe couplings, regardless of pipe type:
 - 1) Fittings – single wrap.
 - 2) Valves and pipe couplings – double wrap.
 - c. Flanged and mechanical joints, and other appurtenances with significantly different outside diameters from the pipe – double wrap.

- d. Continuously seal seams and overlaps with tape. Seal circumferential overlaps with two turns of tape, half lapped. Gather excess polyethylene on top of pipe so as not to block backfill material from getting under bottom of pipe. Use caution so as not to rip or cut the polyethylene film. Seal any rips or cuts in the film with tape.

C. Potable Water Main Installation:

1. The Contractor is advised that precautions taken to keep the pipeline clean during construction will facilitate achieving the disinfection requirements of this project with a minimum of effort and expense. Compliance with these suggested minimum procedures will not relieve the Contractor of the disinfection requirements.
2. Prior to installation, thoroughly clean the interior of each length of pipe and each fitting or valve and inspect to ensure that no foreign material remains. Cover both ends with plastic and do not uncover them until just prior to completing the joint.
3. Whenever pipe laying is discontinued for short periods, or whenever work is stopped at the end of the day, close the open ends of the pipe with watertight plugs or bulkheads.
4. Provide adequate trench pumping to ensure against groundwater contacting the inside of the pipeline at any time. Do not lower any pipe or fitting into a trench where groundwater is present and may enter the pipe. When necessary, pump the water from trenches and keep the trench dry until the joints have been completed and the open ends of the pipe have been closed with a watertight plug. Do not remove the plug until the trench has again been pumped dry.
5. Keep new pipe sections clean and dry.
6. Wherever the pipeline crosses over or under a sewer main or house service lateral, center a standard length pipe, 18-foot minimum, on said sewer main or lateral so as to have the pipeline joints as far as possible away from the sewer. This may require field cutting of some pipe pieces.
7. When making the connection between a new pipeline and an existing pipeline, or when repairing a damaged pipe, take the following extra precautions:
 - a. Clean the exterior of the existing pipeline of all dirt and debris, and spray or swab with a standard 5.25% or stronger chlorine solution (as specified) in the immediate vicinity of the work. Clean equipment and materials, including new pipe and fittings, to be used in making these connections of all dirt and debris and disinfect them. Allow at least thirty (30) minutes contact time for disinfection before the chlorine solution is diluted or rinsed off. Provide sufficient trench pumps to prevent flooding of the trench.
 - b. When an old line is opened, either by accident or by design, the excavation may be wet or badly contaminated from groundwater. Apply liberal quantities of standard chlorine solution or tablets to the open trench areas to lessen the danger from such pollution. Tablets are recommended because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation. Scatter liberally around and locate the tablets so that

flow entering the work site will contact the disinfecting agent. Trench application should be done very carefully to avoid contact by skin and clothing with chlorine solution. Minimally, safety dictates wearing safety goggles and rain gear.

- c. When excavating a leaking or broken pipeline, "valve-off" the system gradually to less than watertightness. This is to prevent causing areas of zero pressure which would allow entry of foreign material. A flow should be maintained which is slightly less than trench pump capability. Once the break is exposed and cleaned to disallow site contamination, the valving can then be made watertight.

D. Installation Specifics:

1. Ductile Iron Pipe: Buried pipe shall be installed in accordance with AWWA C600.
2. Steel Pipe Assemblies:
 - a. Handle and install in accordance with AWWA C213.
 - b. No field welding is permitted except for connections to the tank and appurtenances. Welded areas shall be coated as part of the tank. Refer to Section 13211, paragraph 3.04.
 - c. Plain end(s) of assemblies may be trimmed to fit field conditions. Resultant exposed steel shall be coated in accordance with any of the following:
 - 1) AWWA C213, Part 4.4.5.2.
 - 2) AWWA C210 (liquid-epoxy), Part 4.5.
 - 3) Section 13211, paragraph 3.04 (ends that are accessible from inside the tank only).
3. Galvanized Steel Pipe: Threaded joints shall have connections made metal-to-metal tight. All burrs shall be removed from ends of pipe, and threads shall be cleaned of all oil and chips. Male threads shall be coated with joint lubrication.
4. Polyvinyl Chloride Pipe: Installation shall conform to AWWA M23, Chapters 6 and 7, as modified herein.

3.02 COUPLING INSTALLATION

- A. Flexible Couplings and Flange Coupling Adaptors: Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolt on opposite sides a little at a time until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches or other favorably reviewed type. Anchor studs on restrained flanged coupling adapters shall be installed so as to lock into holes drilled through pipe wall in accordance with manufacturer's recommendation.
- B. Wrap buried couplings as specified in paragraph 3.01 B of this Section.

3.03 INSTALLATION OF VALVES AND ACCESSORIES

- A. Use reducing fittings where any change in pipe size occurs between valves or accessories and the attached pipeline. Bushings shall not be used, unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines. Inspect each piece of pipe and each fitting carefully to see that there is no defective workmanship on pipe, or obstructions in pipes and fittings.
- B. Wrap buried valve bodies as specified in paragraph 3.01 B of this Section.

3.04 NOT USED

3.05 NOT USED

3.06 LEAKAGE TESTING – PRESSURE PIPE

- A. General: Perform leakage tests on the inlet pipe, outlet pipe and interconnected piping. Furnish all equipment, material, personnel, test media and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified. Perform leakage tests on all piping at a time agreed upon and in the presence of the Engineer.
- B. Buried Piping: Perform the leakage test for buried piping after all pipe is installed and backfilled. However, preliminary tests may be conducted prior to backfill. If preliminary tests are conducted, provide any necessary temporary thrust restraint.
- C. Accessories: It is the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.
- D. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing, addition of test media, and draining lines and disposal of water, as is necessary. Plug these openings in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.
- E. Correction of Defects: If leakage exceeds the allowable, repair or replace the installation and repeat leakage tests as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.
- F. Reports: Keep records of each piping test, including:
 - 1. Description and identification of piping tested.
 - 2. Test pressure.
 - 3. Date of test.
 - 4. Witnessing by Contractor and Engineer.
 - 5. Test evaluation.

6. Remarks, to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.
 - c. Submit test reports to the Engineer.

- G. Venting: Where not shown on the Drawings, the Contractor may install valved "TEES" or corporation stops and saddles at high points on piping to permit venting of air. Valves shall be capped after testing is completed.

- H. Testing Specifics:
 1. Method: AWWA C600, as modified herein.
 2. Duration: Four hours.
 3. Pressure: 150 psi measured at lowest point of section of pipeline being tested.
 4. Medium: Potable water.
 5. Allowable Leakage: Leakage shall be defined as the quantity of test medium that must be added to the section of pipeline being tested to maintain the specified test pressure for the specified test duration. Maximum allowable leakage shall be as specified in AWWA C600.

3.07 DISINFECTION OF POTABLE WATER SYSTEMS

- A. Prior to disinfection, the inside of each completed pipeline shall be thoroughly cleaned of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water internal cleaning device or "pig" or blowing with compressed air, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 2.5 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment while cleaning piping. Cleaning shall be completed after any repairs.

- B. Disinfect all potable water mains and interconnected piping after testing and before being placed into service to ensure their bacteriological safety. Disinfection shall be accomplished under the supervision of the Contractor by a person skilled and experienced in the operation of water systems.

- C. Mains:
 1. Standard: AWWA C651 as amended herein.
 2. Forms of Chlorine: Sodium hypochlorite or calcium hypochlorite.
 3. Method: Continuous-Feed.

- D. Small Pipelines (less than 3-inch):
 1. Preparation: Provide the system with a 1-inch minimum service cock or valve or other means to inject chlorine solution at a point within 2 or 3 feet of its junction with the supply source. When system is complete, thoroughly flush it by fully opening every outlet until clear water flows from all of them.
 2. Disinfecting Agent: Sodium hypochlorite or calcium hypochlorite in sufficient quantities to produce chlorine concentration of at least 50 parts per million in the system.

3. Disinfecting Procedure:
 - a. Connect a hand-operated pump, or other means of injecting the disinfecting agent, to 1-inch minimum service cock or valve or other injection device. Pump must provide a pressure greater than that of supply of system.
 - b. With system completely full of water and supply valve open, proceed to adjust every outlet of system so that a trickle of water flows from each.
 - c. Inject disinfectant slowly and continuously at an even rate, not in slugs, until a test at each outlet shows a free chlorine residual concentration of at least 50 parts per million.
 - d. Close all outlets and valves, including valve connecting to supply line and 1-inch minimum service cock on solution injection connection. Maintain condition for 24 hours. After 24 hours, test for residual chlorine at each outlet. The free residual chlorine concentration indicated should be not less than 10 ppm. If the indicated free chlorine concentration is less than 10 ppm, the disinfection procedure must be repeated until an approved result is obtained.
 4. When the above procedure has been completed to the satisfaction of the Engineer, flush out entire system with fresh water until tests at all outlets show a residual of not more than 0.5 ppm.
- E. Chlorine Residual Testing: AWWA C651, Appendix A, DPD Drop Dilution Method, except where otherwise specified.
- F. Bacteriological Analyses of Water: After the completion of disinfecting procedure, including the final flushing as described heretofore, obtain water samples from this system for bacteriological analyses. See paragraph 1.04 of this Section. Requirements for satisfactory disinfection of water supply are that bacteriological analyses (Heterotrophic plate count) indicate that water samples are negative for coliformnerogenes organisms, and that total plate count is less than 100 bacteria per cubic centimeter. If bacteriological analyses do not satisfy the above requirements, then disinfection procedure must be repeated until these requirements are met, at no cost to the Owner.
- G. Disposal of Disinfection Solution: Dechlorinate, if necessary, and dispose of disinfection solution in accordance with applicable regulations. Take care to assure that chlorinated water is not spilled in drains.

END OF SECTION