

SECTION 02660

WATER DISTRIBUTION SYSTEMS

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SECTION 02660

WATER DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

Furnish labor, materials, services, equipment, and other necessary items required for accompanying the construction of the water systems. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line and fire water line, valves and fire hydrants, set lines, elevations, and grades for water distribution systems work and control system for duration of work including careful maintenance of benchmarks, property corners, monuments, or other reference points.

1.02 RELATED SECTIONS

- A. Section 02220 - Excavation, Backfill and Compaction.
- B. Section 02227 - Aggregate Materials.
- C. Section 02605 - Manhole and Catch Basin Structures.
- D. Local Governing Authority and Code Requirements.
- E. All Necessary Construction Permits.
- F. The public utility for water is the Biddeford-Saco Water Company. All materials, installation, and workmanship will comply with the requirements specified in this section, the requirements of the Public Utilities Commission and The Biddeford-Saco Water Company. Where a more stringent standard exists, the more stringent standard shall apply.

1.03 REFERENCE

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ANSI/ASME B16.18 - Cast Copper Allow Solder Joint Pressure Fittings.
- C. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54 Kg) Rammer and 18-in. (457 mm) Drop
- E. ANSI/ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
- F. ANSI/AWS A5.8 - Brazing Filler Metal.
- G. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe Fittings for Water.
- H. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquid.

- I. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- J. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- K. ANSI/AWWA C500 - Gate Valves, 3 through 48 in NPS, for Water and Sewage Systems.
- L. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.
- M. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.
- N. ANSI/AWWA C508 - Swing-Check Valves for Waterworks Service, 2 in through 24 in NPS.
- O. ANSI/AWWA C509 - Resilient Seated Gate Valves 3 in through 12 in NPS, for Water and Sewage Systems.
- P. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- Q. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.
- R. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.
- S. ASTM B88 - Seamless Copper Water Tube.
- T. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- U. ASTM D2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- V. ASTM D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
- W. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- X. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
- Y. ASTM D3139 - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- Z. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
- AA. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, ½inch through 3 inch, for water.
- BB. UL 246 - Hydrants for Fire - Protection Service.

1.04 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, hydrants, valves and accessories including ASTM designations, AWWA certifications and UL labels as required.
- B. Manufacturer's Certificate: Certify that products meet or exceed state or local requirements.

1.05 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of piping mains, valves, connections, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with utility company and/or municipality requirements.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

PART 2 - PRODUCTS

2.01 PIPE

- A. Pipe sizes less than 3" that are installed below grade and outside building shall comply with the following:
 - 1. Seamless Copper Tubing: Type "K" roll form to comply with ASTM B88-62. Fittings shall be brass compression manufactured by Ford, Mueller, or McDonald.
- B. Pipe: Sizes 4" and larger shall comply with the following:
 - 1. Ductile Iron Water Pipe: In accordance with ANSI A21.51. (AWWA C151) ductile iron pipe shall be cement mortar lined in accordance with AWWA C104. Joints shall meet requirements of AWWA C111. Push-on joint pipe to be supplied with gaskets and gasket lubricants. Pipe shall be 62-42-10 strength; 60,000 psi minimum tensile strength; 42,000 psi minimum yield strength; 10 but not including 12 inch shall have a Class 52 wall thickness. Size 12" and over shall have Class 51 wall thickness. The bituminous coating used for the sealing of the cement mortar lining shall be of a quality that will not have a deleterious effect on the quality, color, taste or odor of potable water.
- C. Ductile Iron Fittings: Fittings shall be manufactured by Tyler or Griffin and material shall be ASTM A536-72 mini grade 70-50-05, in accordance with AWWA C110. Fittings shall be cement lined (AWWA C104-74). Interior seal coated (AWWA C104-74) and exterior bituminous coated. Mechanical joint with accessories furnished; D.I. glands, gaskets, Cor-Ten T-bolts and nuts; Class 350 pressure rating in accordance with AWWA C110. Thickness shall be equal to ductile iron pipe Class 53 in accordance with AWWA C151. All plain end fittings shall be beveled-edged (60⁰) to fit slip-joint fitting and shall be long body design.
- D. Retainer Glands: Glands shall be heavy duty ductile iron body as manufactured by Romac or Ebba Iron and shall have a minimum working pressure rating as follows:
 - 1) 4" - 350 psi (pounds per square inch)
 - 6" - 350 psi
 - 8" - 350 psi
 - 12" - 350 psi

Set screws shall be:

- 1) cupped style ends;

- 2) composed of Cor-Ten Steel or Ductile Iron

The number of set screws shall be equal to or greater than the number of inches of nominal diameter of the gland (i.e. 4" - 4 set screws; 6" - 6 set screws, etc.).

Gland shall meet AWWA specifications.

E. Bolts and Nuts: General description of properties required.

1. Stainless Steel: Type 316 - contains the addition of molybdenum to the nickel-chromium steels.

Specific Chemical Composition:

a)	Carbon	-	0.08% max.
b)	Manganese	-	2.00% max.
c)	Silicone	-	1.00% max.
d)	Phosphorus	-	0.04% max.
e)	Sulphur	-	0.03% max.
f)	Chromium	-	16-18.00%
g)	Nickel	-	10-14.00%
h)	Molybdenum	-	2-3.00%
i)	SAE No.	-	30316
j)	ASM No.	-	5361A, 5524A, 5573, 5648B, 5690D

2. Cor-Ten Steel: Trade name for cold formed T-head bolts containing alloying elements such as copper, nickel, and chrome.

Specific Chemical Composition:

a)	Carbon	-	0.2% max.
b)	Manganese	-	1.25% max.
c)	Sulphur	-	0.05% max.
d)	Nickel	-	0.25% min.
e)	Copper	-	0.20% min.
f)	Combined (Ni,Cu,Cr)	-	1.25% min.

- F. Resilient Sealed Gate Valve: Valve shall meet all provisions of ANSI/AWWA C509-87 specification as latest revised; shall have a smooth unobstructed water way which shall be a minimum of the nominal diameter of the valve. Valve ends to be specified and shall be furnished with Cor-Ten (or equal) bolts and nuts. Valves shall be manufactured by Mueller, Clow or Eddy and shall open right.

- G. Valve Boxes: The valve box bottom section shall be slide-type with bell-type base. The valve box top section shall be slide-type. It shall have a top flange, but shall not have a "bead" or bottom flange. The valve box cover shall be a 2" drop-type cover to fit the 7-1/4" opening of the top section. The valve box extension shall be slide-type with a minimum 3" belled bottom. Material shall be cast iron or ductile free from defects. Interior and exterior of all components shall be bituminous coated with a minimum of 4 mils dry film thickness.

H. Service Box and Rod:

1. Service Box Specification:

Shall be 1.0" (in.) I.D. black iron or steel pipe with top having N.P.I. threads for 1.0" screw-on cover.

Shall be Erie style with 5-6' (ft.) slide-type riser.

2. Service Box Cover Specifications:

Shall be Quincy type (heavy duty) cover that screws on (1.1 above).

Shall be tapped with a 1" rope thread with a solid brass plug with pentagon operating head.

3. Service Box Foot Piece Specifications

The standard foot piece shall be heavy duty (Ford style or equal) cast iron design.

The large, heavy-duty foot piece shall have an arch that will fit over 2" ball-valve curb-stops.

4. Service Rod Specifications

Shall be 24"-30" in length and have a self-aligning design.

Shall be of circular dimension and constructed of:

- a) 5/8" dia. min. cold rolled steel with an epoxy coating (minimum 4 mil D.F.T.), or,
- b) 1/2" dia. min. #304 stainless steel.

Shall have a yoke design that is an integral part of the rod.

The curb-stop attachment point shall be a brass cotter pin.

The rod "wrench-flat" shall have a minimum thickness of 1/4" tapered to 1/16" and width of 5/8" or 1/2".

I. Tapping sleeves shall be as approved by the local water company. Options include the following:

Tapping sleeve shall be mechanical joint with recessed outlet flange for tapping valve; conform to AWWA C207, Class D, with rated maximum working pressure of 200 psi. The side rubber gaskets shall be rectangular in cross-section and fit into grooved channels in the casting. These gaskets shall extend the entire length of the sleeve and shall not require cutting or trimming to match MJ end gaskets. Tapping sleeve shall be AB-CD pattern to permit use of plain rubber and duck-tipped gaskets for various O.D. piping sizes.

Mechanical joint with accessories furnished; glands, gaskets, and Cor-Ten T-bolts and nuts or equal. All flange bolts shall be 316 stainless steel or silicone bronze. Interior and exterior to be bituminous coated with a minimum of 4 mils dry film thickness. The sleeve shall be provided with a 3/4" F.I.P.T. test port and brass plug.

The tapping sleeve shall be Romac Industries Inc., 304 Stainless Steel Tapping Sleeves with ductile iron flange. Flange bolts shall be stainless steel or silicon bronze. The sleeve shall be rated for a maximum, working pressure of 200 psi. The interior and exterior shall be bituminous coated with a minimum of 4 millimeters dry film thickness. The sleeve shall be provided with a 3/4" F.I.P.T. test port and plug.

J. Corporation Stop:

1. 3/4" - 1" shall be a ball valve design with a brass ball that is teflon (or equal) coated. 1-1/2" - 2" shall be ball-corp design with an on-off identification mark on the operating nut.
2. The valve shall be supported by 2 seats for water tight shut-off in either direction.
3. The valve shall have a full port opening.
4. The body of the corporation-stop shall be of heavy duty design.

K. Specifications for Services:

1. Material

Copper Tubing: ASTM B88, Type K, Seamless, Annealed, 2 Inch Diameter Maximum.

2. Fittings

Brass Compression Manufactured by Ford, Mueller or McDonald.

L. Curb Stops

1. For sizes 3/4" - 2", the valve shall be a brass ball that is teflon (or equal) coated.
2. The ball shall be supported by seats which are water tight in either direction.
3. The valve shall have a full-port opening.
4. The valve shall open with ¼turn (90⁰) with a check or stop.
5. The valve shall not have a drain.
6. The valve stem shall have 2 "o" rings and a bronze ring lock which holds the stem solidly in the valve body.
7. The valve body shall be a heavy duty design.

M. Hydrant: Hydrant shall be Mueller Centurion or Eddy F-2641 all with stainless steel nuts and bolts below grade. The hydrant shall have an epoxy coated base, and open left. The nozzles shall have National Standard Threads. Operating nut shall be 1-15/16".

All material used in the production of fire hydrants for ordinary service shall conform to the specifications designated for each material listed in AWWA Standard C502.

N. Joint Restraint: Place thrust blocking consisting of 2,500 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 lbs./sq. ft. when water main pressure is 100 psi.

MINIMUM THRUST BLOCKING BEARING AREAS

Pipe Tees 90 Deg. Bend 45 Deg. Bend 22 Deg. Bend

<u>Diameter</u>	<u>Sq. Ft.</u>	<u>Sq. Ft.</u>	<u>Sq. Ft.</u>	<u>Sq. Ft.</u>
4"	1.0	1.0	1.0	1.0
6"	1.5	2.0	1.0	1.0
8"	2.5	3.5	1.8	1.0
10"	4.0	5.5	2.8	1.5
12"	6.0	8.0	4.0	2.0
14"	8.0	11.0	5.5	3.0
16"	10.0	14.2	7.0	4.0

- O. Rigid Insulation: Installation, when required by the Drawings, shall be Styrofoam SM or TG as manufactured by the Dow Chemical Company or equal.

Materials submitted shall have a K factor of .20 @ 75 degrees by ASTM C518-70, 2-lb. density by ASTM C303-56, compressive strength of 30-lb. by ASTM D1621-64 and a water absorption of less than .05 meet Federal Specifications HH1524B Type II, Class B.

- P. Temporary Water Service: Provide temporary water service as necessary during the site work and building construction. Utilize materials as approved by the Biddeford-Saco Water Company.

PART 3 - EXECUTION

3.01 WATER DISTRIBUTION SYSTEM

- A. Building Service Lines: Install water service lines to point of connection within approximately five feet outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps. Connections of service lines to distribution mains shall be constructed in accordance with the following requirements.
 - 1. 2 Inch and Larger: Connect by rigid connections and provide gate valve below frost line.
- B. Regrading: Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

C. Pipe Laying, General

1. Do not lay pipe on unstable material, in wet trench, or, when trench or weather conditions are unsuitable.
2. Support pipe laid in fill area at each joint, by brick or concrete piers carried down to solid undisturbed earth.
3. Do not lay pipe in same trench with other pipes or utilities.
4. Hold pipe securely in place while joint is being made.
5. At least one foot shall separate water lines vertically from other pipes or underground structures.
6. Where water pipes cross sanitary sewers or are laid parallel and adjacent to them, bottom of water pipe shall be separated by not less than one foot above top of sewer and ten feet horizontally.
7. Do not work over, walk on, pipes in trenches until covered by layers of earth well tamped in place to a depth of 12 inches over pipe.
8. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
9. Install water lines to avoid storm and sanitary sewer lines.
10. Clean interior of pipe thoroughly of all foreign matter before installation. Keep pipes clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.
11. Tees, plugs, caps, bends and hydrants on pipe installed underground shall be anchored. Pipe clamps and tie rods, or concrete thrust blocks may be used. Type of pipe and soil conditions determine methods. Anchor water mains as specified in NFPA No. 24.
12. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of all work thoroughly clean exposed materials and equipment.

D. Laying Ductile Iron Pipe

1. Installing Pipe: Lay pipe in accordance with AWWA C600.
2. Joints:
 - a. Mechanical: AWWA C111. Provide sufficient quantities of bolts, nuts, glands and gaskets for each socket opening on pipe and fittings.
 - b. Push-On: Apply thin film of lubricant to gasket and place in proper position in contour of bell. Insert beveled end of joining pipe and make contact with gasket. Force beveled end of pipe to bottom of bell without displacing gasket. Do not caulk. Only lubricant furnished by manufacturer of pipe shall be used.

- c. Flanges: AWWA C115. Install only in concrete pits. Must be watertight and set not less than six inches from walls to floor.
- E. Setting of Valves:
- 1. Install gate valves as indicated on the Drawings and support on concrete pads with valve stem vertical and plumb. Install valve boxes in a manner that will not transmit loads, stress, or shock to valve body.
 - 2. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.
 - 3. Clean valves and curb stops interior before installation.
- F. Setting of Fire Hydrants
- 1. Install fire hydrant assemblies as indicated on Drawings in vertical and plumb position with steamer nozzle pointed toward building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly braced on side opposite inlet pipe against undisturbed soil or concrete blocking. Place minimum of 6 cu. ft. of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Exercise care when backfilling and compacting so proper vertical position will not be altered.
 - 2. Clean interior of hydrants of all foreign matter before installation.
 - 3. Set center of each hydrant not less than two (2) feet nor more than six (6) feet back of edge of road or face of curb. Set barrel flange not more than two (2) inches above finished grade and eighteen (18) inches between center of steamer nozzle and finished grade.
- G. Pipe Sleeves: Install where water lines pass through retaining and foundation walls. Properly secure in place, with approximately 1/4-inch space between pipe and enclosing sleeve, before concrete is poured. Caulk annular opening between pipe and sleeves, and seal with asphaltic compound consisting of bituminous materials mixed with mineral matter. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.
- H. Meter: The Contractor will obtain the meter from the Biddeford-Saco Water Company and install the domestic water meter for the installation and will pay all usage charges connected with water supply until the installation is accepted by the Owner.

3.02 DISINFECTION

- A. Disinfect distribution system with chlorine before acceptance for domestic operation in accordance with the following procedures:
- 1. The only acceptable method of disinfection shall be the continuous Feed Method of chlorine.
 - 2. The rates of introduction of the chlorine and water shall be so proportioned so that the chlorine concentration in the water is maintained at a minimum of 50mg/l available chlorine.

3. During the application of the chlorine, valves shall be operated in such a manner that the treatment dosage shall not flow back into the line supplying the water. The operation of the valves shall be done under Water Department supervision.
4. The chlorinated water shall be retained in the main for at least 24 hours. At the end of the 24 hour period, the treated water shall contain no less than 25mg/l available chlorine.
5. At the end of the retention period, the chlorinated water shall be flushed from the main until the chlorine in the water leaving the main is no higher than the normal residual in the system, or less than 1 mg/1.
6. All bacteriological tests shall be collected in sample bottles and shall be tested at a State certified laboratory. All costs for disinfection of the main as well as bacteriological costs shall be borne by the Contractor.

3.03 TESTING OF WATER DISTRIBUTION SYSTEM

- A. Test water distribution system pipe sizes installed below grade and outside building in accordance with following procedures:
 1. Before pressure testing the water main, air shall be completely expelled from the pipe. If permanent air valves are not located at all high points, corporation stops shall be installed at all high points so that the air can be expelled as the pipe is being filled. After completion of the test, the corporation stops shall either be removed or left in place at the discretion of the Water Department.
 2. If fire hydrants are installed on the new water main, the test shall be conducted against a closed hydrant valve.
 3. The test pressure shall be 1.5 times the static pressure at the lowest point of elevation of the line and shall not be less than 150 p.s.i.
 4. The test shall not exceed the pipe or thrust restraint design pressures, nor exceed twice the rated pressure of the valves or hydrants and shall not exceed the rated pressure of the valves, if resilient - sealed butterfly valves are used.
 5. Water, only, shall be used to bring the main to the required test pressure. The type of pump shall be approved by the Biddeford-Saco Water Company.
 6. The test shall be of at least two hours in duration. A leakage test shall be conducted immediately after the pressure test.
 7. After the pressure test period, water shall be pumped into the main to bring the pressure back up to the initial test pressure. No pipe installation shall be accepted if the leakage is greater than that listed in Table 1 attached to this Section.

If any pipe installation shows a leakage greater than that specified in Table 1, the contractor at his own expense shall locate and repair the leak until it is within the specified allowance.

The pressure and leakage tests shall be conducted under Biddeford-Saco Water Company's supervision.

---END OF SECTION 02660---