

SECTION 2300

WATER TRANSMISSION AND DISTRIBUTION LINES

1.00 GENERAL

1.01 Scope. Work under this Section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install, disinfect, and test all raw water and potable water transmission and distribution pipelines and appurtenances as specified herein and shown on the Drawings.

1.02 Related Work Specified Elsewhere.

Section 2130 - Trenching, Backfilling and Compaction
Section 2140 - Embedment and Base Course Aggregate
Section 2500 - Hot Bituminous Pavement

1.03 Submittals. Product data including catalog sheets and descriptive literature shall be submitted for all materials and equipment specified. Submittal shall state manufacturer's compliance with all published standards referenced herein.

1.04 Protection of Work. All pipe fittings, valves and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials and protective coatings and linings. At no time shall such materials be dropped or dumped into trench.

Precaution shall be taken to prevent foreign matter from entering the pipe, fittings and valves prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

At such time as pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a watertight plug to prevent entrance of trench water, debris or foreign matter.

Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time as the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe floatation.

If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to cover the pipe ends with close woven bags until the start of the joining operation.

2.00 MATERIALS

This item covers the types of materials that will be required for the construction and installation of water lines. All materials used shall be new, of the best quality available, and conform with applicable standards as indicated herein. [NOTE: Local jurisdiction specifications (i.e., municipality, district, etc.), will govern when two or more alternatives are given in these specifications, or where there is a discrepancy between these specifications and local jurisdiction specifications.

2.01 Ductile Iron Pipe and Fittings.

- A. Ductile Iron Pipe.
 - 1. Reference Standard - ANSI 21.51/AWWA C151-86
 - 2. Thickness Class - 52
 - 3. Pipe joints shall be push on joints, except where specifically shown or detailed otherwise.

- B. Fittings
 - 1. Type - All fittings shall be mechanical joint, except where specifically shown or detailed otherwise.
 - 2. Reference Standard - ANSI/AWWA C153 for flanged, mechanical joint "compact" and push-on joints.
 - 3. Material - Ductile iron
 - 4. Pressure Rating - 350 psi

- C. Joints
 - 1. Mechanical, Reference Standard - ANSI A. 21.11/AWWA C111-72
 - 2. Push-on, Reference Standard - ANSI A 21.11/AWWA C111-72
 - 3. Flanged, Reference Standard - ANSI B 16.1, Class 125

- D. Gaskets
 - 1. Type - Rubber-ring gasket shall be suitable for the specified pipe sizes and pressure
 - 2. Reference Standard - AWWA C-111
 - 3. Lubricant - A non-toxic vegetable soap lubricant shall be supplied with the pipe

- E. Protective Coating
 - 1. Underground Service - Manufacturer's standard bituminous coating - minimum 1 mil thickness.
 - 2. Polyethylene Film Envelope - Polyethylene encasement shall conform to AWWA C-105-88 or ANSI A.21.5. Film shall be Class C with a nominal thickness of 8 mils. Tape for securing the film shall have a minimum thickness of 8 mils and a minimum width of 1 inch. The polyethylene film shall be free of streaks, pinholes, tears or blisters.

- F. Protective Lining
 - 1. Type - Cement mortar
 - 2. Reference Standard - ANSI A 21.4/AWWA C104.85
 - 3. Thickness - Standard

2.02 Polyvinyl Chloride (PVC) Pipe and Fittings.

- A. PVC Pipe

1. Materials - ASTM D1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
2. Reference Standard - AWWA C-900.
3. Class - 200 (DR-14), all sizes.
4. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
5. Specialties - Electric tracing wire, 14 gauge solid copper insulated wire.
6. Size - Shall conform to outside diameter of DIP.

B. Fittings

1. Type - All fittings shall be mechanical joint except where specifically shown or detailed otherwise.
2. Reference Standard - ANSI/AWWA C-110/A.21.10.
3. Pressure Rating - 250 psi.
4. Gasket Reference Standard - AWWA C-111.

C. Joints

1. Push-on rubber gasket.
2. Gasket Reference Standard - AWWA C-111.

2.03 Fire Hydrants.

A. Dry Barrel Type

1. Reference Standard - AWWA C502-80.
2. Outlet Size - one 4 1/2 inch, two 2 1/2 inch.
3. Hydrant Size - 5 1/4 inch.
4. Inlet Size - 6 inch.
5. Operation - 1½-inch pentagonal national standard operating nut, open counter clockwise.
6. Special Features - outlet hydrant shall open when turned to the left (counter clockwise).
7. Depth of Bury - As shown on Drawings.
8. Additional Requirements - Furnish hydrant complete with pipe and tee, 6 inch (6") restrained mechanical joint gate valve and thrust blocks. Hydrant shall be restrained to the hydrant tee by 3/4 inch threaded rods protected from corrosion by the use of an approved bituminous coating.
9. Traffic Model with break-away bolts and coupling.
10. Manufacturers Reference - Mueller Centurion or Kennedy.

2.04 Valves.

A. Gate Valves

1. Double Disk
 - a. Size as shown on Drawings.
 - b. Reference Standard - AWWA C500-86.
 - c. Style - Iron body, bronze-mounted, non-rising stem, double disk, parallel seat, NRS valves with O-ring seals.

- d. Rotation - Open, left or counterclockwise.
- e. Pressure rating - 200 psi.
- f. Operator - 2" square nut.
- g. Manufacturer's Reference - Dresser, Kennedy
- h. Ends - MJ unless specified on Drawings.

2. Resilient

- a. Size as shown on Drawings.
- b. Reference Standard - AWWA C500-86.
- c. Style - Iron body, bronze stem resilient seat gate valves, lubrication free, unobstructed through port to minimize head loss, entire body encapsulated inside and out with epoxy coating.
- d. Pressure Rating - 200 psi.
- e. Wrench Nut - 2 inch square.
- f. Manufacturer's Reference - Dresser M&H RSGV.

B. Combination Air Release Valve.

- 1. Size - 1" Orifice, or as recommended by manufacturer for correct application.
- 2. Inlet - 1" Pipe Thread
- 3. Materials
 - Body - Cast Iron
 - Float - Stainless Steel
 - Seat - Buna-N
 - Lever Frame - Delsrin
- 4. Pressure Rating - 200 psi
- 5. Manufacturer's Reference - APCO
- 6. Performance - Permits efficient filling or draining of long pipelines, for protection against vacuum, and will continuously vent pockets of air as they accumulate in pipeline.

2.05 Valve Boxes.

A. Screw Type - Three Piece

- 1. Material - Cast Iron
- 2. Size - 5 1/4 inch diameter
- 3. Type - Three piece adjustable screw type
- 4. Cover - Deep socket type with the work "water" cast in the top
- 5. Base - #160 type with 20.5" bottom opening

2.06 Mechanical Couplings. M.J. solid sleeves allowed of as approved by the Town..

2.07 Water Service & Tap Components.

A. Corporation Stops

- 1. Material - Brass or bronze
- 2. Size - As shown on Drawings
- 3. Reference Standard - AWWA C800-55
- 4. Thread inlet - Tapered (CC) Type

5. Thread outlet - Copper Service Thread for flared connection.
 6. Manufacturer's Reference - Mueller H 15000, Ford F600
- B. Copper Service Pipe
1. Reference Standard - AWWA 75-CR Type K
 2. Size - As shown on Drawings.
- C. Curb Box
1. Material - Cast iron box, complete w/lid and red brass screw.
 2. Type - McDonald 5605 with stationary rod.
 3. Size - 1" - 1½", depending on local jurisdiction preference.
- D. Curb Stop
1. Materials - Cast bronze body, resilient O-ring seal, standard tee-head operator. Teflon ball valve.
 2. Size - As shown on Drawings.
 3. Inlet - Copper service thread for flared connection.
 4. Outlet - Copper service thread for flared connection.
 5. Manufacturer's Reference - Mueller Oriseal III, Ford B22-333, McDonald 6100.
 6. Valve stem shall be brought to within four(4) feet or closer of finish grade through the use of approved stem riser materials.
- E. Service Clamps
1. For use with Ductile Iron Pipe:
 - A. Materials - Bronze service clamp, O-ring gasket, double strap, (CC) threads.
 - B. Manufacturer's Reference - Mueller H16 series, Smith Blair 323, or equal.
 2. For use with PVC Pipe:
 - A. Materials - Bronze service clamp, O-ring gasket, two section of three section clamp, (CC)threads.
 - B. Manufacturer's Reference - Mueller H-134 series, Smith Blair 397, or equal.

2.08 Concrete for Thrust Blocks and Encasing of Pipe. Concrete for thrust blocks and for encasing the water pipe line shall have a 28-day compressive strength of not less than 3000 psi.

2.09 Tracer Wire. No. 14 or larger, insulated, solid copper. All splices to be watertight, underground type, (Tracer wire is required for ductile iron pipe).

3.00 METHODS AND PROCEDURES

3.01 Cleaning and Inspection. Clean all pipe, fittings, valves and related material thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from jobsite.

The Contractor shall take all necessary precautions to prevent any construction debris from entering the water lines during construction of water lines and appurtenances. If this debris should enter the distribution system, the Contractor shall furnish all labor and material necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing distribution system.

3.02 Verification. Verify dimensions and class of all existing and proposed pipe, valves, fittings and equipment prior to installation to ensure the piping system will fit together properly.

3.03 Pipe Embedment.

- A. Placing Embedment Material - Refer to Section 2130 for placement methods.
- B. Embedment Classes - Refer to Section 2140 for embedment materials as listed below.

Bedding material shall be 3/4" screened rock in accordance with section 2130 of this manual. Contractor shall compact trench bottom before placing bedding.

3.04 Pipe Installation.

- A. Methodology - Pipe shall be laid in straight section with bell ends facing the direction of laying unless otherwise directed by the Engineer. Where pipe is laid on a grade of ten percent (10%) or greater, the installation shall proceed uphill with the bell ends facing upgrade. The pipeline shall be installed so that a continuous positive or negative grade is maintained between high and low points to avoid air pockets. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the coupling.

The pipe shall be brought to correct line and grade, and secured in place with the bedding material as specified herein.

- B. Pipeline Depth - as indicated on Drawings, or as per local jurisdiction but always below frost level. Depth shall be based on depth below finished grade of a project and not existing grade.
- C. Concrete Encasement - Install concrete encasement where indicated on the drawings or as required by other sections of this Specification. Concrete shall have a three thousand (3000)psi compressive strength. Reinforcing shall consist of four (4) evenly spaced longitudinal No. 4 rebars.
- D. Installation of Ductile Iron Pipelines.
 - 1. Pipe Handling. Pipe should be lowered into the trench with ropes, slings or machinery. Under no circumstances should the pipe be pushed off the bank and allowed to fall into the trench.
 - 2. Pipe Laying. Pipe shall be laid in straight sections, in an uphill direction, with bell ends facing in the direction of laying, unless directed otherwise by the Engineer.

3. Jointing of Push-on Joints. In joining the pipe, the exterior four inches of the pipe at the spigot end and the inside of the adjoining bell shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other foreign matter. The gasket shall be placed in the bell with the large round side of the gasket pointing inside the pipe so it will spring into its proper position inside the pipe bell. A thick film of the pipe manufacturer's joint lubricant shall be applied to the gasket over its entire surface. The spigot end of the pipe shall then be wiped clean and inserted into the bell to contact the gasket. The pipe shall be forced all the way into the bell by crowbar or by jack and choker slings.
4. Pipe Cutting. The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an oxyacetylene torch will not be allowed.
5. Polyethylene Film Envelope. Encase main and fittings using procedures recommended by manufacturer. Special care shall be used at all overlap joints.

E. Installation of Polyvinyl Chloride (PVC) Pipe.

1. Pipe Handling. Pipe should be carefully lowered into the trench to avoid pipe falling into trench.
2. Pipe Laying. Pipe shall be laid in straight sections with bell ends facing the direction of laying. When pipe laying is not in progress, the open end of the pipe shall be closed by a water-tight plug.
3. Jointing the Pipe. The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell. Position the completed joint so that the mark on the pipe end is in line with the end of the bell.
4. Pipe Cutting. The cutting of pipe for fitting or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a bevelling tool after the pipe is cut. Place a clearly visible position mark at the correct distance from the end of the field-cut pipe.

3.05 Installation of Pipeline Appurtenances.

- A. General. Install all valves, meters, manholes, and other equipment appurtenant to pipeline at the locations indicated on the drawings or as otherwise designated by the Engineer to accommodate field conditions. A minimum bury of five and a half (5 1/2) feet to the top of pipe is required. Any variations from this must be submitted for approval in writing to the Town and approval given prior to installation. Any pipe found not to meet these requirements shall be relocated at the expense of the

contractor. Record "as-built" measurements prior to backfill referencing all appurtenant equipment to the nearest permanent surface improvement.

- B. Installation of Valves. Install valves in the pipeline in the same manner specified for laying and jointing the pipe and in accordance with details included in Drawings.
- C. Valve Boxes. Except where specified otherwise, install valve boxes on all buried valves. Install boxes such that no stress is transmitted to the valve. Set boxes plumb and directly over the valve with the top of the box placed flush with the finished grade. Backfill and thoroughly compact around each box. Provide extended stems on valves where required such that the operating nut is not lower than seven feet (7') below finished grade.
- D. Fire Hydrants. Install hydrants in accordance with the standard details on the drawings. All tie rods and appurtenances to be completely covered with a bitumastic coating prior to backfill. Hydrant to be set plumb and true to grade. Contractor to bag or cover the fire hydrant that is not in operation.
- E. Reaction Anchor and Blocking. Concrete thrust blocks shall be provided, as shown in the details included with the Drawings for all tees, elbows, plugs, reducers, valves, fire hydrants and crosses if one or more sides of the cross is plugged. The bearing area of the block shall be at least equal to that stated on the drawings. The bearing surface shall be against undisturbed earth. The block shall be placed normal to the thrust as shown on the drawings. Concrete for thrust blocks shall have three thousand (3000) psi compressive strength.

Contractor will be required to use either plywood forms or plastic to protect the nuts and bolts on the fittings when the concrete reaction block is placed.

Contractor to also use star clamps or wood blocking as a method of temporary restraint to secure fittings while concrete reaction blocks set up. (Note: Temporary restraint to be used for those cases where a tie-in is being made and the water needs to be turned back on as soon as possible).

F. Hot Taps. Contractor shall install and test tapping saddles and valves in accordance with the manufacturers recommendations. If testing procedures are not defined, then testing shall be performed prior to actual tap by methods approved by the Town.

3.06 Connection to Existing Water Facilities. All main line connections between existing and proposed piping shall be made during non-business hours or at a time which is acceptable to the Town. All shut-offs shall be planned 24 hours in advance and all persons affected by the shut-off shall be given a 24 hour notice in the local newspaper and/or local radio at the Contractor's expense. In addition, the Contractor shall personally warn those affected 1 hour before the water is shut off.

The tie-ins between existing and proposed mains shall be made so that both the proposed main and existing main are in service at the same time. Only after both mains are in service can the individual proposed service lines tie into the existing service line on the building side of the curb valve. The affected property shall be given a minimum of 1 hour notice before the water is shut off. The new line must have passed the pressure testing and bacteriological test prior to connecting the services to the proposed water line.

Remove existing curb boxes and locate new curb boxes on property line whenever possible. Contractor is to provide all necessary fittings needed to reconnect service line on property side of curb box.

Take all precautions to prevent contamination when making connections to existing potable water lines. No trench water, mud or other contaminating substances shall be permitted to enter the pipeline.

Swab the interior of all new pipe, fittings and valves installed in the existing pipeline with a 5 percent (50,000 ppm) chlorine solution prior to installation. After the connection is completed, flush the main to remove all contaminated water.

3.07 Protection of Water Supplies. Water lines shall be located a minimum of ten feet (10') horizontally from existing or proposed sewer mains. Wherever the sewer line crosses above or within eighteen inches (18") beneath the water mains, the sewer line shall be made impervious by the method listed below:

Portland Cement Concrete Encasement per standard drawing in this manual.

1. For twenty feet centered over the waterline.

In all cases, select granular backfill shall be used to prevent any settling of the higher pipe.

3.08 Service Connections. Customer service connections shall be installed in accordance with the details set forth on the Project drawings or the appropriate standard drawing contained in this manual. Terminate the service with a curb stop and box and mark with a metal fence post or metal stake extending a minimum of three feet above finish grade except where shown otherwise on the Drawings.

3.09 Tracer Wire. Tape electrical tracing wire to the top of the pipe at 20-foot intervals to prevent dislocation of the wire during backfilling. Extend wire to ground surface at all valves, fire hydrants, and other locations shown on drawings. The tracer wire shall be extended to finish grade as detailed on the appropriate standard drawing of this manual. Provide sufficient slack in the wire outside of the box to compensate for any future adjustment to the valve box. Required on all water mains.

4.00 FIELD QUALITY CONTROL

4.01 General. A minimum forty-eight(48) hours notice to be given to the Town prior to all testing. Only Testing performed in the presence of Town Personnel will be accepted.

4.02 Operation of Water Valves. Existing water valves and new valves directly connected to the Town's water system shall be operated by Town personnel only.

4.03 Hydrostatic Tests. Make pressure and leakage tests on all newly laid pipe. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The tests shall be conducted between valved sections of the pipeline, or as approved by the Town.

Furnish the following equipment and material for the tests:

<u>Amount</u>	<u>Description</u>
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2	Approved graduated containers
2	Pressure gauges
1	Hydraulic force pump approved by the Engineer
1	Additional 1/2 inch pressure tap for Engineer's test gauge
	Suitable hose and suction pipe as required

Conduct the tests after the trench has been partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted by the Town. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure test until at least 5 days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

Conduct pressure test in the following manner, unless otherwise approved by the Town: after the trench has been backfilled or partially backfilled as hereinbefore specified, fill the pipe with water, expelling all air during the filling. The test pressure shall be 100 psi or 1½ times normal working pressure at the point of lowest project elevation whichever is greater.

A. Duration

1. The duration of each pressure test shall be 2 hours, unless otherwise directed by the Engineer.

B. Procedure

1. Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Allow and maintain the specified test pressure by continuous pumping if necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the Engineer. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately.
2. Before the line is pressurized, the Engineer shall verify that all necessary main line valves are open or closed with regard to the section of line being tested. In addition, the Engineer shall verify that all hydrant valves are open.

C. Leakage

1. Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

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In the above formula:

L = Allowable leakage, in gallons per hour
N = Number of joints in the length of pipe tested

- D = Nominal diameter of pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch gauge.

- D. The pressure testing of water service lines shall follow the same procedure as outlined in the section. In all cases, however, the corporation stop, service line and curb stop shall be visually inspected under full test pressure and any leaks fixed.
- E. Correction of Excessive Leakage
1. Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

5.00 DISINFECTION OF POTABLE WATERLINES

5.01 General. Flush and disinfect potable waterlines in accordance with the procedure set forth in AWWA C601-68 Disinfecting Water Mains.

Provide all temporary blow-offs, pumps, chlorination equipment, chlorine and all other necessary apparatus required.

5.02 Pipe Cleaning. If the pipe contains dirt or heavy encrusted matter that, in the opinion of the Engineer, will not be removed during the flushing operation, the Contractor shall clean and swab the interior of the pipe with a five percent (50,000 ppm) chlorine solution.

- A. Preliminary Flushing. Flush pipeline to disinfection, except when the tablet method is used, to remove all remaining foreign material. The flushing operation shall develop a minimum velocity of 2.5 ft./sec.

5.03 Chlorine Application. In general, chlorine shall be applied using the continuous feed method. However, on large diameter lines where this would not be practical, the slug method may be used. The tablet method may be used on short extensions (up to 2500 feet) of small diameter mains (12 inches and smaller).

- A. Continuous Feed Method. Introduce water into the line at a constant rate while adding chlorine at a minimum concentration of 50 mg/l. Maintain the chlorinated water in the pipeline for a minimum of 24 hours after which period the treated water shall contain no less than 25 mg/l of chlorine throughout the entire length. Repeat the above procedure if the residual at the end of 24 hours fails to meet the minimum concentration.
- B. Tablet Method. This method shall not be used if trench water or foreign material has entered the line or if the water is below 5°C (41°F). Because preliminary flushing cannot be used, this method shall only be used when scrupulous cleanliness has been exercised.

Place tablets in each section of pipe in sufficient number to produce a dose of 50 mg/l. Refer to Table 3 of AWWA C601 for the required minimum number of tablets. All tablets within the main must be attached at the top of the pipe. Introduce water into the pipeline at a rate no greater than 1 ft./sec. and retain the water in the pipeline for a period of 24 hours.

5.04 Final Flushing. After the required retention period, flush all heavily chlorinated water from the main until the chlorine concentration is no higher than that prevailing in the system.

5.05 Bacteriologic Tests. After completion of the final flushing and prior to placing the pipeline in service, the Town shall be notified to collect samples from the end of the line and test for bacteriologic quality to show the absence of coliform organisms.

5.06 Repetition of Procedure. If the original disinfection fails to produce satisfactory samples, repeat the disinfection procedure until satisfactory results are obtained.

5.07 Tracer Wire. A continuity test will be required for final acceptance of pipeline construction.

5.08 Valve Operation. Existing water valves and new valves directly connected to the Town's water system shall be operated by Town personnel only.

5.09 Compliance with Requirements. Failure to comply with these requirements may result in the suspension of the contractors license. In addition, all expenses as a result of this failure to comply shall be the sole responsibility of the contractor. This shall include any fines imposed by the Colorado Department of Health and the Town of New Castle.

End of Section