

**SECTION 33 11 00**

**WATER LINES**

**PART 1 - GENERAL**

- 1.01 Contractor shall be responsible for safely storing materials needed for the work that has been accepted by him until they have been incorporated into the completed project. Keep the interiors of all pipes, fittings and other accessories free from dirt and foreign matter at all times.
- 1.02 Wherever reaction blocking is necessary, it shall be considered an integral part of the waterline work and no separate payment shall be made for it.
- 1.03 All water line construction shall be in accordance with standard specifications of the local review authority. Standard specifications of the local review authority supersede these specifications on areas of conflict.

**PART 2 - PRODUCTS**

**2.01 DUCTILE IRON PIPE AND FITTINGS**

- A. Ductile cast iron pipe shall be made of good quality ductile iron that meets the requirements for modular iron castings of ASTM E8. It shall be plain end ductile iron pipe with push-on single gasket joints. The design thickness shall be that specified by ANSI A21.50/AWWA C150, pressure class 350.
- B. Ductile iron pipe shall be centrifugally cast in metal or sand-lined molds and shall conform to the specifications of ANSI A21.51/AWWA C151. It shall be made and tested in accordance with ASTM A339 and shall be subjected to and able to withstand a hydrostatic pressure of 500 psi. The maximum depth of pits shall be half that allowed in the AWWA specifications.
- C. The length of each individual piece of ductile pipe shipped must be plainly marked on that piece of pipe.
- D. The push-on, single gasket joints shall be Fastite (manufactured by American Cast Iron Pipe Company), Tyton (U.S. Pipe and Foundry Company), Super Bell-Tite (Clow Corporations), or other joints of similar type and equal quality. They shall be UL approved and able to withstand 350 psi of operating pressure.
- E. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The gasket groove shall have a flared design so that the maximum deflection will be provided. The plain spigot end of the pipe shall be beveled in order to simplify its entry into and centering within the bell and the compression of the gasket.
- F. The gasket shall be of high-quality vulcanized rubber made in the form of a solid ring to exact dimensions. The design of the gasket groove in the bell of the pipe, design hardness and other properties of the gasket itself shall be such that the joint is liquid tight for all pressures from a vacuum to a maximum rating of 350 psi of internal liquid pressure.
- G. Enough lubricant shall be furnished with each order to provide a thin coat on a spigot end of each pipe. The lubricant shall be nontoxic, impart no taste or smell to the water and have no harmful effect on the rubber gasket. It shall have a consistency that will allow it to be easily applied to the pipe in either hot or cold weather and that will enable it to adhere to either wet or dry pipe.

- H. Standard and special fittings shall be ductile iron. Use compact mechanical joint fittings. All fittings shall conform to the specifications of AWWA C153, compact body.
- I. Pipe and fittings shall be lined with enameled or a thin cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices. A petroleum asphaltic coating approximately 1 mil thick shall be applied to the outside of the pipe.
- J. Fitting laying lengths shall conform to AWWA C153, compact body.
- K. Fittings shall be in accordance with the compact mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, Clow Corporation, Griffin, McWane, or equal.
- L. The pipe manufacturer is to furnish the A/E a certificate of inspection, sworn to by the factory inspector in the presence of a notary public stating that the pieces of pipe in the shipment were made and tested in accordance with ANSI A21.51 and that they were subjected to and withstood a hydrostatic pressure of 500 psi. Each statement is to give the number of pieces, the length, serial number and weight of each piece of pipe making up the shipment.

**2.02 PVC PIPE**

- A. All plastic pipe shall be made from Class 12454-B polyvinyl chloride plastic (PVC 1120) as defined by ASTM D1784.
- B. All Class 305 pipe shall be AWWA C-900, DR 14, 305 psi rating and have NSF approval and be manufactured in accordance with ASTM D2241. The following tests shall be run for each machine on each size and type of pipe being produced.
  - 1. Flattening Test: Once per shift in accordance with ASTM D2412. Upon completion, the specimen shall not be split, cracked or broken.
  - 2. Acetone Test (Extrusion Quality Test): Once per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking or visible deterioration on the inside or outside surface after completion of the tests.
  - 3. Quick Burst Test: Once per 24 hours in accordance with ASTM D1599. SDR = 21; Pressure Rating = 200; Minimum Bursting Pressure, psi = 800.
  - 4. Impact Tests: in accordance with ASTM D2444 for 6" and larger, once per shift; for 4" and smaller, once every 2 hours.
  - 5. Wall Thickness and Outside Dimensions Test: Once per hour – ASTM D2122.
  - 6. Bell Dimensions Test: Once per hour – ASTM D3139.
- C. If any specimen fails to meet any of the above-mentioned tests, all pipe of that size and type manufactured between the test periods must be scrapped and a full set of tests re-run.
- D. Furnish a certificate from the pipe manufacturer stating that he is fully competent to manufacture PVC pipe uniform in strength and texture and in full compliance with these specifications and further stating that he has manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these specifications.
- E. All pipe shall be manufactured in the United States of America. The same manufacturer shall make all pipe for any one project.

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- F. The contractor's methods of storing and handling the pipe shall be approved by the A/E. All pipe shall be supported within 5 feet of each end and in between the end supports in 15-foot intervals. The pipe shall be stored away from heat or direct sunlight. Stringing pipes out along the proposed water line routes will not be allowed.
- G. Certain information shall be applied to each piece of pipe. At the least, this shall consist of: 1) Nominal size; 2) Type of material; 3) SDR or Class; 4) Manufacturer; 5) NSF Seal of Approval.
- H. Pipe that fails to comply with the requirements set forth in these specifications shall be rejected.
- I. The pipe shall have push-on joints designed with grooves in which continuous molded rubber ring gaskets can be placed. Gaskets shall be made of vulcanized natural or synthetic rubber. No reclaimed rubber will be allowed. Gasket materials shall meet the requirements of ASTM F477. The gaskets shall be of the manufacturer's standard design dimensions and of such size and shape as to provide a positive seal under all combinations of joint and gasket tolerance. The gasket and annular groove shall be designed and shaped so that when the joint is assembled, the gasket will be radially compressed to the pipe and locked in place against displacement, forming a positive seal.
- J. The spigot end of each pipe shall be beveled so that it can be easily inserted into the gasket joint, which in turn shall be designed so that the spigot end may move in the socket as the pipe expands or contracts. The spigot end shall be striped to indicate the distance into which it is to be inserted into the socket. Each joint shall be able to accommodate the thermal expansions and contractions experienced with a temperature shift of at least 75 degrees F.
- K. Enough lubricant shall be furnished with each order to provide a coat on the spigot end of each pipe. This lubricant shall be nontoxic, impart no taste or smell to the water, have no harmful effect on the gasket or pipe material or support or promote any bacterial growth. The lubricant containers shall be labeled with the manufacturer's name.
- L. Joints shall be either integral bell and ring joints with rubber compression gaskets as manufactured by the Clow Corporation, H & E or Vulcan Plastic Corporation; twin gasket couplings like those used by Certain-Teed Products Corporation. The pipe and bell must have the same manufacturer.
- M. Standard and special fittings shall be ductile iron. Use compact mechanical joint fittings. All fittings shall conform to the specifications of AWWA C153, compact body. The gaskets shall be ducked tipped transition gaskets for use with PVC pipe.
- N. Fittings shall be lined with enameling or a thin cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices. A petroleum asphaltic coating approximately 1 mil thick shall be applied to the outside of the pipe.
- O. Fitting laying lengths shall conform to AWWA C153, compact body.
- P. Fittings shall be in accordance with the compact mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, Clow Corporation, Griffin, McWane or equal.
- Q. Locator wire shall be No. 14 copper wire, the contractor may elect to use detectable metallic locator tape in lieu of wire. Detectable tape shall be 2" wide and shall be an inert, bonded layer plastic with metallic foil core, highly resistant to alkalis, acids and other destructive chemical

components. The tape shall be brightly colored to contrast with soil and bear the imprint, "CAUTION WATER LINE BURIED BELOW."

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION OF WATER LINES**

- A. Lay water lines to and maintain at the lines and grades required by the drawings. All fittings, valves and hydrants shall be at the required locations; spigots centered in the bells and all valves and hydrant stems plumb.
- B. Unless otherwise indicated by the drawings or approved by the A/E, all water pipes shall have at least 36 inches of cover.
- C. Provide and use tools and facilities that are satisfactory to the A/E and that will allow the work to be done in a safe and convenient manner. All pipe, fittings, valve and hydrants are to be unloaded from the trucks using suitable tools and equipment. Use a derrick, ropes or other suitable tools/equipment to lower each piece carefully so that nothing is damaged. Under no circumstances drop or dump water line materials from the truck to the ground or into the trench.
- D. Any pipes strung out along the route of the proposed lines before the actual installation of those lines is due to take place, shall not be lowered into the trench until they have been swabbed to remove all mud and debris. PVC pipe shall be strung out a maximum of one day ahead of pipe laying. Remove all unnecessary material, brush and wipe clean the outside of spigot and inside of bell, leaving dry and oil free.
- E. Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside, then put a heavy, tightly woven canvas bag of suitable size over each end and leave in place until it is time to connect it to the one adjacent to it.
- F. Place no debris, tools, clothing or other materials in the pipe during laying operations.
- G. After length of pipe has been placed in the trench, center spigot end in the bell of the adjacent pipe and insert to the depth specified by the manufacturer and bring to correct line and grade. Secure the pipe in place by tamping approved backfill around it.
- H. Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.
- I. Whenever pipe laying is not in progress, close the open ends with either a watertight plug or something approved by the A/E. If the joints of any pipe in the trench cannot be completed until a later time, caulk them with packing to make them as watertight as possible; this shall be done not only at the end of each working day, but also before work is stopped for lunch periods, bad weather or any other reason. If there is water in a trench, leave the seal in place until trench has been pumped completely dry.
- J. Cut pipe so that the valves, fittings or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.
- K. Lay pipe with bell ends facing in the direction of laying unless otherwise directed by the A/E.

- L. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions of plumb stems, or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by the A/E.
- M. Lay no pipe in water or when it is the A/E's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding pipe, its use is considered incidental to the project, and no separate payment will be made for its use.
- N. Where a water line crosses over a sanitary sewer, use a full joint of pipe with a standard mechanical joint and center over the sewer. Where a water line is to be parallel to a sanitary storm sewer, lay it at least 10 feet away. If it is not practical for them to be separated, then lay the water line at least 18 inches above the top of the sewer.
- O. Join all pipes in the exact manner specified by the manufacturer of the pipe and jointing materials.
- P. Locator wire shall be buried in the trench directly above the installation to be identified. A vertical distance of 12 inches between the top of the pipe and the wire shall be provided. Wire to be grounded to metallic water valve stem and circuit verified prior to acceptance. The wire shall be placed in the trench essentially parallel to the finished surface. The contractor will take necessary precautions to ensure that the wire is not pulled, distorted or otherwise misplaced in completing the trench backfill. Wire will be placed in all trenches above all nonmetallic pipe used on both main and service lines.

**3.02 HYDROSTATIC TESTS**

- A. Pressure Test
  - 1. After pipe has been laid and backfilled as specified above, subject all newly laid pipe or any section with valves to a pressure of 200 psi. All services are to be laid prior to testing the main and tested as part of the test of the main.
  - 2. The duration of each pressure test shall be at least one hour. Slowly fill each valved section of the pipe with water and apply the specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) with a pump connected to the pipe in a manner satisfactory to the A/E. Furnish the pump, pipe, connections, gauges and all necessary apparatus'.
  - 3. Before applying the specified test pressure, expel all air from the pipe. If hydrants or blow offs are not available at high places, make the necessary taps at the points of highest elevation before testing and insert plugs after the test has been completed.
  - 4. Carefully examine all exposed pipes, fittings, valves and hydrants during the test. Remove any cracked or defective pipe, fittings, valves or hydrants discovered in consequence of this pressure test and replace with sound material in the manner specified. Repeat the test until the results are satisfactory to the A/E.
- B. Leakage Test
  - 1. Conduct the leakage test after the pressure test has been satisfactorily completed. Furnish the pump, pipe, connections, gauges, measuring devices and all other necessary apparatuses as well as all necessary assistance to conduct the test.
  - 2. Each leakage test shall be 2 hours with the main subject to a pressure of 150 psi.
  - 3. Leakage is defined as the amount of water which must be supplied to the newly laid pipe or any valved section in order to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
  - 4. No pipe installation will be accepted until the leakage is less than the number of gallons per 2-hour period listed below:

Pipe Sizes in Inches	Gallons per 1,000 ft of pipe
1 – 2-1/4	0.2
3	0.3
4	0.4
6	0.6
8	0.8
10	1.0
12	1.1

5. At the contractor's expense, all pipes and joints that have leakage greater than that specified, shall be located, repaired and retested until satisfactory results are obtained.

### **3.03 DISINFECTION**

- A. During construction, take precautions to protect pipe interiors, fittings and valves against contamination.
- B. If dirt or other foreign material has gotten into a pipe that the A/E thinks will not be removed by normal flushing, swab pipe with a disinfecting solution of 5% hypochlorite.
- C. Make water flow from the existing distribution system (or by another A/E approved source) into the new pipeline, adding chlorine at a constant, measured rate to ensure that the concentration is kept at a minimum of 50 mg/l. Measure the concentration residual at regular intervals, adjusting concentration as needed.
- D. A 1% chlorine solution may be prepared with 1 pound of calcium hypochlorite for each 8.5 gallons of water or with sodium hypochlorite.
- E. While the chlorine is being applied, manipulate valves so that the treatment dosage will not flow back into the line supplying the water. Continue the application of chlorine until the entire line being treated is filled with the chlorine solution. Then retain the chlorinated water in the line for at least 24 hours, during which time all valves and hydrants in the line being treated shall be operated so that appurtenances can also be disinfected. After 24 hours, the treated water shall have a chlorine concentration of at least 25 mg/l throughout the line.
- F. After the applicable retention period, flush the heavily chlorinated water from the line until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system or less than 1mg/l. Perform flushing only at sites where there is adequate drainage.
- G. The velocity of the water used to flush shall be at least 2.5 fps.
- H. Once a line has been flushed, test to make certain that the residual chlorine in the water is within acceptable units.
- I. It must be noted that flushing is no substitute for taking preventative measures before and during the laying of water lines. Certain contaminants, especially those in caked deposits, are difficult or even impossible to remove by flushing, no matter how high the velocity. Furthermore, in pipes with diameters 16 inches and greater, it can be difficult to achieve even the minimum recommended flushing velocity. In mains larger than 24 inches, an acceptable alternate is to broom sweep the main carefully removing all sweepings prior to chlorinating the main.

### **3.04 BACTERIOLOGICAL TESTS**

- A. After a water line has undergone final flushing but before it is placed into service, collect a sample for bacteriological testing from the end of that line. In the case of extremely long lines, take additional samples if the A/E so directs.
- B. Collect these samples in sterile bottles treated with sodium thiosulfate. Do not use a hose or fire hydrant to collect samples. One suggested sampling method is to install a standard corporation cock in the line with a copper tube gooseneck assembly. After the samples have been taken, the gooseneck assembly can be removed and retained for later use.
- C. Take the sample collected to an approved laboratory to be tested for bacteriological quality in order to determine if they contain any coliform organisms. If the initial disinfection fails to produce satisfactory samples, repeat disinfection until satisfactory samples are obtained.
- D. When the samples tested are satisfactory, the water line may be placed in service.

**3.05 DISINFECTION PROCEDURE AFTER CUTTING INTO OR REPAIRING LINES**

- A. Leaks and breaks that are repaired with clamping devices while the lines remain full of water under pressure present little danger of contamination and require no disinfection.
- B. When an existing line is opened by accident or design, the excavated area could be wet and contaminated because of the presence of sewers nearby. The danger of contamination from such pollution can be decreased if liberal quantities of hypochlorite are applied to the open trenches. It is better to use tablets because they dissolve slowly and continue to release as water is pumped from the excavation site.
- C. Where practical, treat the lines by the slug method in accordance with AWWA C651.
- D. The following disinfection procedure is considered the minimum that may be used when existing lines are repaired:
  - 1. Swab the interior of all pipes and fittings, particularly couplings and tapping sleeves that are to be used with a solution of 5% hypochlorite before installation.
  - 2. The most practical means of removing contamination introduced into a line during repairs is to give the line a thorough flushing. If the locations of valves and hydrants make it possible, flush in both directions. Start flushing as soon as repairs are completed and continue until all discolored water is eliminated.

**3.06 CLEAN UP**

- A. After completing each section of water line, remove all debris and all construction materials from the work site. Grade and smooth over the surface on both sides of the line, leaving the entire area clean and in a condition satisfactory to the A/E.

**-END OF SECTION-**