SECTION 12 - WATER DISTRIBUTION SYSTEM

12.1 General.

Work in this Section includes all water system piping including all valves, hydrants, fittings, anchors, air vents, and other allied equipment or material as indicated on the construction plans.

12.1.1 Related requirements specified in other Sections of the Specifications:

A. Section 8 - General Construction Standards

B. Section 9 - Site Clearing

C. Section 10 - Trenching & Backfilling

D. Section 11 - Seeding

E. Section 13 - Sanitary Sewer System

12.1.2 Reference Specifications are referred to by abbreviation as follows:

A. American National Standards Institute ..... ANSI

B. American Railway Engineering and Maintenance-of-Way Association ..... AREMA

C. American Society for Testing and Materials .....ASTM

D. American Water Works Association ..... AWWA

12.2 Products.

A. Submit shop drawings or product data sheets, as appropriate, on all products as required by the Department.

B. Provide certified test results of pipe testing.

12.2.1 Ductile iron pipe shall meet requirements of AWWA C151 for the pressure and thickness class indicated on the Drawings. Thickness classes shall meet requirement of AWWA C150. All pipe shall have a cement mortar lining on the interior and an asphaltic coating on the exterior. Minimum thickness shall be Class 52 for 12-inch and smaller, and Class 51 for 16-inch and larger.

12.2.2 Reinforced concrete water pipe, steel cylinder type, prestressed, rubber gaskets for joints, and fittings and specials shall meet requirements of AWWA C301. Design pressure as defined in these standards shall be as indicated on the Drawings. Design limits of pipe shall be such that they shall not be exceeded by the combined requirements of design pressure plus 40 percent for water hammer, plus earth dead load.

12.2.3 Polyvinylchloride (PVC) pipe shall meet the requirements of AWWA C900, Table 2 (Cast Iron OD) Class 150 except that all connections shall be made using elastomeric gasket joints. No PVC pipe larger than 8" shall be used for water lines.

12.2.4 Copper tubing shall meet requirements of ASTM B88 for Type "L" copper, hard drawn, for above ground use and Type "K" hard drawn for below ground use. Copper tubing for direct burial shall meet the requirements of ASTM B88 for Type “K” copper, hard drawn, and annealed.

12.2.5 Water service accessories shall consist of a corporation stop, meter coppersetter and meter box.

A. The corporation stop will have tapered inlet threads in accord with AWWA C800 latest edition. The corporation stop shall be made of a bronze alloy.

B. Meter coppersetters shall be provided for all 5/8" through 2" meters. Each shall have removable pack joints suitable for copper tubing. All coppersetters shall have saddle nuts and padlock wings.

C. The meter box for each size meter shall be in accordance with the appropriate detail drawing in Section 7, Standard Drawings.

D. All water service accessories shall be lead-free in compliance with Section 1417 of the Safe Drinking Water Act, and NSF 61 approved.

12.2.6 Steel casing pipe for boring or jacking under highways and railroads shall meet the requirements of ASTM A139, Grade B. Nominal pipe diameter and wall thickness shall be as indicated on the Drawings. No protective coating or lining will be required.

12.2.7 Reinforced concrete casing pipe and fittings shall meet requirements of ASTM C76, reinforced concrete culvert, storm drain, and sewer pipe.

A. Class of casing pipe shall be as indicated on the Drawings.

B. Rubber gaskets for concrete casing pipe joints shall meet requirements of ASTM C443, Joints for Circular Concrete and Culvert Pipe, using Flexible, Watertight,

Rubber Gaskets.

12.2.8 Casing pipe laid in open cut shall be ductile iron pipe, steel pipe, or reinforced concrete pipe, meeting requirements specified above.

12.2.9 Fittings shall be cast iron or ductile iron. Fittings shall meet the requirements of AWWA C110. Ductile Iron compact fittings shall meet the requirements of AWWA C153. Pressure rating shall be 350 psi. All fittings shall be all bell, mechanical joint, or mechanical joint plain end unless otherwise approved by the Engineer. All fittings shall have a cement mortar lining on the interior and a petroleum asphaltic coating on the exterior. All fittings shall be lead-free in compliance with Section 1417 of the Safe Drinking Water Act and NSF 61 approved.

12.2.10 Mechanical joints and jointing materials shall meet requirements of AWWA C111.

A. Mechanical joint restraint shall meet requirements of AWWA C111.

B. Locked type mechanical joints may be used where restrained joints are required.

12.2.11 Push-on joint and rubber gasket shall meet requirements of AWWA C111.

A. Restrained push-on joints may be used where restrained joints are required. Joint Restraint Devices shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.12 Flanged joints for ductile iron pipe shall meet requirements of ANSI B16.1.

12.2.13 Flanged joint gaskets shall be full-face, made of rubber, and shall meet requirements of ANSI B16.21.

12.2.14 Cement mortar lining with asphaltic seal coat for ductile iron pipe and fittings or for cast iron fittings shall meet requirements for AWWA C104.

A. Cement mortar lining shall be standard thickness.

12.2.15 Exterior, asphaltic coating for ductile iron pipe and fittings and cast iron fittings shall meet requirements of AWWA C151 as applicable.

12.2.16 Metal harness shall be galvanized rods and clamps as detailed on Drawings. Where retainer glands are used, they shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.17 Fittings for copper piping shall meet requirements of ANSI B16.22 for wrought copper,

compression fitting or pack joint.

12.2.18 Detector Check Valves

A. Detector Check Valves shall be epoxy coated UL and FM approved, hot dipped galvanized cast iron with brass by-pass meter trim. Valves shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.19 Gate Valves

A. Gate valves, 12 inches and smaller shall be iron body, bronze mounted, non-rising stem with O-ring seals and parallel double-disc gates meeting the requirements of AWWA C500. Valve ends shall be mechanical joint for underground service or flanged for meter vaults and above ground service. Valves shall open clockwise and shall be equipped with a 2-inch square AWWA operating nut. Valves shall be factory tested in accordance with AWWA C500 and upon request the manufacturer shall furnish certified copies of test reports.

B. Valves shall be as allowed in Section 14 - Approved Water and Sewer Materials.

C. Gate valves smaller than 3 inches shall be bronze, solid wedge, rising stem, at least 200 psig working pressure, as allowed in Section 14 - Approved Water and Sewer Materials.

D. Tapping valves shall meet requirements of gate valves specified above except that seat opening shall be larger than normal size and valve outlet end shall have mechanical joint.

E. All bolts and nuts (including bonnet) shall be Grade 304 or Grade 316 stainless steel.

F. All valves shall have be fusion bonded epoxy coated inside and out, or shall be field-coated with mastic prior to installation. Mastic shall be Roskote R28 or equal.

12.2.20 Resilient Seat Gate Valves

A. Resilient seat gate valves, 16 inches and smaller shall be iron body, bronze mounted, non-rising stem with 0-ring seals meeting the requirements of AWWA C509. The wedge shall be of cast or ductile iron completely encapsulated with rubber. Valve ends shall be mechanical joint for underground service or flanged for meter vaults and above ground service. Valves shall open clockwise and

shall be equipped with a 2-inch square AWWA operating nut. Valves shall be factory tested in accordance with AWWA C509 and upon request the manufacturer shall furnish certified copies of test reports.

B. Valves shall be as allowed in Section 14 - Approved Water and Sewer Materials.

C. Tapping valves shall meet requirements of gate valves specified above except that seal opening shall be larger than normal size; valve outlet end shall have mechanical joint by flanged connection. Flanged end shall have centering lip.

D. All bolts and nuts (including bonnet) shall be Grade 304 or Grade 316 stainless steel.

E. All valves shall be fusion bonded epoxy coated inside and out, or shall be field-coated with mastic prior to installation. Mastic shall be Roskote R28 or equal.

12.2.21 Butterfly Valves

A. Butterfly valves, 16 inches through 24 inches shall be of the rubber-seated tight closing type meeting requirements of AWWA C504, Class 150B.

B. Valve ends shall be mechanical joint in accordance with AWWA C111. Accessories (bolts, glands, and gaskets) shall be supplied by the valve manufacturer.

C. Valve operator shall be of the traveling-nut type, sealed, gasketed, and lubricated for underground service. Operator shall be capable of withstanding an input torque of 450 ft. lbs. at full open or closed position, without damage to the valve or valve operators.

D. Rubber seat may be applied to the body or the disc.

E. Valves shall open clockwise and shall be equipped with a 2-inch square AWWA operating nut.

F. Valve shall be factory tested in accordance with Section 5 of AWWA C504 specification. Upon request the manufacturer shall furnish certified copies of test reports.

G. Valves shall be as allowed in Section 14 - Approved Water and Sewer Materials.

H. All bolts and nuts (including bonnet) shall be Grade 304 or Grade 316 stainless steel.

I. All valves shall be fusion bonded epoxy coated inside and out or shall be field coated with mastic prior to installation. Mastic shall be Roskote R28 or equal.

J. Where possible, butterfly valves should be installed with the valve operator away from the curb and gutter.

12.2.22 Valve boxes shall be 5 ¼" shaft Buffalo style, screw type, adjustable cast iron valve boxes of the two piece type, consisting of top section with cover and bottom section. Base shall be proper type and size for the valve with which it is used. The word "water" shall be cast or embossed on the valve box cover in letters not less than 1 inch high. Screw type extension pieces if required shall be cast iron or ductile iron. Valve box shall be manufactured by as allowed in Section 14 - Approved Water and Sewer Materials. PVC pipe is not allowed for extensions.

12.2.23 Pressure Reducing Valve

A. Valves shall be hydraulically operated and shall generally function to reduce high upstream pressure to a preset lower downstream pressure without shock or hammer.

B. The valve body shall be cast iron with 125 lb. flanges. The piston shall be guided above and below the seat. The piston, seat, and guide shall slide on replaceable "leathers". No metal to metal sliding contact will be allowed.

C. The valve body shall be constructed to allow the removal and servicing of all parts without removing the valve body from the water line. An indicator shall be furnished as an integral part of the valve to show piston position within the body.

D. The working pressure (both HIGH PSI and LOW PSI) shall be determined by the Engineer, approved by the County and shown on the plans. The valve shall be ordered with the PSI specified, and the factory shall preset the pilot for the specified pressure.

E. The external pilot (although preset to the specified pressure when shipped from the factory) shall be field adjustable between 40 and 100 PSI.

F. The valves shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.24 Tapping sleeves shall meet requirements of AWWA C110 for Ductile Iron Fittings and AWWA C223 for Fabricated Steel and Stainless Steel Tapping Sleeves. Fittings shall be

certified per ANSI/NSF Standard 61. The tapping sleeve shall be for the size and type of pipe shown on the Drawings. Full size or smaller taps shall be made using materials specified. Sleeves shall be built in two sections (no straps). A test connection shall be provided.

A. Tapping sleeves shall be rated 150 psi minimum working pressure and factory pressure tested at 200 psi minimum.

B. Two part fabricated steel, bolted tapping sleeves shall be mechanical joint type with a flanged outlet, epoxy coated and furnished with stainless steel bolts and nuts.

C. Stainless steel tapping sleeves shall consist of triangular section side bars (lugs) and have a flanged outlet. The body, flange and test plug shall be made of 304-type passivated stainless steel. Bolts, hex head nuts and washers shall be stainless steel and coated to prevent seizing and galling.

D. Tapping Sleeves shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.25 Bolted, sleeve-type couplings, reducing or transition couplings, and flanged coupling adapters used to join plain-end pipe shall meet the requirements of AWWA C219. Each coupling shall have similar components: a center sleeve (sometimes called a "middle ring"), end rings (sometimes called "followers"), and threaded fasteners (bolts and nuts), that, when tightened, pull the end rings together. These components compress elastomeric gaskets in the space formed between the end rings, center sleeve, and pipes being joined, thereby sealing the coupling/pipe combination. They shall be manufactured from ductile iron and are intended for use in systems conveying water. Couplings shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.26 Fire hydrants shall be of the safety, flange, breakaway top type, meeting requirements of AWWA C502. Hydrants shall have a barrel diameter no smaller than 6 inches, a hydrant valve diameter no smaller than 4-1/2 inches, and shall be equipped with two 2-1/2 inch hose nozzles and one 4-1/4 inch pumper connection. Fire Hydrants shall open clockwise. Hose and pumper outlet threads shall match City of Richmond special threads. Hydrants shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.27 Flanged adapters for joining plain-end pipe to flanged items shall be as allowed in Section 14 - Approved Water and Sewer Materials

12.2.28 Pressure gages shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4-½ inch white coated dial graduated from 0 to 100 psi. Gages shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.29 Compound gages shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4-½ inch white coated dial graduated from 0 to 200 psi and 0 to 30 inch vacuum. Gages shall be as allowed in Section 14 – Approved Water and Sewer Materials.

12.2.30 Air and vacuum valves shall be constructed with cast iron bodies, type 302 stainless steel floats, bronze trim and Buna-N seats. Valves shall be of the size and at the locations indicated on the Drawings. Valves shall be of the combination type to relieve large volumes of air as the lines are filled or emptied and also to release small quantities of entrained air under pressure. Valves shall be for working pressures indicated in Drawings. Manufacturers shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.31 Thrust blocking and/or joint restraint units shall be as shown on drawings or as directed by Project Representatives based upon field conditions. Concrete shall have 2000 psi strength at 28 days and shall meet requirements of ASTM C94.

12.2.32 Non-ferrous water mains shall have a warning tape in the trench 18 inches above the main but no less than 24 inches below grade. The tape shall be marked for water lines. Material shall be Terra Tape Premium strength or equal.

12.2.33 Install passive electronic markers (ball type) on all water pipe in accordance with these Standards and in accordance with approved plans.

12.2.33 Service saddle shall have stainless steel double straps and bolts and shall be as allowed in Section 14 - Approved Water and Sewer Materials.

12.2.34 Flushing hydrants shall be 2" in size and as allowed in Section 14 - Approved Water and Sewer Materials.

12.3 Execution.

12.3.1 Pipe Laying.

A. Take all precautions necessary to insure 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. Bedding of pipe shall be as specified in Section 10.2.0 & 10.3.0 of these Standards.

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 and material and type pipe involved. 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 and with bell ends upgrade.

G. Separation of sanitary sewer lines and water lines shall be in accordance with Virginia Department of Health Regulations.

12.3.2 Joining 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 soap solution (half cup granulated soap dissolved in 1 gallon water). 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. 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 tighten all nuts to torque listed below:

Bolt Size – (Inches)	Torque - (Ft. – Lbs)
5/8	40 - 60
¾	60 - 90
1	70 - 100
1 ¼	90 - 120

C. Tighten nuts on alternate side of the gland until pressure on the gland is equally distributed.

D. Join lock-type mechanical joint pipe according to manufacturer's recommendations.

E. Permissible deflection in mechanical joint pipe shall not be greater than 2/3 of that listed in AWWA C600.

F. Permissible deflection in lock-type mechanical joint pipe shall be as recommended by manufacturer.

12.3.3 Joining 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 gasket lubricant supplied by pipe manufacturer, to either the gasket or 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 to 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. Join restrained push-on joints according to manufacturer's recommendations.

C. Permissible deflection in push-on joint shall not be greater than 2/3 of that listed in AWWA C600.

D. Permissible deflection in restrained push-on joint pipe shall be as recommended by manufacturer.

12.3.4 Join reinforced concrete water pipe with rubber gaskets installed as recommended by manufacturer.

12.3.5 Join PVC pipe and fittings in accordance with manufacturers' instructions and install in accordance with ASTM D2321.

12.3.6 Setting Valves and Valve Boxes

A. Install valves with operator stems in the vertical plane through the pipe axis and perpendicular to the pipe axis. Locate valves where shown on Drawings. Thoroughly clean before installation. Check valves for satisfactory operation.

B. Equip all underground valves with valve boxes where shown on the Drawings. Set valve boxes in accordance with Standard Drawings. Set box in alignment with valve stem centered on valve nut. Set the valve box to prevent transmitting shock or stress to the valve. Set the box cover flush with the finished ground surface or pavement. PVC extensions shall not be permitted.

12.3.7 Locate Fire Hydrants as shown on Drawings and in accordance with Standard Drawings.

12.3.8 Provide air and vacuum valve at locations shown on Drawings. Install gate valve between water main and relief valves. Construct manholes for air and vacuum relief valve as

shown on Drawings.

12.3.9 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 1 inch above top surface.

A. Use cast iron 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 oakum and leadite.

B. Provide "link-seal" pipe to wall closures manufactured by Thunderline Corp., Wayne, Michigan 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.

12.3.10 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.

A. Concrete reaction anchors shall bear against undisturbed earth and shall be of the size and shape shown on the Drawings.

B. Use metal harness restraints as shown on Drawings.

C. 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.

12.3.11 Encase water pipelines crossing under highways and railways in a larger pipe or conduit called a casing pipe. The casing pipe shall be of the diameter and wall thickness indicated on the Drawings. Steel casing pipe shall be joined in accordance with AWWA C206. Install by jacking or boring. Acceptable casing spacers are named in Section 14.

A. The installation shall meet requirements of AREMA Standards for installation of pipelines carrying nonflammable substances under railway tracks. Brick up casing pipe ends to protect against foreign matter, but do not tightly seal. Prior to beginning work, notify the Railway Company or Highway Department.

12.3.12 Installation of Tapping Sleeves and Tapping Valves

A. All tapping sleeves shall be set to avoid interference with existing pipe joints.

B. After all tapping sleeves and valves have been set in place, a hydrostatic pressure test of 150 psi shall be made to insure 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 the presence of a representative of the Owner. The Owner shall be notified 48 hours in advance of making the tap.

12.3.13 Install warning tape in utility trench above all non-metallic pipes in accordance with manufacturer's recommendations. Install tape approximately 12 to 18 inches above the pipe, not less than 24 inches nor more than 54 inches deep along the side of the trench, in such a manner as not to be broken or otherwise damaged during backfilling or compacting operations.

12.3.14 Acceptance Tests.

A. Owner will supply water, at no cost, for testing potable water lines only.

B. After the line has been backfilled and at least seven days after the last concrete reaction anchor has been poured, subject the line or any valved section of the line to a hydrostatic pressure test in accordance with AWWA C600, except as modified herein. Fill the system with water at a velocity of approximately 1 ft. per sec. while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 1.5 times the working pressure. Test pressure shall: (1) Not be less than 1.25 times the working pressure at the highest point along the test section; (2) Not exceed thrust restraint pressure; (3) Not vary by more than plus or minus 5 psi; (4) Not exceed twice the rated pressure of the valves or hydrants when test includes closed gate valves; (5) Not exceed rated pressure of valves if resilient-seated gate valves or butterfly valves are used; (6) Shall be at least 150 psig. Measure pressure at the low point on the system and compensate for gage elevation. Maintain this pressure for two hours. If pressure cannot be maintained, determine cause, repair, and repeat the test until successful.

C. A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and the pipe filled with water. Leakage shall not exceed that specified by AWWA C-600. If the leakage exceeds that specified, then find and repair the leaks, and repeat the test until successful.

D. All visible leaks shall be repaired regardless of the amount of leakage.

12.3.15 All water mains shall be disinfected prior to being placed in operation. 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 the vehicle should also include all appurtenances used such as valves, hoses, etc.

A. Preliminary Flushing: The main shall be flushed prior to disinfection, except when the tablet method is used. Flushing shall be at a velocity of not less than 2.5 ft./sec. Adequate provisions shall be made for drainage of flushing water.

B. Form of Chlorine for Disinfection:

(1.) Liquid chlorine shall be used only:
   a. In combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water to be chlorinated.
   b. Under the direct supervision of someone familiar with the biological, chemical, and physical properties of liquid chlorine and who is trained and equipped to handle any emergency that may arise.
   c. When appropriate safety practices are observed to protect working personnel and the public.

(2.) Calcium hypochlorite is available in either granular form or in 5-g tablets and must contain approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry and dark environment to minimize its deterioration. (CAUTION: Tablets dissolve in approximately 7 hours and must be given adequate contact time.)

(3.) Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine, and the storage conditions and time must be controlled to minimize its deterioration. 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. Do not use sodium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to remove from the pipe after the desired contact time has been achieved.

(4.) Application: The hypochlorite solutions shall be applied to the water main with a gasoline or electrically-powered chemical feed pump 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 withstand safely 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.

C. Methods of Chlorine Application:

(1.) Continuous Feed Method:

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 pipeline. 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 not exceeding 2,000 feet in accordance with the procedures described in the current edition of Standard Methods and AWWA Manual 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 1 gives the amount of chlorine required for each 100 ft. of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 lb. of calcium hypochlorite in 8.5 gal of water.

TABLE 1

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

PIPE SIZE (IN.)	100 PERCENT CHLORINE (LB.)	1 PERCENT CHLORINE SOLUTION (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 the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. 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.

(2.) Slug Method (use only if authorized by Public Utilities Department):

a. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at no less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/l for at least 3 hours. The application shall be checked at a tap near the upstream end on the line by chlorine residual measurements.

b. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect appurtenances.

(3.) Tablet Method:

a. Use only when scrupulous cleanliness has been exercised because preliminary flushing cannot be used. Do not use this method if trench water or foreign material has entered the main or if the water is below 41 deg. F (5 deg. C). This method may be used for mains up to 12 inches in diameter and where the total length of the main is less than 2,500 feet. Tablets shall not be used with PVC pipe.

b. Place tablets in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. Attach tablets using food-grade adhesive or other adhesive approved by the Virginia Department of Health, except for the tablets placed in hydrants and in the joints between the pipe sections. Tablets shall be free of adhesive except on the one broad side to be attached. Place all tablets at the top of the main. If the tablets are attached before the pipe section is placed in the trench, mark the position of the tablet in the pipe and assure that the pipe is placed with the tablet at the top.

c. The following table shows the number of 5 grain HTH tablets necessary per joint of pipe to obtain 50 mg/l chlorine.

PIPE SIZE (IN.)	TABLETS (PER 18 – 20 FT. JOINT)
3	1
4	1
6	2
8	3
10	4
12	7

(4.) When installation is completed, fill the main with water at a velocity of less than 1 foot per second. The water shall remain in the pipe for at least 24

hours. Operate valves so that the strong chlorine solution will not flow back into the line supplying the water.

D. Flush to remove disinfecting solution: This is a low velocity and low flow flush through fire or flushing hydrants to remove the disinfecting solution from the new line. In new subdivisions, or in areas where there is an existing sanitary sewer, this discharge may be made into the sanitary sewer system. The Contractor shall provide sufficient hoses to connect from the hydrants to a manhole in a manner that provides a suitable air gap for backflow prevention. In projects or areas where there are no sanitary sewers, the flushing of the disinfecting solution must not enter any streams or be discharged in a manner that causes any environmental damage. The contractor may use a neutralization station to reduce the chlorine residual as required by local and state regulations for discharge to the ground. A standard detail for a neutralization station is included in Section 7. All costs and expense for the neutralizing station is the responsibility of the Contractor.

E. Final flushing: After the applicable retention period the heavily chlorinated water shall be flushed using potable water 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. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.

F. 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 bacteria. At least two samples shall be collected at least 24 hours apart at intervals not exceeding 1,200 ft. and tested by a State Health Department approved laboratory. Results shall be submitted to engineer.

a. The Developer may have an independent testing laboratory collect and test samples in accordance with these requirements. The samples shall be taken by laboratory personnel in the presence of the County Construction Inspector. The testing laboratory shall submit the results to the Department's Construction Division Director.

(2.) 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 owner, but the contractor shall include in his bid the cost of loading, hauling, and discharging the water. Testing of repeat samples shall be in accordance with either Paragraph 1 or 1(a).

(3.) A sampling tap consisting of a corporation cock with metal pipe shall be installed within two feet of valves. The corporation stop inlet shall be male one inch in size and the outlet shall have one inch I.P. threads and a cap.

G. Testing and disinfection of the completed sections shall not relieve the contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be done at the contractor's expense.

12.3.16 Electronic Marker Balls

A. Electronic markers (ball type) shall be installed on all water mains, sewer gravity mains and sewer force mains in accordance with the following:

(1.) Ball type electronic markers shall be passive type as manufactured by 3M or Omni.
   a. Sewer line markers shall be rated and color coded for sewer.
   b. Water main markers shall be rated and color coded for water.

(2.) Locations for electronic markers shall be as shown on Standard Drawings titled Electronic Marker Placement Detail for Water Mains and Sewer Force Mains.
Minimum distance between markers shall be 6 feet.
   a. Markers shall be a minimum of 4 inches above the pipe.
   b. Markers shall have a maximum of 3 feet of cover.
   c. When pipe joints are deflected, place markers at the pipe joint beginning and ending the deflection and at intermediate joints for every 1 foot (maximum) of deflection.
   d. Locations for Markers on water mains and appurtenances shall be in accordance with the following:
      1. Valves
      2. Tee
      3. Cross
      4. Bends
      5. Deflections (begin, end, max of each 1 foot of deflection)
      6. Casing ends
      7. Pipe vertical adjustments (beginning and end)
      8. Corporation stop
      9. Maximum spacing of 100 feet for metallic pipe and 50 feet for non-metallic pipe
      10. All points where the line crosses over or under other utilities
      11. Dead end

B. Electronic Marker Balls shall be rated for sewer (green) and for water (blue) and shall be installed in accordance with manufacturer’s recommendations and the

following to ensure that marker is installed over centerline of pipe.

(1.) The locations for Electronic Marker Balls shall be as described in Paragraph A, above.
(2.) Hand place at least 6 inches of backfill material over marker ball to ensure that it stays in place.
(3.) Locations for marker balls shall be as shown on Standard Drawings titled Electronic Marker Placement Detail for Water Mains and Sewer Force Mains (D-740).
(4.) The locations of Electronic Marker balls for gravity sewer lines shall be as shown on Standard Drawing titled Electronic Marker Placement Detail for Gravity Sewer (D-750).

C. Acceptance of Electronic Marker Ball Installation

(1.) Contractor shall certify in writing that all electronic markers are in place prior to paving.
(2.) Prior to Substantial Completion, contractor shall demonstrate to Construction Division that all markers are installed as required and are working properly. Any missing or non-functioning Electronic Marker Balls shall be replaced by the contractor prior to substantial completion.
(3.) The locations of all markers shall be shown on as-built drawings.