

## 4.5 WATER DISTRIBUTION SYSTEM INSTALLATION

### 4.5.01 General Requirements

- A. The Contractor shall have a sufficient number of competent workers at the work site at all times to ensure the utility placement is made in a timely, satisfactory manner.
- B. Locate fire hydrants as shown on the Plans and install in accordance with these Standards and the appropriate Standard Detail(s).
- C. Provide combination air/vacuum valves at locations shown on drawings. Install a ball valve between water main and combination air/vacuum valves. Construct manholes for air and vacuum relief valve as shown in the Standard Details.
- D. Use sleeves where pipes, valve stem extensions or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be either cast iron or schedule 40 steel of sufficient size to allow sealing around pipes and clearance for valve stems or equipment. Extend vertical sleeves through slabs 2 inches above top surface.
- E. Use cast iron or PVC sleeves with intermediate collars to anchor and provide a water stop on outside of sleeves that go through exterior walls below grade. Seal pipe using link-seals.
- F. Provide mechanical pipe seals to wall penetrations where shown on drawings. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening to provide watertight seal between pipe and wall opening.
- G. Provide reaction anchors of concrete blocking, metal harness, retainer gland type or restrained joint type pipe at all changes in direction of pressure pipelines and as shown on drawings. Always restrain the joints at bends, valves and fittings. Joint restraints shall be installed upstream and downstream of each bend, valve, and fitting for the minimum distance determined by the Engineer. Restraint calculations shall be provided on the drawings and length of restrained joints shall be indicated on the profiles.
- H. Concrete reaction anchors (thrust blocks) shall bear against undisturbed earth and shall be of the size and shape shown on the Standard Details.
- I. Use metal harness restraints as specified elsewhere in this section.

- J. Where retainer glands are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested.
- K. Encase water pipelines crossing under highways and railways in a casing pipe. The casing pipe shall be of the diameter and wall thickness required in the Standard Details or the controlling authority with jurisdiction over the crossing, whichever is more stringent. Joining of steel casing pipe shall meet requirements of AWWA C206. Install casing pipe by jacking, boring, or open cut if permitted.
  - 1. Install casings at railroad crossings in accordance with the requirements of AREMA Standards for installation of pipelines carrying nonflammable substances under railway tracks.
  - 2. Install casings per the Standard Details or as otherwise required by the right-of-way owner.
  - 3. The Contractor is responsible for obtaining all required permits from the right-of-way owner prior to beginning work. Copies of the permits shall be submitted to the Department for approval.
  - 4. Casing ends shall be sealed to protect against foreign matter entering casing.
  - 5. Casing pipe shall meet the requirements of Section 5.1 of these Standards.

#### 4.5.02 Pipe Laying

- A. Take all precautions necessary to ensure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.
- B. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.
- C. Bed pipe as specified in Section 4.3 - Trenching & Backfilling.
- D. Do not lay pipe when trench bottom is muddy or frozen or has standing water.
- E. Use only those tools specifically intended for cutting the size, material and type of pipe being installed. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.
- F. Lay pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, lay pipe uphill with bell ends upgrade.

- G. Separation of sanitary sewer lines and water lines shall be in accordance with Virginia Department of Health *Waterworks Regulations* and these Standards.
- H. NOTE: The use of pipe lubricants other than Blue Lube has been shown to cause significant taste and odor conditions when used in drinking water disinfected with chloramines. The Department will not accept completed water lines that exhibit taste and odor conditions as a result of the use of unapproved lubricants.

4.5.03 Mechanical Joint Pipe

- A. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter. Paint the bell and the spigot with Blue Lube pipe lubricant. Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.
- B. Push the spigot end forward to seat in the bell, and then press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts and screw nuts up finger tight. Then use a calibrated torque wrench to tighten all nuts to torque listed below, or as otherwise specified by the manufacturer.:

<u>Bolt Size (inches)</u>	<u>Torque (foot-pounds)</u>
1. 5/8	40 – 60
2. 3/4	60 – 90
3. 1	70 – 100
4. 1-1/4	90 – 120

- C. Tighten nuts on alternate side of the gland until pressure on the gland is equally distributed. If a bolt tightening pattern is specified by the manufacturer it shall be followed exactly.
- D. Join lock-type mechanical joint pipe according to manufacturer's recommendations.
- E. Permissible deflection in mechanical joint pipe shall not be greater than 1/2 of that listed in AWWA C600 or as 1/2 that allowed by the pipe manufacturer.
- F. Permissible deflection in lock-type mechanical joint pipe shall be 1/2 that recommended by manufacturer.

4.5.04 Push-On Joint Pipe

- A. Thoroughly clean inside of the bell and 8 inches of the outside of spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex

rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of Blue Lube pipe lubricant to the gasket and the spigot end of the joining pipe. Start the spigot end of the pipe into the socket with care. Then, complete the joint by forcing the plain end of the bottom of the socket with a forked tool or jack-type device. File the end of field cut pipe to match the manufactured spigot end.

- B. No joint deflection is allowed in PVC push on joints. All deflections of PVC pipe which cannot be accomplished with bend fitting(s) shall be by bending of the pipe in accordance with manufacturers' specifications and instructions.
- C. Maximum joint deflection at DIP push-on joints shall be 1/2 that allowed by the manufacturer.

#### 4.5.05 Setting Valves and Valve Boxes

- A. Install gate valves with operator stems in the vertical plane through the pipe axis and perpendicular to the pipe axis. Install valves with gear operators with the operating nut in the vertical plane. Locate valves where shown on drawings. Thoroughly clean before installation. Check each valve for satisfactory operation prior to installation.
- B. Provide all underground valves with valve boxes, except as specifically noted otherwise on the drawings. Set valve boxes in accordance with Standard Details.
- C. Set box in alignment with valve stem centered on valve nut, using a valve box adaptor. Set the valve box to prevent transmitting shock or stress to the valve. PVC extensions shall not be permitted.
- D. All underground valves shall have valve stem extensions. Extension shall be pinned to the operating nut and terminate 1 foot below grade with a 2-inch operating nut.

#### 4.5.06 Installation of Tapping Sleeves and Tapping Valves

- A. All tapping sleeves shall be set to avoid interference with existing pipe joints. Typically, tapping sleeves shall be installed perpendicular to the vertical axis of the pipe being tapped. Proposed alternate configurations will be considered by the Department on a case by case basis.
- B. All tapping sleeves and valves shall undergo a pressure test of 150 psi to ensure that there are no leaks around the sleeve or through the valve. All leakage shall be corrected.
- C. The actual tap shall be made in presence of a representative of the Inspector. Installation of taps shall be scheduled with the Inspector a minimum of 48 hours in advance.

#### 4.5.07 Warning Tape

- A. Detectable tracer tape shall be installed in utility trenches directly above all water mains approximately 18 inches above the pipe but no less than 18 inches below finished grade and in accordance with manufacturer's recommendations. The detectable tape shall comply with the product specifications and as specified in Section 5.1.

#### 4.5.08 Tracer Wire and Access Boxes

- A. In addition to detectable tracer tape, tracer wire shall be installed with all water mains and shall be attached to all fittings. Tracer wire shall be taped directly to the top of the pipe at a maximum spacing of 8 feet and within 12" on each side of all fittings, and shall be installed in a continuous traceable manner.
- B. Tracer wires must be interconnected at pipe intersections. When non-metallic water lines have metallic service lines attached, the conductive tracer wire shall be attached to both the main line tracer wire and the corporation stop.
- C. In valve boxes, tracer wire shall be brought to within 6 inches of the surface and left in a coil containing at least 24" of wire.
- D. Tracer wire shall be adequately and securely connected to tracer wire access boxes in accordance with the manufacturer's specifications.
- E. Tracer wire access boxes are to be utilized and spaced no more than 1,000 feet apart.
- F. Tracer wire access boxes shall be installed adjacent to all fire hydrants, and at other locations as shown on the plans or directed by the Inspector.
- G. A concrete mow collar shall be installed at finished grade around all tracer wire access boxes.
- H. Tracer wire shall comply with the product specifications as detailed in Section 5.1.24 of these Standards.

#### 4.5.09 Acceptance Tests

- A. The County will supply water at no cost, for testing potable water lines only. Where water must be trucked to the test site, the Contractor shall be responsible for the cost of transportation.
- B. A temporary RPZ Backflow Preventer flushing apparatus is required if a direct connection to public water is used to fill the line.
- C. After the line has been backfilled and at least seven days after the last thrust blocking has been poured, the line, or any valved section of the line, shall be

subjected to a hydrostatic pressure test. Testing shall be in accordance with AWWA C600, except as modified herein.

- D. The line to be tested shall be filled with potable water at a velocity of approximately 1 foot per second (fps). Take necessary measures to eliminate all air.
- E. After the system has been filled, pressure shall be raised by pump to 1.5 times the working pressure or 150 psi, whichever is greater. Test pressures shall:
  - 1. Not be less than 1.25 times the working pressure or 125 psi at the highest point along the test section.
  - 2. Not vary by more than plus or minus 5 psi.
  - 3. Not exceed twice the rated pressure of the valves or hydrants when test includes closed gate valves.
  - 4. Not exceed rated pressure of valves if resilient-seated gate valves or butterfly valves are used. Thrust restraint shall be designed for the test pressure. Measure pressure at the low point on the line being tested, compensating for gage elevation.
  - 5. Test pressure must be maintained for two hours. If pressure cannot be maintained, the Contractor shall determine the cause, perform necessary repairs, and repeat the test until successful.
- F. A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water required to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and the pipe filled with water.
- G. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = SD * P^{0.5} / 148,000$$

Where: L is the allowable leakage, in gallons per hour;  
S is the length of pipeline tested, in feet;  
D is the nominal diameter of the pipe, in inches; and  
P is the average test pressure during the leakage test in pounds per square inch gage.

- H. All visible leaks shall be repaired regardless of the amount of leakage.
- I. Disinfection
  - 1. The Contractor shall disinfect, flush and test water mains and accessories in accordance with the procedures listed below. The water used in the

disinfection process shall be potable water from an approved supply. If water is to be transported to the subject site, then the tank trucks must also be properly disinfected prior to transporting water. Disinfection of tank trucks shall include disinfection of all appurtenances to be used, such as valves, hoses, etc.

2. Preliminary Flushing: The main shall be flushed prior to disinfection. Flushing shall be at a velocity of not less than 3.0 feet per second (fps). Adequate provisions shall be made for drainage of flushing water. The following chart provides the pipe flow rates needed to maintain 3.0 fps velocity for various pipe diameters, based on CL 52 DIP

D (in)	Flow (GPM)
4	130
6	290
8	585
12	1,140
16	2,025
18	2,565
20	3,165
24	4,560

3. Form of Chlorine for Disinfection:
  - a. Calcium hypochlorite contains 70 percent available chlorine by weight. It shall be either granular or tabular form. The tablets, 6-8 to the ounce, are designed to dissolve slowly in water. A chlorine-water solution shall be prepared by dissolving the granules in water in the proportion requisite for the desired concentration.
  - b. Sodium hypochlorite is supplied in strengths from 5.25 to 16 percent available chlorine. The chlorine-water solution shall be prepared by adding hypochlorite to water. Product deterioration shall be reckoned with in computing the quantity of sodium hypochlorite required for the desired concentration.
  - c. Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person who is familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine-gas directly from the supply cylinder is unsafe and shall not be permitted.

4. Application: The hypochlorite solutions shall be applied to the water main with a chemical feed pump specifically designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump, for example, a hydraulic test pump. Feed lines shall be of such material and strength as to safely withstand the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.
  
5. Method of Chlorine Application:
  - a. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly laid water line. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 MG/L available chlorine. To assure that this concentration is maintained, the chlorine residual shall be measured at intervals along the pipe not exceeding 1,200 feet in accordance with the procedures described in the current edition of "Standard Methods" and AWWA M12 - "Simplified procedures for water examination". In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume. Table I gives the amount of chlorine required for each 100 feet of pipe of various diameters. Solutions of one percent (1%) chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 pound of calcium hypochlorite in 8.5 gallons of water.

TABLE I  
 CHLORINE REQUIRED TO PRODUCE  
 50 MG/L CONCENTRATION  
 IN 100 FT. OF PIPE - BY DIAMETER

<u>PIPE SIZE</u> (IN.)	<u>100 PERCENT</u> <u>CHLORINE</u> (LB.)	<u>1 PERCENT CHLORIDE</u> <u>SOLUTIONS</u> (GAL.)
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
16	0.430	5.12
20	0.675	8.00



- b. During the application of chlorine, valves shall be operated or a backflow preventer shall be provided to prevent the treatment dosage from flowing back into the line supplying the water.
- c. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than 25 MG/L chlorine throughout the length of the main.
- d. As chlorinated water flows past tees and crosses, related valves and hydrants shall be operated to disinfect appurtenances.
- e. Final flushing: After the applicable retention period the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 MG/L.
- f. Chlorinated water shall be de-chlorinated before disposal. Water shall not be allowed to flow into a waterway without neutralizing the disinfectant residual. See the appendix of AWWA C651, C652, and C653 for acceptable neutralization methods.
- g. Chlorine residual testing shall be performed to assure that the heavily chlorinated water has been removed from the pipeline.

J. Bacteriologic Tests:

- 1. After final flushing, and before the water main is placed in service, samples shall be collected and tested for bacteriologic quality and shall show the absence of coliform organisms. At least 2 samples shall be collected at least 24 hours apart at intervals not exceeding 1,200 feet along the water line. Samples shall be tested by a State Health Department approved laboratory and results submitted to the Inspector.
- 2. In the case that trench water and/or excessive soil or construction debris has entered the new water main as determined by the Contractor, the Owner, or the Department, bacteriological samples shall be collected approximately every 200 feet along the water main from water that has stood within the water main for at least 16 hours after final flushing.
- 3. The Contractor may have an independent testing laboratory collect and test samples in accordance with these specifications. The samples shall be taken by laboratory personnel in the presence of the Inspector. The testing laboratory shall submit the results to the Department of Public Utilities.

4. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory, and disinfection shall be repeated until the samples are satisfactory. Cleaning, disinfection, and testing will be the responsibility of the Contractor. Water for these operations will be furnished by the County, but the contractor shall be responsible for the cost of loading, hauling, and discharging the water.
  5. A sampling tap consisting of a corporation cock with metal pipe shall be installed within two feet of the valves which isolate the section of water line to be tested. The corporation stop inlet shall be male one inch in size and the outlet shall have 1-inch I.P. threads and a cap. After bacteriological testing is completed, the piping shall be removed and the corporation cock shall be closed and capped.
- K. Testing and disinfection of the completed sections shall not relieve the contractor of his responsibility to repair or replace any cracked or defective pipe.

END OF SECTION 4.5