

**SECTION 02667
WATER LINES**

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification applies to all ductile iron, copper and brass water piping, and fittings including sanitary water cold, process water and fire protection piping.
- B. The contractor shall be responsible for safely storing materials needed for the work that have 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.
- C. Wherever reaction blocking is necessary, it shall be considered an integral part of the water line work, and no separate payment shall be made for the blocking.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions apply to this Section.
- B. Section 02222 – Excavation for Utilities

1.3 SUBMITTALS

- A. Submit shop drawings for all products specified in this section in accordance with the requirements of General and Supplementary Conditions.
- B. Certificate of Conformance to ASTM A339 (see paragraph 02667.2.1.B).

1.4 STANDARDS

- A. Products and installation shall conform to the applicable portions of NFPA 24-1995.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe shall be centrifugally cast of iron that meets the requirements of ANSI A21.51-96 / AWWA C151. The pipe shall be plain end with push-on, single gasket joints. The design thickness shall be that specified by ANSI A21.50 / AWWA C150, latest revision, with a wall thickness of Pressure Class 350.
- B. Pipe shall be tested in accordance with A21.51-96 / AWWA C151. The pipe manufacturer is to furnish the CM a certificate of compliance, signed to by the factory inspector, stating that the pieces of pipe in the shipment confirm to A21.51-96 / AWWA C151.. Each certificate shall list the day and hour of casting for all pieces of pipe in the shipment.
- C. The push-on, single gasket joints shall be either Fastite (manufactured by American Cast Iron Pipe Company), Tyton (U.S. Pipe and Foundry Company), Super Bell-Tite (Clow Corporation), or other joints of similar type and equal quality.

- D. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The plain spigot end of the pipe shall be beveled.
- E. 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 and the 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.
- F. Enough lubricant shall be furnished with each order to provide a thin coat on the spigot end of each pipe. This 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.
- G. Fittings shall be ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110, standard body.
- H. Pipe and fittings shall be lined with a thin cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately one mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices. A petroleum asphaltic coating approximately one mil thick shall be applied to the outside of the pipe.
- I. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, Clow Corporation, Griffin, McWane, or equal.
- J. Restrained pipe and fittings, where specified or shown on the drawings, shall be ductile iron. Retainer glands and similar devices will not be allowed in such cases unless otherwise noted or shown on the Drawings. Restrained push-on pipe shall be American Cast Iron Flex-Ring, U.S. Pipe TR Flex or approved equal.
- K. Where shown on the Drawings, mechanical joint valves and fittings shall be restrained with EBAA Iron Megalug Series 1100 restraining system. Retainer glands and similar devices using set screws shall not be allowed.
- L. Pipe shall be UL listed or FM approved.

2.2 COPPER PIPE AND FITTINGS

- A. Pipe shall meet the requirements of ASTM B88, Type K, annealed.
- B. Fittings shall meet the requirements of ASME B16.18, cast bronze or ASTM B16.22 wrought copper and bronze.
- C. Joints shall meet the requirements of ASTM B32, solder, Grade 95TA.

2.3 BRASS PIPE AND FITTINGS

- A. Brass pipe shall conform to ASTM B43 for seamless red brass pipe.
- B. Fittings shall be bronze screwed fittings conforming to ASTM B61.

PART 3 - EXECUTION

3.1 INSTALLATION OF WATER LINES

- A. Lay water lines to and maintain at the lines and grades required by the drawings. All fittings and valves shall be at the required locations, the spigots centered in the bells, and all valve stems plumb.
- B. Provide and use tools and facilities that are satisfactory to the CM and that will allow the work to be done in a safe and convenient manner. All pipe, fittings, and valves are to be unloaded from the trucks using suitable tools and equipment. Use a derrick, ropes, or other suitable tools or equipment to lower all pipe, fittings, and valves into the trench one piece at a time. Lower each piece carefully so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances drop or dump water line materials from the truck to the ground or into the trench.
- C. During construction, take precautions to protect pipe interiors, fittings, and valves against contamination. When pipe laying is not in progress (e.g., at the end of the day's work), place watertight plugs in the ends of all pipe already in the trench; if water accumulates in the trench, leave the plugs in place until the trench is dry. Complete the joints of all pipe in the trench before stopping work for any reason.
- D. If dirt or other foreign material that has gotten into a pipe will not, in the opinion of the CM, be removed by flushing, clean the interior of the pipe, and swab with a disinfecting solution of five percent hypochlorite.
- E. Place no debris, tools, clothing, or other materials in the pipe during laying operations.
- F. Lubricate the spigot end of the pipe with a thin coat of lubricant. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe, and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material around it.
- G. Whenever pipe laying is not in progress, close the open ends of pipe either with a watertight plug or by other means approved by the CM. If the joints of any pipe in the trench cannot be completed until a later time, caulk them with packing in order 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 this seal in place until the trench has been pumped completely dry.
- H. Field cut pipe shall be tapered on the spigot end in accordance with the manufacturer's recommendations.
- I. Lay pipe with the bell ends facing in the direction of laying unless otherwise directed by the CM.
- J. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions or 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 CM.

- K. Thrust blocks shall be installed wherever the water main changes direction (at tees and bends), at dead ends, or at any other point recommended by the manufacturer or required by the Drawings. Thrust blocks shall be considered an integral part of the water line work. Where thrust blocking is inadequate or inappropriate, tie rods or restrained joints shall be installed. Except as noted on the Drawings, thrust blocks, tie rods and restrained joints are an integral part of the work.
- L. Lay no pipe in water or when it is the CM's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, its use is considered incidental to the project, and no separate payment will be made for its use.
- M. Where a water line crosses over a sanitary sewer, use a full joint of pipe and center over the sewer and provide a minimum of 18 inches from the bottom of the water line to the top of the sewer line. Where a water line is to be parallel to a sanitary or storm sewer, lay it at least ten feet from the sewer. If it is not practical for the water and sewer lines to be separated as described above, then lay the water line at least 18 inches above the top of the sewer. If this is not possible, construct the sewer of ductile iron pipe conforming to Section 02667 and pressure test the sewer prior to acceptance.
- N. Unless otherwise indicated by the drawings, all water pipes shall have at least 36 inches of cover.

3.2 HYDROSTATIC TESTS

A. Pressure/Leakage Test

- 1. Conduct the leakage test of all underground waterpiping, including all building connection piping shown on the Drawings. Furnish the pump, pipe, connections, gauges, measuring devices, and all other necessary apparatus as well as all necessary assistance to conduct the test.
- 2. The duration of each leakage test shall be two hours; during the test, subject the main 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 two hour period listed below:

<u>PIPE SIZES</u>	<u>GALLONS PER 1,000 FEET OF PIPE</u>
2 inches - 2-1/4 inches	0.2
3 inches	0.3
4 inches	0.4
6 inches	0.6
8 inches	0.8
10 inches	1.0
12 inches	1.1
14 inches	1.3
16 inches	1.5

- 5. Should any test of pipe laid disclose leakage greater than that specified, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.
- 6. If desired, the disinfection water may be used to conduct the pressure test.

3.2 DISINFECTION

- A. Fill the new water lines from the existing potable water distribution system or some other source approved by the CM into the newly laid pipeline. Feed water into the pipe, and chlorine into the water, at constant, measured rates so proportioned that the chlorine concentration in the water in the pipe is kept at a minimum of 50-mg/l available chlorine. To ensure that this concentration is maintained, measure the chlorine residual at regular intervals.
- B. Table I shows how much chlorine is needed for each 100 feet of line for pipes of various diameters. A one percent chlorine solution may be prepared either with one pound of calcium hypochlorite for each 8.5 gallons of water or with sodium hypochlorite.

TABLE I

CHLORINE REQUIRED TO PRODUCE A 50 MG/L CONCENTRATION
IN 100 FEET OF PIPE, BY DIAMETER

Pipe Size (Inches)	100% Chlorine (Pounds)	1% Chlorine Solutions (Gallons)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
14	0.328	3.96
16	0.428	5.12
18	0.540	6.48
20	0.680	8.00
24	0.980	11.52

- C. While the chlorine is being applied, manipulate valves so that the treatment dosage will not flow back into the line that is 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. Prior to beginning 24 hour holding period, 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. If concentration is less than 25 mg/d after 24 hours, rechlorinate the line and begin new 24 hour period.
- D. 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 one mg/l. Perform such flushing only at sites where there is adequate drainage. Chlorinated water shall be captured and trucked off site and disposed of at a location approved by the Construction Manager or dechlorinated and disposed of onsite in a manner approved by the Construction Manager.
- E. The velocity of the water used to flush a line shall be at least 2.5 fps. The flow rates required to produce this velocity in various sizes of pipe are shown in Table II.

TABLE II

REQUIRED OPENINGS TO FLUSH PIPELINES
(RESIDUAL PRESSURE)

Pipe Size (inches)	Flow Required To Produce 2.5 fps Velocity (gpm)	Orifice Size (inches)	Number	Hydrant Outlet Nozzles Size (inches)
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1,200	3-1/4	2	2-1/2
16	1,565	3-5/8-1/4-3/16	2	2-1/2
18	1,980	4-3/16	2	2-1/2
20	2,440	-----	2	2-1/2
24	3,470	-----	2	2-1/2

- F. Once a line has been flushed, test to make certain that the residual chlorine in the water is within acceptable limits.
- G. It must be noted that flushing is no substitute for taking preventive 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.

3.3 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 CM so directs.
- B. Collect these samples in sterile bottles treated with sodium thiosulphate. 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 samples 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. Forward testing results to the Tennessee Department of Environment and Conservation.
- E. When the samples tested are found to be satisfactory, the water line may be placed in service.

3.4 CLEANUP

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

END OF SECTION 02667