

SECTION C1
DUCTILE IRON PIPE AND FITTINGS

GENERAL

This section covers the furnishing and installation of ductile iron water pipe, fittings, thrust restraint and pipe disinfection.

MATERIALS

Ductile Iron Pipe

Unless otherwise shown on the plans or specified herein all water pipe shall be ductile iron cement lined designed in accordance with ANS21.50/AWWA C150-96 and manufactured in accordance with ANS A21.51/AWWA C151-96 or latest versions.

Unless otherwise indicated or specified, ductile iron pipe shall be special thickness Class 56. Pipe classified according to pressure classes designated under AWWA C150/A21.50-96 such as 250 or 350 is not acceptable.

Pipes shall be double cement-mortar lined in accordance with ANS A21.4/AWWA C104-95.

Unless otherwise specified all pipe and fittings shall have an external zinc coating conforming to AWWA C150 AND C151. Pipe shall be coated with a layer of arc-sprayed zinc; a minimum of 200 g of zinc shall be applied per m² of pipe surface area. A bituminous based topcoat compatible with zinc shall be applied on top of the zinc coating. The mean dry thickness of zinc shall be greater than or equal to 3 mils. The mean dry film thickness of the topcoat shall be a minimum of 2 mils. Pipe shall be clearly labeled as zinc coated.

All ductile iron fittings shall have as the initial exterior coating a zinc rich primer/paint with an asphaltic topcoat. The zinc rich primer/paint shall have a zinc content of at least 85% by weight and the mass of zinc applied should not be less than 150 g/sq.m. The primer/paint shall be Sherwin Williams Corothane I Galvapac 1K Primer or equal.

All pipe shall be push-on joint conforming to ANS A21.11/AWWA C111 latest version. Pipe shall be delivered in 18-foot lengths.

Push-on joints shall be provided with sufficient quantities of accessories conforming to ANS A21.11/AWWA C111.

Fittings

The Contractor shall furnish and install all the required fittings shown on the plans or as directed by the Engineer. All fittings shall be ASTM A-536 ductile iron, cement lined, zinc coated, mechanical joint. All fittings 3-inch through 48-inch in diameter shall meet or exceed the requirements of AWWA C-110. Compact fittings shall be ductile iron meeting or exceeding the requirements of AWWA C-153. Compact fittings shall only be used in sizes 4" to 24".

All fittings 4" to 24" shall be pressure rated at 350 PSI working pressure. Fittings 30" to 48" shall be pressure rated at 250 PSI working pressure. Fittings shall conform to the weights, excluding accessories, and dimensions shown in the latest edition of the Handbook of Ductile Iron Pipe and come complete with all joint accessories as required. All accessories (gland, gaskets, T-bolts and nuts) shall be in accordance with AWWA C-111. Gaskets used for installations in close proximity to steam lines (as identified on the contract drawings or determined by the Engineer) shall be heat resistant, EPDM type or equivalent. All mechanical joint bolts (T-bolts) shall be Cor-Ten or equal.

Couplings

When connecting ductile iron pipe to cast iron pipe the contractor shall use sleeve couplings. When connecting ductile iron pipe to ductile iron pipe the contractor shall use solid sleeve mechanical joint fittings manufactured in accordance with these specifications.

Sleeve couplings and accessories shall be pressure rated for a minimum of 150 PSI. Couplings shall be compression type with multiple bolts required to provide compression for a watertight seal. Couplings shall be ductile iron or steel. The couplings shall be provided with stainless steel or "Cor-Ten" bolts and nuts or approved equal. Bolts shall be 5/8 - inch diameter.

After assembly, all surfaces of the bolts and nuts shall be thoroughly coated with two coats of an epoxy paint coating. The

interior and exterior of the coupling shall be epoxy-coated in accordance with Section C7, Epoxy Coatings, of the Commission's standard specifications.

CONSTRUCTION METHODS

Care shall be taken in loading, transporting, and unloading to prevent injury to the pipes or coatings. Pipe or fittings shall not be dropped.

Pipes and fittings shall be subjected to a careful inspection before installation. All defective pipe and fittings shall be removed from the site at no cost to the Commission. If any portion of the pipe is cracked or defective the entire length shall be removed.

Pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until used in the work. Each pipe shall be cleared of all excess debris, dirt, etc., before installation.

Push-on joints shall be made up by first inserting the gasket into the groove of the bell and applying a thin film of the pipe manufacturer's gasket lubricant uniformly over the inner surface. The chamfered end of the plain pipe shall be inserted into the gasket and forced past it until it seats against the bottom of the socket.

When cutting pipe is required, the cutting shall be done by machine leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.

Whenever encountered within the trench, existing water mains shall be removed. All existing water mains, which are left in place and abandoned, shall be capped at all open ends.

Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA Standard Specification C600, except as otherwise provided herein. A firm, even bearing throughout the length of the pipe shall be constructed by tamping selected material at the sides of the pipe up to the springline. **Blocking will not be permitted.**

Water pipe shall be laid with a minimum cover of five and one-half (5 1/2) feet or to the grade of the existing pipe unless otherwise shown on the plan or directed by the Engineer.

When construction is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means. The Contractor shall keep the trench free from water while the pipe is being installed.

Fittings, in addition to those shown on the plans, shall be provided, as required, for crossing utilities, which may be encountered.

All existing valves and hydrants removed from service shall be delivered to the Commission's storage yard. All pipe which is removed shall be the property of the Contractor, and it shall be the Contractor's responsibility for disposal.

THRUST RESTRAINT

Fittings, plugs and hydrants shall be restrained against hydraulic thrust equal to the test pressure of the pipe with a safety factor of 1.5. The Commission will accept the following methods of thrust restraint but may require any method or combination of methods as directed by the Engineer.

THRUST BLOCKS

Thrust blocks may only be used against undisturbed soil. Where approved for use they shall be designed in accordance with Commission specifications using the appropriate pressures as noted in this section. Concrete shall be in accordance with Commission specifications.

TIE RODS

Tie rod systems may be used where approved by the Engineer. All materials shall be steel and coated with an approved bituminous coating or other approved corrosion resistant coatings. Unless otherwise required or approved by the Engineer the contractor shall install tie rods in accordance with the following schedule for all fittings:

PIPE SIZE	NUMBER	DIAMETER
4"-12"	2	3/4"
16"	4	3/4"
20"-24"	4	1-1/2"

MECHANICAL JOINT FOLLOWER GLANDS

Wedge action mechanical joint follower glands shall be ductile iron ASTM A536. They shall be rated for a working pressure of 350 PSI for sizes 4"-12" and 250 PSI for sizes 16"-48". The bolts shall be ductile iron or Cor-ten and hand tightened to the manufacturer's required torques.

Wedge action follower glands utilize wedge-activating screws, which tighten around the circumference of the pipe to prevent the pipe from separating from its joint. Use of these glands requires that the restraint extend beyond the fitting being restrained. The length of pipe involved depends on the pipe size, pressure and soil conditions. Manufacturers provide information for the design applications for their products. The Contractor shall follow those requirements when preparing the design schedule for fittings. The design shall be made using the test pressure for the main with a factor of safety of 1.5. Where the recommended length of pipe to be restrained is less than the distance to the nearest joint, that joint shall be restrained.

Note: this type of restraint is only to be used with ductile iron pipe.

MECHANICAL JOINT RESTRAINING GASKETS AND FOLLOWER GLANDS

Mechanical joint restraining gaskets may be utilized for thrust restraint providing the gasket and follower gland are purchased as a unit requiring only standard mechanical joint assembly. The unit shall include a rubber gasket conforming to ANSI/AWWA C111/A21.11 with steel locking segments, which provide for the restraint. The follower gland shall be ductile iron meeting ASTM A536. The unit shall be NSF approved for use with ductile iron pipe. The gasket and follower gland shall be purchased as a complete kit. Bolts are to be Corten, stainless steel or approved non corrosive material. The units shall be pressure rated for 350 psi up to 16-inch diameter and 250 psi for 20 and 24-inch diameter pipe with a 2:1 safety factor. The units shall be of a type that can be disassembled as any mechanical joint fitting. Installation shall be in accordance with the manufacturer's instructions. Acceptable products include MJ FIELD LOK Gasket or equal.

Note: this type of restraint is only to be used with ductile iron pipe.

Deflection

In laying a full 18 foot length of ductile iron pipe along a curve, the maximum changes in alignment of each length of pipe using push on joints shall not exceed 19 inches for pipes 4"-36". The amount of allowable deflection for pipe greater than 36" shall be in accordance with the manufacturers' specifications.

Pressure Tests

The pipelines shall be tested (in sections if required by the Engineer) for strength and for leakage at a pressure of 150 pounds per square inch. The tests for leakage shall last for at least one hour and may be required to last two hours. The additional water needed to maintain the required pressure shall be accurately measured in a manner approved by the Engineer. The container shall be clearly labeled with its capacity in gallons.

Tests shall be made for all newly installed pipe and when required by the Engineer. A 24-hour notice shall be given to the Engineer prior to all tests. The Contractor shall furnish all apparatus; material and labor necessary for making the tests, including caps temporarily set to accommodate pressure testing.

The Contractor will make all necessary arrangements for securing the water for test purposes and will stand the expense of these arrangements. The water required for testing will be furnished by the Commission without charge to the Contractor from the Commission's existing water system.

During this test all hydrant laterals shall be in the open position. Methods of testing and plans showing sections to be tested are to be submitted to the Engineer for approval as requested. The Contractor shall not perform a pressure test against existing valves unless authorized by the Engineer. Generally he shall set a cap at the limit of work for main line water work.

The rate of leakage shall not exceed the following for pipe of 18 foot nominal laying length when tested at 150 psi:

<u>Pipe Diameter</u>	<u>Allowable Leakage per 1000 Feet</u>
(inches)	<u>of Pipeline</u>
	(gallons)
4	0.33
6	0.50

8	0.66
12	0.99
16	1.32
20	1.66
24	1.99
30	2.48
36	2.98
40	3.48
48	3.97

per AWWA C600 effective December 1, 2005

The Contractor shall repair all leaks discovered under any of the required tests.

Chlorination of the Pipeline

Upon completion of the pipe line and all the testing thereof, the interior of the pipe shall be flushed and then thoroughly disinfected in all parts. This disinfection must result in eliminating from the various parts of the new pipe line all evidence of the existence therein of bacteria indicative of any contamination, as determined by tests of the bacterial content of samples of water taken from the new water main. The disinfection may be accomplished by introducing into all the various parts of the new water mains a liquid solution containing one percent available chlorine in such volume that the rate of dosage to the water mains shall be at least 50 parts per million of available chlorine. The contact period for this disinfection shall be at least twenty-four hours, and a longer period will be required if tests of residual chlorine show it to be less than the required minimum of 25 mg./l. The water system shall be flushed out after its disinfection. The Contractor shall furnish and install suitable temporary testing plugs, caps, pumps, pipe connections and other appurtenances as necessary and all labor required for testing bacteria and disinfecting the water mains. The Engineer shall approve of the location of the discharge of the chlorinated water.

All work shall be done in accordance with AWWA C-651. Connections at cuttings shall be swabbed with a 50-PPM solution of chlorine at locations when other methods are not applicable.

The Contractor shall provide a copy of the results of the pressure and chlorination tests to the Inspector **and** the Engineer prior to activation of the water main. Results of the

chlorination tests shall be documented by a laboratory certified by the Massachusetts Department of Environmental Protection.

The Pressure Testing and Disinfection Report in the Appendix of these specifications shall be completed by the Contractor and approved by both the BWSC Engineer and Inspector prior to any payments being made for pipe.

MEASUREMENT AND PAYMENT

C1-4	Lay 4 inch D1CL water pipe	L.F.
C1-6	Lay 6 inch D1CL water pipe	L.F.
C1-8	Lay 8 inch D1CL water pipe	L.F.
C1-10	Lay 10 inch D1CL water pipe	L.F.
C1-12	Lay 12 inch D1CL water pipe	L.F.
C1-16	Lay 16 inch D1CL water pipe	L.F.
C1-20	Lay 20 inch D1CL water pipe	L.F.

The length of ductile iron water pipe to be paid for under the appropriate size designated shall be measured by the linear foot along the finished grade over the pipe from end to end as laid. The length of pipe for hydrant connections shall be measured from the centerline of the water main to the centerline of the hydrant. The length of pipe for service connections 4 inches and greater shall be measured from the centerline of the water main to the point of interception with the existing service pipe. No deduction for the length of valves or fittings in the pipe shall be made.

The unit price paid for Ductile Iron Water Pipe shall be full compensation for cutting and disposal of pavement and trench excavation, including disposal transportation cost, dewatering, placing and compacting backfill materials, removal and disposal of existing water mains, removal and delivery to BWSC facility (or disposal if ordered by the Engineer) of all valves and appurtenances, furnishing and laying of new water pipe and fittings as shown on the plans or ordered by the Engineer, all items and labor related to the approved installation of thrust restraint, and all else in connection with the laying of water main for which there is no separate pay item. Where required polywrap encasement shall be installed in accordance with Commission specification C-17. The cost of the purchase and installation of the polywrap encasement is incidental to the cost of the installation of the pipe.

ITEM C1-99 Additional Fittings LB.

The quantity of additional fittings to be paid for shall be the number of pounds of standard fittings or compact fittings, including plugs, which are furnished and installed by order of the Engineer exclusive of those, required to conform to the pipeline layout indicated on the drawings. The Commission will pay for the weights of the fittings minus accessories based upon the manufacturer certification, which is to be furnished by the contractor.

The unit bid price for additional fittings shall include furnishing and installing by cutting of pipe if required, making and restraining joints and all incidental work thereto. Any fittings used for the Contractor's convenience shall be at his own expense. If a different fitting must be used in lieu of the fitting shown on the drawings, payment shall be made on the basis of the difference in weights.

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