# SECTION 331000 – WATER DISTRIBUTION SYSTEM

1. GENERAL
	1. RELATED DOCUMENTS
		1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this section.
	2. SUMMARY
		1. Provide all labor, materials and equipment as necessary to complete all work as indicated on the Drawings and specified herein.
		2. This section includes the furnishing and installation of a water distribution system.
		3. Related sections include the following:
			1. Division 31 Section “Earthwork.”

**NOTE: If bore and jacking is used, add the following.**

* + - 1. Division 33 Section “Boring and Jacking.”
	1. REFERENCES
		1. Except as herein specified or as indicated on the Drawings, the work of this section shall comply with the following:
			1. ASTM Standard Specifications:
				1. A48 - Grey Iron Castings.
				2. A126 - Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
				3. A167 - Standardized Specification for Stainless and Heat-Resistant Chromium-Nickel Steel Plate, Sheet, and Strip.
				4. A240 - Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
				5. B62 - Composition Bronze or Ounce Metal Castings.
				6. B88 - Seamless Copper Tube.
				7. D449 - Asphalt Used in Dampproofing and Waterproofing.
			2. ANSI/AWWA:
				1. C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
				2. C105/A21.5 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
				3. C110/A21.10 - Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids.
				4. C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
				5. C150/A21.50 - Thickness Design of Ductile-Iron Pipe.
				6. C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
				7. C153/A21.53 - Ductile-Iron Compact Fittings, 3-inch through 24-inch (76 mm through 610 mm), and 54-inch through 64-inch (1,400 mm through 1,600 mm) for Water Service.
				8. C301 - Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, For Water and Other Liquids.
				9. C304 - Design of Prestressed Concrete Cylinder Pipe.
			3. AWWA Standards/Manuals:
				1. C502 - Dry-Barrel Fire Hydrants.
				2. C509 - Resilient-Seated Gate Valves for Water Supply Service.
				3. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
				4. C651 - Disinfecting Water Mains.
				5. C800 - Underground Service Line Valves and Fittings.
			4. DIPRA - Ductile Iron Pipe Research Association.
			5. MDOT:
				1. 2012 Standard Specifications for Construction. Divisions 1-9, excluding Sections 823 & 923.
				2. Standard Plans.
			6. NSF Standards:
				1. 60 - Drinking Water Treatment Chemicals.
				2. 61 - Drinking Water System Components.
				3. 372 – Drinking Water Systems Components – Lead Content
			7. Michigan Plumbing Code
				1. Section 312.10 – Inspection and testing of backflow prevention assemblies
	2. DEFINITIONS
		1. Abbreviations:
			1. DI - Ductile iron.
			2. EJIW - East Jordan Iron Works.
	3. SUBMITTALS
		1. Product Data:
			1. Pipe.
			2. Gaskets (if special).
			3. Hydrants.
			4. Valves.
			5. Thrust control materials.
		2. Tapping Materials and Methods: Required information:
			1. Dimensions.
			2. Details of construction and installation.
			3. Name of manufacturer.
			4. Model.
		3. Sequencing/Phasing Plan for Watermain Construction (required prior to other work):
			1. Phase limits and duration.
			2. Sequence of watermain construction relative to other utility construction.
			3. Details of temporary water mains or connections, not indicated on the Drawings, but to be completed at the Contractor’s discretion to facilitate other proposed work.
			4. Anticipated dates and durations of proposed shutdowns and tie-ins.
			5. Schedule meeting with MSU and Engineer to discuss watermain construction plan prior to beginning any utility work.
		4. Procedures: For flushing, pressure testing and chlorinating. Required information:
			1. Equipment.
			2. Methods.
		5. Submit manufacturer's sworn and notarized statements that the materials furnished comply with this Specification.
		6. Water Distribution System: Provide pressure and leak tests.
		7. Water Quality: Provide bacteriological tests.
	4. QUALITY ASSURANCE
		1. Installation Personnel Qualifications:
			1. Trained and experienced in the installation of the materials.
			2. Knowledgeable of the design and the reviewed Shop Drawings.
		2. Water Distribution System: Pressure and leak tests.
		3. Water Quality: Bacteriological tests.
	5. PROJECT CONDITIONS
		1. Scheduling of Water Shutoffs:
			1. Approval required.
			2. Not to exceed 4 hours.
			3. Standby service may be required by utility agency.
			4. Required Notice:
				1. MSU.
				2. Fire Department: 1 week.
				3. Affected Customers: 1 week.
			5. Operation of Existing Valves: By Owner's employees only.
		2. Contamination of Existing Lines:
			1. Backflow Prevention
				1. Backflow prevention procedure

AWWA C651-14, section 4.8.9.

* + - * 1. Backflow prevention devices, installation, and testing

Michigan Plumbing Code – Testable Backflow Prevention Assemblies – Section 312.10.2

* + - * 1. Backflow prevention devices shall be supplied by the contractor, installed and tested by an ASSE certified tester. Installation to be coordinated and approved by MSU Distribution Shop Supervisor prior to use.
				2. Contractor to provide and install a gate valve, located downstream and separate from the backflow device, to be used for on/off flow control. Contractor will not be allowed to operate valves associated with the backflow device, or hydrant valves, after the backflow installation has been certified.
				3. Backflow prevention device certification and testing reports for each installation shall be provided to the MSU Distribution Shop and maintained in project records.
			1. Be responsible for all costs of chlorinating and flushing contaminated lines.
1. PRODUCTS
	1. PIPE AND FITTING MATERIALS
		1. Ductile Iron Pipe:
			1. ANSI/AWWA C150/A21.50 and C151/A21.51.
			2. Class: 52.
			3. Cement Mortar Lining:
				1. ANSI/AWWA C104/A21.4.
				2. Standard thickness.
			4. Joints:
				1. All joints shall be restrained, by either mechanical means or restrained gaskets as listed below.
				2. ANSI A-21.50 and ANSI A-21.51.
				3. Bell Tite, Tyton; or equal.
				4. Mechanical joint.
				5. Restrained: 6-inch through 24-inch:

U.S. Pipe: TR Flex Restrained Joint; Field Lok gasket.

American: Flex-Ring Restrained Joint; Fast Grip gasket.

Clow: Super-Lock Restrained Joint.

Griffin Pipe: Snap-Lok Restrained Joint.

Mechanical joint restraint with Megalugs by Ebaa Iron Sales; Uniflanged Series 1400 by Frod Meter Box Co.; or equal.

* + - * 1. Lubricant: Provide in accordance with manufacturer’s recommendation.
			1. Polyethylene Encasement:
				1. 8 mils minimum thickness.
				2. Tube type.
				3. Use recommended size for pipe being installed.
		1. High Density Polyethylene Pipe (HDPE) – ADD AS SPECIFIER NOTE,
			1. ASTM F714, PE 4710, DR 11
		2. Fittings:
			1. All fittings shall be restrained to pipe.
			2. Ductile Iron Fittings:
				1. 6-inch through 24-inch:

ANSI/AWWA C153/A21.53, compact fittings.

Manufacturer’s restrained joints.

350 psi pressure rating.

Lining:

Standard thickness, cement mortar lining in accordance with ANSI A 21.11.

Fusion bonded epoxy in accordance with AWWA C550, nominal 6 to 8 mils.

* + - * 1. Joint Restraint for Ductile Iron Fittings to Ductile Iron Pipe:

6-inch through 24-inch Pipe:

Mechanical joints with Megalugs by Ebaa Iron Sales or Uniflange Series 1400 by Fort Meter Box Co.; or equal.

* + - * 1. Polyethylene Encasement:

8 mils minimum thickness.

Tube type.

Flat tube width of manufacturer recommended size.

* + 1. Gaskets:
			1. ANSI/AWWA C111/A21.11.
			2. Styrene Butadiene (SBR).
	1. MANUFACTURED UNITS
		1. Valves:
			1. 6-inch through 24-inch Valves:
				1. Manufacturer: Clow; American Flow Control; U.S. Pipe; EJIW; or equal.
				2. Resilient-Seated Gate Valves; ANSI/AWWA C515:

Nonrising stem (NRS).

Open left (counter clockwise).

Mechanical joint end connections.

* + - 1. Valve Boxes:
				1. Manufacturers and Models: EJIW. 8560 Series with No. 160 base; Tyler Pipe (made in USA Only), 6860 series with No. 160 base.
				2. Valve box lid shall say “Water.”
		1. Hydrants:
			1. Manufacturers and Models: East Jordan Iron Works, 5-BR250.
			2. AWWA C502.
			3. Bury Depth: 5.0 feet minimum, contractor responsible for providing and installing extensions as required to adjust nozzle height.
			4. Outlet Nozzles:
				1. Hose:

Number: 2.

Diameter: 2-1/2 inches.

Threads: NFPA.

* + - * 1. Pumper:

Number: 1.

Lansing standard, Storz connection.

* + - 1. Main Valve: 5-1/4 inches in diameter.
			2. Inlet Connection:
				1. Side.
				2. Diameter: 6 inches.
				3. Mechanical joint.
				4. Maximum of 18 inches from hydrant.
				5. Auxiliary valve required for all hydrants.
			3. Operating Stem and Mechanism: Operating Nut: 1-1/8-inch pentagon.
			4. O-ring packing.
			5. All companion valves are required to be 8” resilient seated gate valves ANSI/AWWA C515.
	1. WATER SERVICE MATERIALS
		1. General: AWWA C800
			1. Pipe
				1. Soft Copper Tube, ASTM B 88, Type K, water tube, annealed temper
				2. Polyethylene?
			2. Service Clamps:
				1. Bronze, double strap, iron pipe thread, o-ring seal cemented in place.
				2. Manufacturers: Mueller; Rockwell; or equal.
			3. Corporation Stops:
				1. Bronze, iron pipe thread by compression copper.
				2. Manufacturers: Mueller; McDonald; Ford; Hays; or equal.
			4. Curb Stops:
				1. Bronze, compression copper by compression copper.
				2. Minneapolis pattern.
				3. Manufacturers: Mueller; Ford; McDonald; Hays; or equal.
			5. Curb Boxes:
				1. Minneapolis pattern, extension type.
				2. Manufacturers: Mueller; McDonald; M&E Manufacturing; or equal.
1. EXECUTION
	1. EARTHWORK
		1. In accordance with Division 31 Section “Earthwork.”
	2. LINE AND GRADE
		1. Lay pipe to the grades and elevations indicated on the Drawings.
		2. Where no grades are indicated:
			1. Lay pipe with a minimum of 5 feet of cover below finish grade.
			2. Lay pipe at constant uphill and downhill grades to and from air release valves.
			3. Avoid high points except at air release valves.
	3. INSTALLATION
		1. General:
			1. Except as herein provided or indicated on the Drawings, install in accordance with:
				1. DI: AWWA C600.
			2. Protect materials before, during and after installation.
			3. Install pipe, fittings and appurtenances in accordance with manufacturer's recommendations except as indicated herein or on the Drawings.
			4. Prevent entrance of foreign materials.
			5. Restrain pipe, fittings, valves and couplings as required.
			6. Install full sections of pipe at sewer crossings with joints as far from the sewer as possible.
			7. Maintain eighteen inches minimum vertical separation at all utility crossings, unless specifically noted on the plans and approved by the Engineer.
		2. Placement of Pipe:
			1. Bearing: Support entire length of pipe barrel evenly with extra excavation at joints.
			2. Bell and Spigot: Clean and lubricate immediately prior to assembly.
			3. Jointing:
				1. Mechanical: Tighten evenly to 75 to 90-foot-pounds of torque.
				2. Restrained: Manufacturer's recommended method.

Mechanical Joint/Flanged Joint Connection: Tighten bolts evenly to 75 to 90-foot-pounds of torque on slip on ductile flanges.

* + - 1. Cutting Pipe:
				1. Power saw.
				2. Ductile Iron Pipe: Taper cut end by grinding or filing back at least 1/8-inch on a 30 degree bevel.
		1. Setting Valves and Valve Boxes:
			1. Set plumb on 4 inches of compacted MDOT 902 Granular Material Class II, MDOT 902 Open Graded Aggregate 34R, or pea stone.
			2. Valve Boxes:
				1. Shall not transmit shock to valve.
				2. Plumb over operating nut.
				3. Set cover to finished grade.
				4. Witness.
			3. Pressure Tap Sleeve and Valve:
				1. Set at the direction of tapping Subcontractor.
				2. Set and remove tapping machine.
		2. Hydrants: Place “Out of Service” placards on pumper nozzle of all hydrants immediately after installation. Remove after water line is placed in service.
			1. Under Each Hydrant:
				1. Excavate ground to a depth of at least 1 foot below hydrant base and over an area of at least 3 feet square.
				2. Fill excavation to the elevation of the hydrant base with well compacted 6A aggregate.
			2. Connect the hydrant to the main by using approved retainer glands and/or stainless steel clamps and stainless steel.
			3. After connection to the main an additional depth of MDOT 6A aggregate shall be placed a minimum of 6 inches above the drain hole and tamped around the hydrant. The remaining fill shall be placed and compacted, taking care to avoid jarring or shifting the hydrant.
			4. Location:
				1. When Placed Behind the Curb:

Barrel shall be set so that no portion of the pumper or hose nozzle cap will be closer than 3 feet from the curb face.

Or less than 20 feet from the curb line intersection of any street.

If between streets the hydrant shall be placed in the manner designated by the Engineer.

* + - * 1. When set in lawn space between the curb and the sidewalk or between the sidewalk and the property line: No portion of the hydrant or nozzle cap shall be within one foot of the sidewalk.
				2. Pumper Nozzle:

24 inches above finished grade.

Extensions required to place hydrant at proper grade shall be considered included in the cost of the hydrant.

* + - * 1. Auxiliary valve shall be installed a distance of three feet from center of valve to center of hydrant as shown on standard detail in plans.
		1. Thrust Control:
			1. Provide at all fittings.
			2. Installation:
				1. In accordance with Shop Drawings reviewed by Engineer.
				2. In accordance with manufacturer's instructions.
				3. As indicated in Table 1 – Length of Restrained Pipe Required, located at end of this section.
	1. TESTING AND DISINFECTION
		1. Observation: By Engineer.
		2. Notification:
			1. Pressure Testing: Arrange with Engineer following successful pretesting.
			2. Bacteriological Testing: Arrange with Engineer following successful pressure test.
		3. Equipment and Manpower: Provide everything required for testing, disinfection and flushing.
		4. Water: To be provided by Owner.
		5. Disinfection:
			1. In accordance with AWWA C651:
				1. Sodium hypochlorite or calcium hypochlorite.
				2. Continuous-feed method.
				3. Simultaneously MSU will fill water main.
			2. Alternate Procedure:
				1. Place HTH chlorine tablets in each length of laid pipe.
				2. Secure to the top of the pipe with permatex or approved equal mastic.
				3. Minimum 50 parts per million chlorine residual solution when completely dissolved.
				4. Fill pipe by MSU.
				5. Chlorine solution to remain in place for minimum of 24 hours, increase to 48 hours if temperatures are below 41 degrees.
		6. Pressure and Leak Tests for DI Pipe:
			1. ANSI/AWWA C600, Section 4.
			2. Duration: 2 hours.
			3. Pressure:
				1. Maintain 150 pounds per square inch at the average elevation in water main segment being tested.
				2. Do not exceed the pipe’s rated test pressure.
			4. Water:
				1. To be provided by Owner.
				2. Contractor shall be responsible for providing temporary connections from municipal water system to force main, or for hauling water.
			5. Make-Up Water: From measurable source.
			6. Maximum Allowable Leakage:
				1. L = SD(P).5/148,000 + 0.0078 gal/hr/in of diameter for each closed valve tested against.
				2. L = Leakage in gallons per hour.
				3. S = Length of pipe tested in feet; maximum value 2,000. When length of pipe tested exceeds 2,000 feet, the allowable leakage will be based on 2,000 feet.
				4. D = Pipe diameter in inches.
				5. P = Test pressure: 150 pounds per square inch.
			7. Maximum Length of Pipe to be Tested: 2,000 feet, or nearest 2 valves if water on opposite side of valve is not in service.
			8. Perform test against tapped cap or plug with a standpipe and not against existing valve if water on opposite side of valve is in service.
			9. Repair leaks and repeat tests until acceptable results are achieved.
		7. Flushing:
			1. In accordance with AWWA C651-14.
			2. Water: MSU supplied.
			3. Velocity: Minimum 3 feet per second.
			4. Duration:
				1. Initial: Until entire volume of water in pipeline has been replaced.
				2. Final: Until residual chlorine equals that of adjoining system.
			5. Dispose of chlorine residual in accordance with applicable state and local requirements.
			6. Disposal location to be inspected by Engineer. If there is any questions that the discharge will harm the environment, apply a reducing agent to the water to neutralize the chlorine to a 1 ppm residual.
		8. Bacteriological Testing:
			1. Performed by MSU in accordance with AWWA 651.
			2. Repeat flushing if first bacteriological test fails and retest.
			3. Repeat disinfection if bacteriological test fails after second test.
		9. Sequence:
			1. Fill & Flush line to remove air
			2. Pressure Test
			3. Chlorinate.
			4. Wait 24 hours.
			5. Flush.
			6. Wait 16 hours
			7. .
			8. Bacteriological sample.
			9. Wait 16 hours.
			10. Bacteriological sample.
			11. Place in service if bacteriological test passes.
		10. Corporation stops installed for sampling or testing purposes shall remain in place, shut off and plugged. GPS location to be documented by MSU Mapping Coordinator, and burial location to be marked with water main tape or other approved notification method.

**Edit the following table to suit your project**

| TABLE 1LENGTH OF RESTRAINED PIPE REQUIRED\* |
| --- |
| PipeDiameter | 22-1/2 Degree Bends and Less | 45 DegreeBends | 90 Degrees Bends, Plugs | TeeRun | TeeBranch |
| 6-inch | 5-foot | 10-foot | 20-foot | 10-foot | 10-foot |
| 8-inch | 5-foot | 10-foot | 25-foot | 10-foot | 20-foot |
| 10-inch | 5-foot | 15-foot | 35-foot | 10-foot | 25-foot |
| 12-inch | 10-foot | 15-foot | 40-foot | 10-foot | 30-foot |
| 16-inch | 10-foot | 20-foot | 50-foot | 10-foot | 40-foot |

\*ALL NEW PIPING SHALL BE FULLY RESTRAINED, LENGTHS APPLY TO EXISITNG PIPE AT CONNECTION POINTS.

END OF SECTION 331000