

PART IV

WORK ASSOCIATED WITH WATER LINE CONSTRUCTION

A. GENERAL INFORMATION

Any new water system to be connected to the public supply shall not be constructed until final plans are approved by the Authority. The Authority shall be furnished for review three (3) sets of plans and specifications prepared by a Registered Engineer certified to do business in the State of Virginia. Plans shall be in sufficient detail to accurately indicate all pertinent design and construction details for a comprehensive interpretation of the work to be performed. Plans shall be reviewed for compliance with the following standards as have been adopted by the Service Authority.

B. DESIGN CRITERIA

1. Pipe Size

All main distribution pipe lines shall be of a size to adequately serve all the needs of the proposed subdivision or water system, but in any event shall not be less than six (6) inches (nominal size) in diameter except as may otherwise be permitted herein.

The minimum size of the pipe where fire protection is to be provided or required shall be six (6) inches in diameter. If more than one (1) fire hydrant is required, then the minimum line size shall be eight (8) inches or the system shall be reinforced using a grid system layout. Dead-ends shall be minimized by looping all mains. Where dead-ends are necessary they shall be provided with a fire hydrant, or blow-off assembly. The nominal pipe diameter of water mains without fire hydrants shall not be less than four (4) inches. The consultant shall be responsible to properly design the water system for fire protection under all conditions. Hydraulic calculations for sizing the water system must be submitted to the Authority for review.

2. Flow Requirements

All distribution systems shall be capable of providing a flow of three (3) gallons per minute per connection at a minimum working pressure of 20 psi at each service connection, plus the required fire flow as determined by the County Fire Official.

3. Depth of Cover

Water pipe shall be laid with a cover of three (3) feet measured from established finished grade to the top of the pipe. The contractor shall establish adequate elevation control to ensure that upon final grading a minimum of three (3) feet of cover over waterlines has been maintained. It shall be the contractor's

responsibility and expense to verify the cover at any location questioned by the Authority. Any potential changes in alignment or grade of roadways shall be considered in the original utility design. Loss of adequate cover will necessitate relocation or lowering of the waterline. Every effort shall be made to maintain the finished grade so as to not exceed a trench depth of 5 feet.

4. Gate Valve Locations

Approved gate valves shall be installed at all pipe junctions and street intersections in such a manner as to control and cut off flows in all segments of the system. Three (3) valves are required at crosses on systems, two (2) valves at tees; the valves are to be placed on the smaller lines at each cross and tee location, unless otherwise approved by the Authority. In other areas gate valves will be required every 1000 feet, except as may otherwise be approved by the Authority. No gate valve shall be located under a concrete storm gutter or sidewalk. Additional valves may be required under certain circumstances, such as in looped systems, where it is necessary to isolate certain sections of the system.

5. Crossing Water Courses

Waterlines intended to cross streams, rivers, or other surface waters, either continuous or intermittent flows, present special problems and should be discussed with the Service Authority and the State Health Department before final plans are prepared. Only under extraordinary conditions will above ground crossings be approved by the Authority. The waterline is to be installed a minimum of three (3) feet under the stream or riverbed and be of special construction having flexible watertight joints. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repairs; the valves shall be easily accessible and not subject to flooding. Permanent one-inch (1") taps shall be made for testing and locating leaks at each end of the water crossing. Ductile iron water pipe, Class 52, shall be used. (See Part VII, Figure W-12, Page TD-30).

The developer is reminded that specific requirements of the Army Corp of Engineers, DEQ, and/or VMRC may apply to any stream crossing. A joint permit application may be filed with VMRC for review of these agencies.

6. Constructing Under Culverts & Storm Drains

The Authority shall require a minimum separation from open-ended culverts of six (6) inches with insulation to prevent freezing or three (3) feet without insulation. The type of insulation and the method of application shall conform to the manufacturer's published recommendation.

The minimum distance between waterlines and storm drainage appurtenances where crossing shall be twelve (12) inches.

C. WATER LINE CONSTRUCTION

Construction of water lines and appurtenances shall be in accordance with the approved plans and specifications. The Authority shall insist that good workmanship

and standard waterline construction principles apply in the work in order that the finished project may qualify on final inspection for acceptance into the Authority water system.

1. Handling of Materials

Pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall they be dropped. Pipe shall not be skidded or rolled against pipe already on the ground. Pipe shall be handled so that the coating and lining shall not be damaged.

2. Pipe Laying - General Comments

The water mains shall be laid and maintained to the required lines and grades with fittings, valves, hydrants, and accessories set at the required locations as indicated on the approved plans. All valves and hydrant stems shall be set plumb. Blue marking tape shall be placed in the trench two (2) feet above the top of all water mains, service lines and appurtenant items during backfill operations. Wherever obstructions not shown on plans are encountered during progress of the work, the Authority or its representative shall be advised. If any deviation is contemplated from that shown on the plans approved by the Authority, details shall be submitted for review and approval before construction. Verbal approval may be granted for minor alterations. Major alterations will require written approval. No water main shall terminate under a curb, gutter, ditch or storm drainage structure.

3. Tapping Water Lines

All tapping on existing lines shall be accomplished with Authority forces unless otherwise approved.

(a) Tapping PVC, Transite or DI Pipe

The following procedures are required when tapping existing PVC, transite or ductile iron water lines:

Taps shall be located at least eighteen (18) inches from the joint.

Tapping procedures shall be in accordance with the manufacturer's published recommendations.

Tapping sleeves and valves shall be used on four (4) inch or larger taps.

(b) Special Requirements For Tapping PVC & Transite Pipe

The following procedures are required when tapping existing PVC or transite pipe water lines:

Only one tap shall be located in a common line parallel to the longitudinal axis.

When multiple taps are necessary on the same length of pipe they shall be located on slightly different planes and separated by at least three (3) feet.

The pipe shall be tapped only when the temperatures fall within the following range limits:

Temperature Limits for Tapping PVC Pipe

Connection Minimum Maximum

Dry Taps 0o F (-18o C) 100o F (38o C)

Wet Taps 32o F (0o C) 90o F (32o C)

No taps shall be made where the pipe is discolored.

Saddles shall be used on all taps.

Tapping sleeves on PVC or transite waterlines shall be supported by a concrete pad, cast in-place, prior to the tap being made. A concrete thrust block shall also be provided behind the tapping sleeve.

4. Excavation and Laying of Pipe

(a) Excavation

Pipe line construction shall be made by open cut unless otherwise specified or required. During the excavation operations, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins.

All open trenches shall be adequately shored and braced to provide a safe working environment. Trench boxes shall be made available onsite and utilized in accordance with appropriate OSHA standards. It is the contractor's responsibility to comply with the requirements of OSHA as pertaining to men working in an open trench.

All excavated material not suitable for backfill shall be removed and disposed of in an acceptable manner. Grading shall be done as may be necessary to prevent water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by approved methods.

The trenches in which the pipe is to be laid shall be opened in accordance with the approved plans so pipe can be laid to the alignment and depth required. The exposed end of all pipes shall be fully closed by means of an approved stopper to prevent earth or other substances from entering the pipe which may interfere with the disinfection process. All waterlines shall be laid true to line and grade. The pipe and trench shall be kept free of water during the laying operation. Not more than one hundred (100) feet of trench shall be opened in advance of the completed waterline when located along streets or highways, and not more than two hundred

(200) feet at other locations.

(b) Construction in Fill Areas

Where pipelines are to be installed in fill areas, the fill shall be compacted to 95% of the optimum density as determined by AASHTO T-99 to an elevation not less than thirty-six (36) inches above the pipe bells before excavation begins for the pipe trench. Certification shall be required of all compaction in fill areas, at intervals as directed by the Authority. This certification shall be signed by a professional geologist and shall state the exact area the certification applies to.

Hydrants, valves and other appurtenances shall not be located in fill.

(c) Trench Width

The trench width shall be as narrow as is practicable to permit the pipe to be laid and joined properly, and to permit the backfill to be placed and compacted properly. In general, the clear width of the trench at an elevation of 1'-0" above the top of the pipe shall be approximately equal to the external diameter of the pipe plus sixteen inches (16"), or in accordance with the trench widths specified for various types and sizes of pipe. The provisions of this section shall not relieve the contractor from responsibility to ensure all trenching methods are in accordance with the appropriate safety requirements of the applicable OSHA regulations.

(d) Rock Excavation

Where rock is encountered in trench excavation, whether solid or in the form of loose rock, shale, or large boulders, it shall be removed by blasting or other approved methods to the extent that no projection of rock shall be nearer than six (6) inches to any part of the water pipe, valves and fittings when laid, nor project beyond the lines and grades of structures. No blasting shall be done within twenty-five (25) feet of any completed work or adjacent to any other structure unless proper precautions are taken. Ends of water line adjacent to blasting shall be covered to avoid receiving debris. No rock or asphalt over six-inches (6") in any dimension shall be placed in the trench and in no case shall rock or asphalt be placed closer than two (2) feet vertically to the installed pipe.

(e) Overexcavation

Where the excavation has been carried too deep, the Contractor shall refill the over-excavated trench with No. 68 or 21A Virginia Department of Transportation stone in order to ensure the stability of the various structures.

(f) Pipe Installation (General)

When installing pipe in the trench, proper implements, tools, and facilities satisfactory to the Authority and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants, and accessories shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, slings, or

other suitable tools or equipment in such a manner as to prevent damage to the water main materials and any protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

(g) Condition of Pipe

All lumps, blisters and excess coal tar coating shall be removed from the ends of each pipe. The outside of the spigot and the inside of the bell shall be thoroughly cleaned and dried, and be free from oil and grease before the pipe is joined.

(h) Special Precautions

The contractor shall visually examine each joint of pipe to prevent foreign material from entering the pipe while it is being placed in the trench. During the laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. Water lines shall be plugged at the end of each construction day to prevent foreign matter from entering them.

5. Pipe Installation

Ductile iron pipe shall be installed in accordance with ANSI/AWWA C-600-93 or current revision. Specifically, ductile iron pipe shall be installed in accordance with Figure W-2, Page TD-13, of these specifications with bedding requirements similar to Figure 58 Class C in ASCE Manual #37 for shaped bottom.

(a) Cutting of Pipe

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

When machine cutting is not available for cutting pipe twenty (20) inches in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall be used on this work. The flame cutting of pipe by means of an acetylene torch shall not be allowed.

(b) Pipe Deflection

Wherever it is necessary to deflect the pipe from a straight line, either in vertical or horizontal plane, to avoid obstructions or to plumb the line for valve installation, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory jointing of the pipes, as specified by the manufacturer. The following table shall be used as a guideline. In no case shall these limits be exceeded.

Longitudinal Bending of Ductile Iron Pipe

Pipe Size	Min.Allow. per 18' length	Offset per 18'
	Radius (ft)	Length (in)
4	205	19
6	205	19
8	205	19
10	205	19
12	205	19

6. Hydrants, Valves, and Fittings Construction

(a) Bracing of Fittings

All tees, valves, fittings, plugs, caps and fire hydrants shall be substantially braced, blocked and/or anchored to prevent any movement by providing adequate reaction backing. This backing shall be a concrete thrust block with a compressive strength of not less than 2500 psi. Backing shall be placed between solid undisturbed earth and the fitting to be anchored and shall be so placed that pipe and fitting joints will be accessible for repairs. (See Part VII, Figures W-3, W-3A, and W-3B, Pages TD-14, TD-15 and TD-16).

(b) Fitting Installations

Hydrants, valves and valve boxes shall be set plumb, and centered, with valve boxes placed directly over the valves. If possible, valve boxes shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around the valve box to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than four (4) feet.

7. Pipe Foundation

(a) General:

The trench shall be excavated to a depth required so as to provide a uniform and continuous bearing and support for the pipe. It shall be permissible to disrupt the finished surface of the trench over a maximum length of eighteen (18) inches near the middle of each length of pipe for the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools. Where excavation is made in rock or boulders, the subgrade shall be made by backfilling with six (6) inches of No. 68 or 21A Virginia Department of Transportation stone which shall be thoroughly compacted. The bedding material shall extend evenly to the trench wall.

(b) Foundation in Good Soil:

The bottom of the trench shall be scraped and compacted. All stones shall be removed to insure the pipe doesn't rest on rock, or a four (4) inch bedding of No. 68 Virginia Department of Transportation Stone shall be provided. The bedding material shall extend evenly to the trench wall. Bell holes shall be cut for the proper marking of the joints and to prevent the pipe from resting on the bells.

(c) Foundation in Poor Soil:

Whenever the soil at the bottom of the trench is soft, unstable or saturated with water, a foundation of granular fill beneath the bedding shall be provided to a depth required to stabilize the soil. (See Part VII, Figure W-2, Page TD-13). Bedding type shall be submitted to the Authority and approved before incorporating into the work.

8. Backfilling and Compaction

(a) General

All trenches or excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown on the approved plans.

Backfilling shall be subject to the approval of the Authority for the type of construction used. All backfilling shall be carried along as speedily as possible, the trench being filled, in general, as soon as the cement, or mortar and masonry are sufficiently set. New trenching will not be permitted when earlier trenches need backfilling or labor is needed to restore the surfaces of streets or other areas to a safe and proper condition.

(b) Materials

All material used for backfilling of trenches shall be free of excessive amounts of unsuitable materials such as all organic material, frozen clods, and sticky masses of clay and gumbo which are difficult to properly compact. Backfill material shall contain no rock or asphalt larger than six (6) inches in any dimension and in no case shall rock or asphalt be placed closer than two (2) feet vertically to the installed pipe.

(c) Backfilling

Backfill over all pipe to a depth of twenty-four (24) inches shall be carefully placed in layers approximately six (6) inches thick, each layer being thoroughly tamped and compacted by hand or pneumatic tamper in place. Special care shall be taken in using a mechanical tamper directly over the pipe.

Above 24", backfill shall be deposited in 6" layers in traffic areas, 12" layers in non-traffic areas or a thickness which will permit compaction to a density of at least 95% of the maximum density at optimum moisture content as determined by the AASHTO Standard Proctor test (AASHTO Designation T-99) under all proposed traffic areas. Backfill in existing traffic areas shall be in accordance with the Virginia Department of Transportation's standards.

(d) Compaction

Unless otherwise shown on the plans, the backfill in all trenches shall be thoroughly compacted. The compacting shall be done by suitable mechanical means. In all cases, special care shall be taken to see that the spaces at the sides of the trench are thoroughly filled and compacted. If necessary, the earth shall be moistened during the operations.

It shall be required that a minimum of one (1) compaction test will be conducted on trench backfill per 400 linear feet of waterline. Compaction tests may be waived by the Authority on projects less than 400 linear feet in length. The contractor shall bear the expense of all compaction tests. The location of tests shall be selected in the field by the Authority and will not necessarily be limited to regular intervals.

The results of all compaction tests shall be submitted to the Authority for review and approval prior to acceptance of construction. The degree of compaction required for trenches in streets and paved areas is 95 percent of maximum density and for trenches in all other areas the required density shall be 90 percent of maximum density. If the tests indicate the required density has not been obtained, the contractor shall remove, replace and recompact the material to the specified density. Failure of any compaction tests may result in additional compaction tests being required.

(e) Protection of Pipe & Appurtenances

Backfilling shall be done in such a way as to prevent dropping of material directly on top of the pipe from more than a three (3) foot vertical distance. When placing material from a bucket it must be lowered so that the shock of the falling earth will not damage the water line.

D. WATER PIPE MATERIAL & JOINTING

All pipe shall be approved by the Authority.

1. General Requirements

Unless otherwise approved in writing by the Authority, all water mains and distribution lines shall be of the material herein listed. The Authority reserves the right to select the type and/or class material which shall be used from the following list:

(a) Ductile Iron Pipe & Fittings

Ductile iron pipe shall be centrifugally cast pipe manufactured in accordance with AWWA/ANSI C151-91/A21.51-91 or current revision. The joints shall be push-on, mechanical or flanged in accordance with AWWA/ANSI C-111-90/A21.1190. All ductile iron pipe shall have a cement mortar lining in accordance with AWWA/ANSI C104-90/

A21.4-90) or current revision. Ductile iron pipe shall be manufactured by Griffin Pipe Products, Inc., U.S. Pipe and Foundry Co., or approved equal.

The minimum wall thickness for ductile iron pipe shall be the thickness necessary to safely and effectively install corporation stops. Pipe 8" and smaller shall have a minimum wall thickness of 0.31". Pipe 10" and larger shall have a minimum wall thickness of 0.34". Structural requirements for the pipe under field installation shall be used in determining the appropriate class of pipe. Under no circumstances shall the pipe wall thickness be less than that noted above.

Cast iron or ductile iron fittings shall have standard mechanical joints manufactured in accordance with AWWA/ANSI C-110-93/A21.10-93 or current revision. All fittings shall be cement mortar lined inside in accordance with AWWA/ANSI C104-90/A21.4-90 or current revision.

(b) Galvanized Steel Pipe & Fittings

Galvanized steel pipe shall conform to ASTM A-102-77, Schedule 40 or 80 or current revision.

Fittings for galvanized steel pipe shall be galvanized malleable iron in accordance with ASTM A-120-77 or current revision.

Galvanized pipe shall not be used below ground except for blow-off assemblies and where exposed to atmosphere. Galvanized pipe shall not be used under wet conditions in any event, except where special approval of application is given.

(c) Copper Pipe & Fittings

Copper pipe for service laterals shall be soft type "k" copper with standard water works flare fittings.

2. Jointing

Jointing of all pipe shall conform to the manufacturer's published recommendations and specifications. Gaskets for water pipe and fittings shall be vulcanized natural or vulcanized synthetic rubber free of porous areas, foreign material or visible defects. Rubber gaskets shall conform to all applicable provisions of AWWA/ANSI C111/A21.11-90, or current revisions. Gaskets shall be protected from exposure to excessive heat and cold, direct sunlight, ozone (from electric motors and equipment), oil, grease or other contaminants.

E. VALVES & ACCESSORIES

1. Gate Valves

Two (2) inch and smaller gate valves shall be inside screw, solid bronze, tapered seat, double disc construction and rated for 200 psi working pressure.

Larger gate valves shall be double disc type or resilient seated. The double disc type shall be parallel seat, bronze mounted type with non-rising stems in accordance with ANSI/AWWA C500-93, or current revision. The resilient seated type shall be non-rising stem, fully encapsulated wedge in accordance with ANSI/AWWA C509-94 or current revision.

Gate valves shall be one make and shall open by a counterclockwise rotation of the valve stem with a two (2) inch square operating nut. The operating nut shall be no greater than three (3) feet below finished ground. Operating nuts placed greater than three (3) feet below finished ground shall be equipped with approved operating nut extensions to meet the minimum depth requirement. Gate valves installed in access vaults, pumping stations, etc., shall be equipped with handwheels.

Gate valves fourteen (14) inches and larger shall have a working pressure of no less than 150 psi and a test pressure of 300 psi. Four (4) inch to twelve (12) inch gate valves shall have a working pressure of no less than 120 psi and a test pressure of 400 psi. Gate valves greater than or equal to twelve (12) inches on high pressure systems (greater than 100 psi) shall be provided with gear case and a by-pass. Gate valves shall have one "O" ring above and one "O" ring below the stem thrust collar. The thrust collar shall be lubricated with oil to assure positive operation in opening and closing.

Double disc gate valves shall be Mueller A-2380-20, Kennedy 571X, or approved equal. Resilient seated valves shall be US Pipe Metroseal 250, American Flow Control Series 500, Kennedy Valve-Ken Seal II or approved equal (Part VII, Figure W-5, Page TD-18).

2. Butterfly Valves

Butterfly valves shall be designed, manufactured and tested in accordance with the provisions and requirements of ANSI/AWWA C504-94, or current revision, and in accordance with the requirements of these Specifications. All valves shall be drop-tight when subjected to the specified working pressure (differential pressure), and all valves shall be capable of droptight seating under bidirectional flow conditions (maximum working pressure applied as differential pressure from either direction).

Valve bodies shall be constructed of cast (gray)iron ASTM A126-73 Class B, ductile iron ANSI/ASTM A536-80 Grade 65-45-12, or alloy cast iron ANSI-ASTM A436-78 Type 1 or 2 or ANSI/ASTM 439-80 Type D2.

Valve discs shall be solid construction, and shall be stainless steel as specified under Section 2.2.4 of the above referenced AWWA Standard or alloy cast iron ANSI/ASTM A436-78 Type 2. Edges of discs shall be shaped, machined and polished to such configuration as will ensure smooth and even mating with the rubber seat over an acceptable angle of interference (+ 2-1/2 degrees). The disc shall rotate 90 degrees from full open position to tightly closed position.

Valve seats shall be new natural rubber or new synthetic rubber conforming to the requirements of ANSI/AWWA C504-94, or latest revision. Rubber seats shall mate with the seating surfaces of the valve discs specified hereinabove. Rubber seats shall be either bonded in the valve body or mechanically fastened in the valve body. All clamps, retaining rings and fasteners shall be stainless steel specified in the above referenced AWWA Standards.

Valve shafting shall be stainless steel in accordance with the above referenced AWWA Standard, and may be either one-piece through-body-and-disc construction or may be stub-shaft construction. If of stub-shaft construction, each stub-shaft shall be inserted into hubs integral with the valve disc for a distance of at least 1-1/2 times the diameter of the shaft. Lengths of hubs extending from the disc shall be such that the full required insertion can be attained. The connection between the shaft and the disc shall be designed to transmit shaft torque equivalent to at least 75% of the torsional strength of the minimum shaft diameters. Dowel and taper pins, if used, shall be mechanically secured. Any penetrations in the shaft shall be compensated for so that the relationship of transmitted torque to shaft torsional strength will be maintained.

Valve bearings shall be sleeve type, non-corrosive, and of "self-lubricated" materials. Thrust rings and/or bearings shall maintain the disc in designed centered position. Valve shafts shall be designed for connections to operators as required, and shaft seals shall be provided at capped ends and projecting ends.

All valves shall fully meet or exceed the requirements of ANSI/AWWA C504-94, or current revision. The valves shall be furnished in complete accordance with the requirements of Section 5 of ANSI/AWWA C504-94, or current revision.

Valve operators shall be traveling-nut type or geared type designed to withstand 300 ft. lbs. of input torque at fully open or fully closed positions without damage to valve or operator. Operator case shall be fully-enclosed type to prevent entrance of dirt or moisture, and the case shall be grease-packed. Stop-limiting devices shall be provided in the operators for open and closed positions. Travel of the valve shall be indicated on quadrant bolted to the body (exposed valves).

Valves installed in locations accessible from floor or ground shall be equipped with handwheels and valves installed in locations higher than 6'-6" above finished floor or ground shall be equipped with chainwheels and chain. The last stated provisions shall apply except when valves are indicated to be operated through floorstands or benchstands located above the valves, and in such cases valves shall be equipped with enclosed operators, extension stems, floorstands (or benchstands), and indicators.

Valves installed underground shall be equipped with grease packed operators having gasketed covers to prevent entrance of moisture into case when subjected to external hydrostatic pressure of 10 psi; and valves shall be operated through a valve nut mounted on vertical operating shaft extending through top of gear case. Operator extension, valve box, indicator, and cover shall be provided for each valve. Extensions and valve boxes shall be of correct length and height to suit elevation of ground surface. Valve boxes shall be fitted with cast iron covers marked "WATER". All valves shall open "left".

3. Tapping Valves

Tapping valves shall meet the same specifications as gate valves, except they shall have a full, unobstructed opening to receive a full size shell cutter. It shall be a standard mechanical joint type on one end and a flanged joint on the other end. A Mueller H-667 or approved equal shall be used.

4. Tapping Sleeves

Tapping sleeves shall be split sleeve with mechanical joint type end seals. They shall have the same working and test pressures as noted for the gate valves above. A Mueller H-615 or approved equal shall be used.

5. Check Valves

Check valves shall be designed for 175 psi working pressures and 350 psi test pressures for sizes up to twelve (12) inches. Check valves from fourteen (14) inches to twenty-four (24) inches shall have an opening suitable for cleaning without disconnecting from the pipe. They shall have a cast iron body with bronze mountings, discs, arms, and seat rings. Check valves shall conform to the most current revision of the ANSI/AWWA C-508-93 standard.

6. Detector Check Valves (Private Fire Protection Line)

Private fire line may be required to have a detector check valve installed on the line at a point as close to the main supply line as possible. A Mueller, Hersey or approved equal shall be used if deemed necessary by the Authority. This detector check valve shall be installed in a custom-designed vault.

7. Valve Boxes

Each valve on underground piping shall be provided with a screw-type adjustable cast iron valve box. They shall have a round shaft (5 1/4 inside diameter), a flared base, and a coat of bituminous paint applied to both surfaces. Also, the head shall be cast iron, round, and have the word "Water" cast on it.

Valve boxes shall be adjusted flush with the finish grade. If the street surfaces are renewed or replaced by the developer, owner or his representative after the water system has been approved and accepted by the Authority, but while such streets are still the obligation of the developer or owner, the valve boxes therein shall be readjusted to the proper finished grade at the developer's or owner's expense. If changes are made in grade at valve boxes by parties other than the developer, owner or his representative after initial construction approval, the cost of this adjustment shall be borne by the party responsible for the construction adjustments. In remote areas, valve boxes shall extend six (6) inches above finished grade and have a witness post securely placed next to the box. Valve boxes shall be Bingham & Taylor (genuine Buffalo style) figure number 4905 or approved equal. (See Part VII, Figure W-5, Page TD-18).

8. Corporation Stops

At the location indicated on the plans and where directed, corporation stops of sufficient size with quarter-bend couplings shall be furnished and installed on the top of the pipe in accordance with applicable standards and specifications. A Mueller H-15000 or Ford F600 stop or approved equal shall be used. (See Part VII, Figure W-6, Page TD-18). A Mueller H-15068 (1 1/2", 2"), H-15069 (3/4", 1"), or a Ford L02-77 (2"), L02-66 (1 1/2"), L02-44 (1"), L02-33 (3/4") quarter-bend coupling, or approved equal, shall be used.

9. Copper Meter Yokes & Coppersettors

All water meters sized up to, and including one (1) inch, shall be placed in a horizontal inlet and outlet copper meter yoke. The yoke shall have a multi-purpose connection on the customer side and a flared connection on the supply side. It shall also have a lock-winged stop on the supply side and a plain stop on the customer side. A Ford VV72 (5/8" x 3/4"), VV74 (1"), VV77-12B-11-77 (1 1/2", 2"), VBB-77-12B-11-77 (1 1/2", 2") or approved equal shall be used. (See Part VII, Figure W-6, Page TD-19). Coppersettors shall be installed a minimum of 12"-15" from the top of the meter box for meters 1" or less. Setters for meters greater than 1" and less than 3" shall be installed no less than 18" from the top of the meter vault. Meters 3" and larger shall be installed no less than 36" from the top of the meter vault.

10. Service Laterals

Copper pipe for lateral connections shall be soft type "k" copper with standard water works flare fittings.

11. Concrete Thrust Blocks

All fittings, plugs, tees, bends, and reducers shall be sufficiently anchored as indicated in Part VII, Figures W-3, W-3A, and W-3B, Pages TD-14, TD-15, and TD-16. Concrete shall have bearing on undisturbed earth with bearing area no less than detailed in Figures W-3, W-3A, W-3B, Pages TD-14, TD-15 & TD-16.

12. Marking Tape

A two (2) inch wide minimum size blue colored non-metallic water marking tape shall be buried at a distance of approximately one (1) foot below ground and directly over all water mains to alert water construction and maintenance crews that a water pipe is below. The marking tape shall be continuous. Marking tape disturbed during the course of construction on existing waterlines shall be restored to its original condition and to the satisfaction of the project inspector.

13. Conductive Wire

Conductive wire disturbed during the course of construction shall be restored to its original condition and to the satisfaction of the project inspector.

F. METER BOXES & METER VAULTS

1. Meter Boxes

Meter boxes shall be installed in non-paved areas. The box and lid shall conform to the finished grade after installation. Meter boxes of appropriate size shall be installed around all meter yokes or coppersettlers as indicated on the plans. Cast iron Bingham & Taylor (genuine Buffalo style) #6015-B, plastic Brooks 2200 Series, or approved equal can be used. Meter box locations shall be in non-paved areas except as approved by the Authority for the single application. A four (4) inch thick bedding of stone shall be provided at the base of all meter boxes for 5/8" and 1" meters. Meter boxes shall be located and installed so as to prevent water, dirt or debris from entering or covering them. If changes in grade at the meter box are made by the owner or customer after initial construction approval, the cost of box adjustment shall be borne by the party responsible for the grade change. Coppersettlers shall be placed in the meter boxes a minimum of 10"-15" from the top of the box.

All meter boxes shall have non-locking cast iron lids and will be used for water meters up to and including one (1) inch in size. (See Part VII, Figure W-7, Page TD-20). Lids shall be provided with a 1-3/4" hole tapped into the lid. Blind taps or plugs shall be provided to prevent debris from entering the box prior to use. The contractor must ensure a clear 1-3/4" opening where the hole is cast into the lid to accommodate a Touch Read sensor.

2. Meter Vaults

(a) General

No sweated fittings are allowed underground. Sweated fittings will be allowed inside 1-1/2" and larger meter vaults only. At no time shall mortar touch copper or galvanized pipe. The internal pipe may need bracing to support the valves and meter assembly. Any such bracing shall be approved by the Authority. Meter vaults shall be designed, located and installed so as to prevent water, dirt or debris from entering or covering them. If changes in grade at the meter vault are made by the owner or customer after initial construction approval, the cost of the vault adjustment shall be borne by the party responsible for the grade change.

(b) 1-1/2" and 2" Meters

Concrete or masonry floorless vaults shall be provided with 6" minimum stone bedding for 1-1/2" and 2" meters. The outside shall be waterproofed with a tar based paint, or approved equal. The minimum wall and top thickness for concrete vaults, either precast or cast in-place shall be 4". A 24"x36" aluminum access hatch shall be provided directly over the water meter. The hatch shall be provided with a 1.75" hole, properly plugged, for future installation of a touch read sensor. Vault dimensions and setter requirements shall conform to Figures W-7A, W-7B and W-7C in Part VII, Pages TD-21 through TD-23.

(c) Meters 3" and Larger.

A masonry or concrete structure shall be used for meters 3" or larger. The outside shall be waterproofed with a tar based paint, or approved equal. Sleeves will be

required around the water pipe entering and leaving the vault. The openings around the sleeves shall be sealed against water seepage. A positive drain extending to grade, or a sump pump shall be provided, whichever is more practical. A sump shall be located on the side of the vault with the floor sloping to it. The top shall be made of reinforced concrete or metal with a metal door insert. In any case, the access door must be waterproof, air-tight, 2' x 3' in size, located over the meter, and easy for one person to lift. The door shall be provided with a 1.75" hole, properly plugged, for future installation of a Touch-Read sensor. Doors shall have a lift handle and hinges. (See Part VII, Figures W-7A, W-7D, and W-7E, Pages TD-21, TD-24 & TD-25).

G. WATER SERVICE LATERALS

Laterals are to be installed for all lots or parcels of land within the development and shall extend from the main to the property line of the lot or parcel. Typically, such laterals are to be three-quarter (3/4) inch for a single service connection or one (1) inch for a double service connection, type "k" copper tubing, installed at a minimum depth of thirty-six (36) inches from the main line to a meter setting below finished grade. Water service laterals larger than 1", crossing under existing roadways, shall be installed in sleeves of appropriate size and material, as approved by the Authority. Meter boxes with meter yokes or coppersettors are to be installed at the end of each service lateral and are to be constructed in such a manner as to prevent conflict with proposed finished grading or other proposed construction such as driveways, drainage ditches, etc. All laterals must be well referenced for future location. (See Part VII, Figure W-6, Page TD-19).

H. BLOW-OFF ASSEMBLIES

Provisions shall be made for blow-offs by means of a regular blow-off assembly or hydrant assembly, as may be directed by the Authority. All pipe work for the hydrant blow-off assemblies shall conform in all respects to applicable portions of these specifications and to the plans. Blow-off assemblies shall not be connected directly to any storm drain or sanitary sewer systems. Blow-off assemblies shall be placed behind the curb, and shall be required at all dead-ends.

Dead-end blow-off assemblies (type A) shall be installed as shown and in accordance with the following specifications:

1. Blow-off lines shall be two (2) inch galvanized pipe.
2. Gate valves and boxes shall be of the type described in the applicable sections of these specifications.
3. If the grade allows, a two (2) inch drain pipe shall be properly installed in the meter box. (See Part VII, Figure W-8, Page TD-26).

In-line blow-off assemblies (Type B) shall be located at major low points in the system as determined by the Authority. (See Part VII, Figure W-8, Page TD-26).

I. AIR RELIEF VALVE ASSEMBLIES

Approved automatic air relief valves shall be installed at the high points in the system. Each assembly shall consist of a riser pipe, gate valve, fittings, and a precast concrete manhole cone section (including frame and cover with the word "WATER" cast on it), or approved equal. The riser shall be Type K copper pipe. Fittings shall be brass or bronze. Gate valves shall be of the type described in Section E-1. An APCO #143C(1") or #200A(1") air relief valve or approved equal shall be used on lines smaller than twelve (12) inches in diameter. An APCO #145C(2") or #200C(2") air relief valve or approved equal shall be used on lines equal to or larger than twelve (12) inches.

If the grade allows, a two (2) inch drain pipe shall be properly installed in the cone section of the manhole.

Air relief valve assemblies shall not be connected directly to any storm drain or sanitary sewer systems. (See Part VII, Figure W-9, Page TD-27).

J. FIRE HYDRANT SPECIFICATIONS

Hydrants shall be manufactured in accordance with the most current revision of ANSI/AWWA C-502-85 and shall be approved by the National Board of Fire Underwriters. Hydrants shall have six-inch (6") barrel with 5.25-inch clear opening through the valve and shall be provided with a 4.5-inch pumper connection and two (2) 2.5-inch I. D. hose connections.

Fire hydrants shall be installed in such a manner as to provide the proper fire protection as approved by the County's fire prevention officer to all structures and no hydrant shall be more than 800 feet from any other hydrant measured along the centerline of the public right-of-way, private road, or other applicable access route. Generally, fire hydrants shall be placed no closer than 40 feet nor further away than 400 feet from all major structures.

Hydrants shall be of the frost-proof and non-flooding type which will not flood in case the barrel or valve stem is damaged, with orifices for draining the hydrant when the valve is closed. A safety flange shall be provided so that the barrel will not break if struck by a vehicle or other object, and the hydrant can be repaired without digging. Hydrants shall have a three foot, six inch (3'6") minimum bury and be designed for 150 psi working pressure and 300 psi hydrostatic pressure. All working parts shall be bronze to bronze. All hydrants shall open counterclockwise and be preceded in the line by a gate valve. The pumper connection shall face the roadway. Fire hydrants shall have a moisture proof chamber around operating threads filled with oil or grease which shall lubricate the threads.

Hydrants shall be set plumb with the invert of the pumper connection eighteen (18) inches above grade. Unless the hydrant location is specifically indicated otherwise, it shall be located so that the center is not less than two (2) nor more than ten (10) feet from the back of the curb of the adjacent street, with the pumper connection facing the street, unless otherwise directed by the fire official. The connecting pipe will have the same depth of cover as the distribution mains. The base and back of the hydrant, opposite the pipe connection, shall be firmly blocked against the vertical face of the trench with cast-in-place concrete to prevent the

hydrant from blowing off the line. If the character of the soil is such that in the opinion of the Authority the hydrant cannot be securely blocked, bridle rods and rod collars and/or a pipe type bracing shall be used. Bridle rods and rod collars shall not be less than three-quarter (3/4) inch stock and shall be protected by a coat of bituminous paint. Not less than seven (7) cubic feet of broken stone shall be placed around the base of the hydrant to ensure drainage. The backfill around hydrants shall be thoroughly compacted to grade line. Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the hydrant or valve shall be inspected in open and closed positions, to see that all parts are in working condition. (See Part VII, Figure W-4, Page TD-17). Bags shall be tied securely over all fire hydrants as soon as they are installed. These bags shall not be removed until approved by the Authority. Each new fire hydrant shall be freshly painted with Glid Guard #4520 safety red by Glidden or approved equal. All pumper caps shall be painted with Alert Series 1440 Silver-White as manufactured by Cataphote, Inc. of Jackson, Mississippi 39208 or approved equal.

The threads on the 4.5-inch pumper (steamer) connection and on the operating nut shall be National Standard threads. The threads on the hose connections shall be Albemarle County Service Authority standard thread (Charlottesville thread), 3 21/64" female, 3 9/32" male, eight threads per inch (Gauge 8-322) except for the Scottsville service area which are National Standard threads. All threads shall be thoroughly lubricated with graphite. All of the male connections shall have caps and chains. The cap nuts and the operating nut shall be 1 1/2" Pentagon and shall open counterclockwise.

All hydrants shall be Mueller Centurion (A-423), Kennedy Guardian (K-81A) or approved equal.

K. ACCEPTABLE TESTS

All testing will be performed in accordance with the ANSI/AWWA C600-93 or current revision. The contractor shall provide the Authority with 48 hours notice prior to undertaking any tests.

Note: Reinspection fees are charged for retesting when initial tests fail. Contact the Authority for current rate schedules.

1. Pressure Test

After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 200 psi.

Test Pressure Restrictions. Test pressures shall:

- (a) not exceed pipe or thrust restraint design pressure;
- (b) be of at least 2-hour duration;
- (c) not vary by more than +5 psi;

(d) not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants;

(e) not exceed the rated pressure of the valve.

Pressurization. Each valved section of pipe shall be filled with water slowly and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Authority. The water and container used to pump up the line to be tested shall be properly disinfected.

Air Removal. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants.

Examination. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the Authority.

2. Leakage Test

A leakage test shall be conducted concurrently with the pressure test.

1. Leakage defined. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

2. Allowable leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:



in which L is the allowable leakage, in gallons per hour; S is length of pipe 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 gauge.

3. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal./hr./in. of nominal valve size shall be allowed.

4. When hydrants are in the test section, the test shall be made against the closed hydrant valve.

5. Acceptance of installation. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than the allowable amount, the contractor shall, at his own expense, locate and repair the

defective material until the leakage is within the specified allowance.

6. All visible leaks are to be repaired regardless of the amount of leakage.

L. DISINFECTION

1. Precautions shall be taken to protect pipe interior, fittings and valves against contamination. When pipelaying is not in progress, all openings in the pipeline shall be closed with watertight plugs. If water accumulates in the trench, plugs shall remain in place until the trench is dry. All pipe and fittings shall be kept free of dirt or any foreign material likely to cause contamination.

2. Mains shall be disinfected by the continuous feed method or the tablet method in accordance with AWWA C-651-92 or current revision, except as specified otherwise or approved in writing by the Authority.

(a). Continuous Feed Method

Potable water shall be introduced into the pipe line at a constant flow rate protected by an approved backflow prevention device. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/l. The chlorinated water shall remain in the pipe line at least 24 hours, after which, the chlorine concentration in the water shall be at least 10 mg/l.

(b). Tablet Method

Tablets of calcium hypochlorite, containing 70 percent available chlorine by weight, shall be affixed to the top of each section of pipe and in appurtenances by a food grade adhesive such as Permatex Form-a-Gasket #2, Permatex Clear RTV silicone adhesive sealant, or approved equal. Tablets shall not be completely covered by adhesive. After completion of the construction the main shall be filled with water at a velocity of less than one (1) foot per second in accordance with the following schedule:

Schedule of Maximum Flow Rates

Diameter	Flow Rate	Diameter	Flow Rate
4"	40 GPM	14"	500 GPM
6"	90 GPM	16"	600 GPM
8"	160 GPM	18"	800 GPM
10"	260 GPM	20"	1000 GPM
12"	350 GPM	24"	1400 GPM

A minimum concentration of 50 mg/l of chlorine solution shall be in the system at this time. A concentration of 25 mg/l residual chlorine must be present after 24 hours.

Number of Hypochlorite Tablets of 5-G Required for Dose of 50 mg/l (based on three and three-quarters grams of 70% available chlorine per tablet):

Joint Length (ft)	Diameter of Pipe (in)					
	2"	4"	6"	8"	10"	12"
13	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	1	2	3	5	1
30	1	2	3	5	1	10
40	1	2	4	6	9	14

Grams of HTH Powder Required for Dose of 50 mg/l (based on 65% available chlorine in HTH powder):

Joint Length	Diameter of Pipe (in)					
	2"	4"	6"	8"	10"	12"
13	0.6	2.5	5.56	9.88	15.45	22.24
18	0.85	2.5	7.69	13.69	21.39	30.8
20	0.95	3.8	8.56	15.21	23.76	34.22
30	1.43	5.7	12.83	22.81	35.65	51.33
4	1.9	7.6	17.11	30.42	47.53	68.44

Grams of HTH Powder Required for Dose of 50 mg/l (based on 65% available chlorine

The cost of all such testing will be the responsibility of the Contractor. All valves and appurtenances shall be operated while chlorinated water is in the pipe

line. After the retention period, the main shall be flushed of the high chlorine water until the water leaving the system shows a chlorine concentration of less than 1 mg/l or no higher than that prevailing in the water used for flushing. After final flushing, two (2) water samples shall be collected 24 hours apart for bacteriological tests. The samples shall be collected at regular intervals not to exceed 2,000 feet throughout the length of the pipe. All bacteriological samples collected following disinfection shall be analyzed by a lab certified by the Virginia Department of General Services, Consolidated Laboratory Services. The results of these samples must indicate the absence of coliform contamination.

Disinfection shall include hydrants and other special pipe, taps and fittings used at connections to existing piping. These shall be thoroughly disinfected before installation. Excavation for such connections shall be kept free from water until the connection is completed and great care shall be exercised to prevent contamination of the pipe and connection fittings. The inside of the existing pipe within three (3) feet of point of connection shall be disinfected by spraying with a solution containing not less than 200 mg/l of chlorine immediately before connection is made. On completion of disinfection the piping shall be flushed thoroughly, and samples shall be taken and tested by a recognized testing laboratory. The water shall be proven safe for human consumption before acceptance of disinfection. Should the samples show the water is unsafe, the piping shall be disinfected until satisfactory tests are obtained.

Note: It is the contractor's and developer's responsibility to ensure their operations do not contaminate the public water supply. If at any time the water in the existing system becomes contaminated, they shall be held financially accountable for any corrective action taken by the Authority, as well as for cost of defending and settlement of all claims resulting from his negligence, including, but not limited to, costs and attorney's fees.

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