02660 - WATER DISTRIBUTION

(Revised 06/10/20)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1- General
Part 2 – Products
Part 3 – Execution
Air & Vacuum Valve-Spec
Butterfly Valve-Spec
Check Valve-Spec

DIP-Installation
DIP Fittings
DIP Joints
Ductile Iron Pipe - Spec
Fire Hydrant Painting
Fire Hydrants-Setting
Fire Hydrant-Spec
Gate Valves-Spec
Meter Boxes, Small-Spec
Meter Selection Table
1 ½" & 2" Service-Spec
Parallel Pipe-Clearances
Pipe Crossing Clearances
Pipe Separation Req'ts
Pressure Test & Leakage
Small Serv. Connection - Spec
Steel Encas't Pipe-Install
Steel Encasement Pipe-Spec
Sterilization
Tunneling Method
Tunnel Liner - Spec
Tapping Sleeve & Valve-Spec
Vault Access Frames-Spec
Valve Boxes-Spec

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 01000 – GENERAL REQUIREMENTS.

C. Section 02220 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

1.2 SUMMARY

This section includes water distribution piping and specialties for municipal water and fire-service mains and services.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to water distribution systems that come under the authority of the City of Lynchburg, Virginia as specified within this section and other sections of this manual.

A. **Water Main**: Exterior water systems for both domestic water and fire suppression needs.

B. **Water Service**: Exterior water piping used to provide water for domestic purposes.

C. **Fire Service**: Exterior fire fighting/suppression water piping.

1.4 SUBMITTALS

A. Submit product data for the following:

1) Pipe and Fittings
2) Valves and accessories
3) Water meters and accessories
4) Backflow prevention assemblies
5) Fire Hydrants
6) Fire Department Connections
7) Tunneling Shop Drawings, liner plates.

B. Submit shop drawings for the following in accordance with Section 01000 – G*eneral Requirements*: Precast Concrete Vaults, including frames and covers, drains, access hatches, wall sleeves, valve support stands.

C. Upon request, valve manufacturers shall furnish certified copies of test reports.

1.5 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards, including but not limited to Virginia Department of Health regulations.

B. In accordance with the Federal Safe Drinking Water Act, all products in contact with potable drinking water shall have a maximum lead content of 0.25% for all wetted surfaces.

C. Piping materials shall be marked clearly and legibly.

1) Ductile Iron Pipe shall show identification marks on or near bell as follows:

a. Weight,
b. Class or nominal thickness,
c. The letters “DI” or “Ductile,”
d. Manufacturer’s identifying mark,
e. Year in which pipe was made,
f. Casting period.

2) Each length of steel pipe and each special section shall be legibly marked by paint stenciling, die stamping or hot-roll marking to show the following:

a. Manufacturer’s name or mark,
b. Size and weight of the pipe or special section,
c. The type of steel from which the pipe or special section was made.

1.6 STANDARD ABBREVIATIONS

AASHTO American Association of State Highway Transportation Officials

ANSI American National Standards Institute

AREA	American Railway Engineers Association
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
DEQ	Department of Environmental Quality
FM	Factory Mutual System
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NSF	National Sanitation Federation International
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories, Inc.
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Pipe Conditions/Pipe Examination**

1) **New Pipe Inspection**: Inspect materials thoroughly upon arrival. Examine materials for damage. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications. Reject any pipe that will not provide watertight seal or is otherwise structurally deficient.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipe damaged or deemed not to conform to these specifications shall be rejected and removed from site. All pipe in which the spigots and bells cannot be made to fit properly will be rejected. The faces of all spigots ends and of all shoulders on the bells must be true.

B. Observe manufacturer's directions for delivery and storage of materials and accessories.

C. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

D. Prevent damage to pipe during transit. Protect stored piping from entry of water or dirt into pipe. Also, protect bells and flanges of special fittings from entry of moisture and dirt.

E. Support pipe to prevent sagging or bending.

F. Use slings to handle valves and fire hydrants if size requires handling by crane or other type of lift. Do not use handwheels or stems to lift or for rigging points.

G. Store fire hydrants and valves in such a way as to prevent entry of water and dirt into openings. Support off the ground or pavement. If fire hydrants or valves are provided with end protectors, do not remove until ready for installation or for inspection. Once inspected, replace protectors. Protect valves against damage to threaded ends or flanges.

1.8 PROJECT CONDITIONS

1.8.1 SEPARATION OF WATER AND SANITARY AND/OR COMBINED SEWERS

Follow the VDH and DEQ standards for separation of water mains and sanitary sewers lines.

A. **Parallel Installations**

1) **Normal Conditions** – Water lines shall be constructed at least 10 feet horizontally from a sewer or sewer manhole. The distance shall be measured edge-to-edge.

2) **Unusual Conditions** – When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sanitary sewer manhole provided that:

a. The bottom (invert) of the water line is at least 18 inches above the top (crown) of the sewer.

b. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved Ductile Iron Pipe pressure-tested in place without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

B. **Crossing**

1) **Normal Conditions** – water lines crossing over sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.

2) **Unusual Conditions** – when local conditions prevent a vertical separation described in *Crossing, Normal Conditions*, paragraph above, the following construction shall be used:

a. Sewers passing over or under water lines shall be constructed of the materials described in paragraph A *Parallel Installation, Unusual Conditions* – subparagraph 2) b, above.

b. Water lines passing under sewers shall, in addition, be protected by providing:

i. A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line.

ii. Adequate structural support for the sewers to prevent excessive deflection of the joints and the settling on and breaking of the water line.

iii. That the length of the water line be centered at the point of the crossing so that joints shall be equal distant and as far as possible from the sewer.

C. **Sanitary and/or Combined Sewers or Sewer Manholes** – no water mains/pipes shall pass through or come in contact with any part of a sewer or sewer manhole.

1.9 COORDINATION

A. The City of Lynchburg will be the sole operator of all valves and hydrants on the City water system.

B. Contact Department of Water Resources to coordinate interruption of services and/or operation of valves. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of the Water Resources (Utilities) Engineer, temporary service may be required to be provided. Provide a minimum of 48 hours notice of the proposed utility interruption or necessary operation of valves.

C. Coordinate tie-in to municipal water mains with the City of Lynchburg Water Resources (Utilities) Engineer.

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 DUCTILE IRON PIPE

A. **Ductile Iron Pipe**

Ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA C151/ ANSI A21.51 for 4-inch and larger diameter pipe, Class 50, minimum (See Design Section). The thickness of Ductile Iron Pipe shall be determined by considering trench load and internal pressure *(the pressure zone and variances in which the pipe will be used)* separately in accordance with AWWA C150/ANSI A21.50. Pipe shall be of the class indicated on the drawings.

The ductile iron pipe shall be cement mortar lined with a seal coat in accordance with AWWA C104/ANSI 21.4. Outside coat shall be a minimum of 1-mil bituminous paint according to AWWA C151/ANSI A21.51 Section 51-8.1.

Ductile Iron Pipe shall be as manufactured by the American Cast Iron Pipe Company, United States Pipe and Foundry Company, or McWane Cast Iron Pipe Company.

B. **Ductile Iron Joints**

Pipe joints may be either mechanical joint or push-on pipe sizes 3 inches through 48 inches. Acceptable types of pipe joints are as follows:

1) **Push-on Joint, Ductile Iron Pipe** shall conform to AWWA C151/ANSI A21.51 (such as "Fastite" or "Tyton"). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be vulcanized natural or vulcanized synthetic rubber, and comply with AWWA C111/ANSI A21.11.

2) **Mechanical Joint, Ductile Iron Pipe** shall be used only at the specific locations indicated on the drawings or as approved by the City Engineer.

a. The mechanical joint shall consist of:

i. A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;

ii. A pipe or fitting spigot;

iii. A sealing gasket;

iv. Separate ductile iron follower gland having cored or drilled bolt holes; and

v. Ductile iron tee head bolts and hexagon nuts.

b. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421, AWWA C111/ANSI A21.11, and ASTM A 536 Standard Specification of Ductile Iron Castings.

3) **Restrained Joints**: Acceptable types of restrained joints shall be:

a. MEGALUG joint restraint system, using MEGALUG series 1100 mechanical joint restraint by EBBA Iron Sales, Inc. See **Standard Detail 26.04** sheet 2 of 2 for figure of MEGALUG or approved equal.

b. TR Flex as manufactured by U. S. Pipe and Foundry Company, Flex Ring as manufactured by American Ductile Iron Pipe Company, or approved equal.

4) **Flanged Joints** shall be firmly bolted with machine bolts; however, where valves or specialties are attached to a flange pipe, stud or tap bolts may be used, providing the number used and diameter for each joint is the same for

each respective size of pipe, specialty, or valve, as recommended by the latest AWWA Standard for flanged drilling. All bolts and nuts shall be grade 9 and of sufficient length to pass through two flanges. Gaskets are to be of red rubber (fiber reinforced).

C. **Ductile Iron Fittings**

Fittings shall be ductile iron and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI 21.53 for compact fittings, pipe sizes 3 inches through 48 inches. All ductile iron fittings shall have a minimum working pressure rating of 350 psi and shall be cement mortar lined and bituminous coated in accordance with AWWA C104/ANSI A 21.4. The fittings shall be tested and the manufacturer shall provide certified test result when requested by the City. This testing shall include hydrostatic proof testing of fittings. Glands, gaskets, and bolts shall conform to AWWA C111/ANSI A 21.11. The use of push-on fittings is not permitted. When restrained joints are specified, they shall be Megalug series 1100 mechanical joint restraint by EBAA Iron Sales, Inc. or approved equal. See **Standard Detail 26.04**, sheet 2 of 2 for figure of Megalug.

2.1.2 COPPER PIPE

Copper pipe shall be Type K Soft Copper Tube, meeting ASTM B88 *Standard Specification for Seamless Copper Water Tube*. Copper pipe shall be used on sizes 3/4 inch through 2-inch.

2.1.3 STEEL CASING PIPE

Steel pipe for encasement and boring applications shall meet the requirements of AWWA C200, *AWWA Standard for mill type steel water pipe*. Nominal pipe diameter and wall thickness shall be as indicated on the drawings. Pipe shall be high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A139, *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)* and ASTM A283/A283M, *Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates,* Grade “B” steel with a minimum yield strength of 35,000 psi.

Encasement pipe shall meet applicable VDOT and AREA specifications. Casing pipe shall include pipe carriers (spiders) to support carrier pipe.

The spiders necessary to support the carrier pipe inside of the steel encasement pipe shall conform to both the shape and dimensions of **Standard Detail 26.24**. Refer to **Standard Detail 26.24** for spider spacing. Spiders shall be of heavy-duty galvanized steel.

2.1.4 TUNNEL LINERS AND APPURTENANCES

A. Grout mix for filling voids in between carrier pipe and tunnel shall consist of the following materials properly mixed in proportions by weight.

1) 1.0 Part Cement,

2) 3.0 Parts Fine Sand, 100 Percent Shall Pass No. 16 Sieve, and

3) 0.5 to 0.6 Part Water.

B. Tunnel lining construction shall comply with the *"Specification for Steel Tunnel Liner Plates"* in the AREA Manual for Railway Engineering. The design and shape of the liner plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel. Plates shall be accurately curved to suit the tunnel cross section, and all dimensions shall be of the size and accuracy that plates of similar curvature shall be interchangeable. All plates shall be connected by bolts on both longitudinal and circumferential joints.

C. The steel lining shall consist of plates 16, 18, or 24 inches wide. Each circumferential ring shall be composed of the number and length plates necessary to complete the required shape shown on the drawings. The nominal tunnel diameter shall be of sufficient size to install the carrier pipe.

D. Plates shall be one-piece steel meeting the requirements of ASTM A 569, ASTM A 570, and ASTM A 611. Plates shall have an ultimate tensile strength of at least 42,000 psi and yield strength of 28,000 psi. Gage thickness shall be a minimum of 8 gage. The liner plate and bolts shall be galvanized in accordance with ASTM A153. The liner plates shall be asphalt coated to meet AREA 1-14-13. For two flange plates, the minimum thickness shall be 0.135 inches. Plates shall be manufactured by Armco Steel Corporation, Commercial Shearing, Incorporated, Republic Steel Corporation, or approved equal.

E. Grout holes 1½ inches or 2 inches (or larger) in diameter shall be provided in each ring to permit grouting as the erection of the tunnel liner plates progresses. Grout hole screw plugs shall be provided in plates.

F. Steel bolts shall meet requirements of ASTM A449 for plate thickness equal to or greater than 0.209 inch and ASTM A 307 for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A 307, Grade A.

2.1.5 CARRIER PIPE FOR CASINGS AND TUNNELS

Carrier pipe shall be restrained joint ductile iron pipe of the class indicated on the drawings.

2.2 VALVES AND FIRE HYDRANTS

2.2.1 GATE VALVES, RESILIENT WEDGE (4 INCHES AND LARGER)

All gate valves shall be of the resilient wedge type complying with AWWA C509 and shall be UL listed and FM approved for a working pressure of 200 psi. All internal parts shall be accessible without removing the body from the line. The

wedge shall be of cast iron completely encapsulated with resilient material. The resilient sealing material shall be permanently bonded to the cast iron wedge with a rubber tearing bond to meet ASTM D429 *Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates* and AWWA C550.

Non-Rising Stems (NRS) stems shall be cast bronze with integral collars in compliance with AWWA. Outside Screw and Yoke (OS&Y) stems shall be bronze. The NRS stuffing box shall have two "O"-Ring seals above the thrust collar. These rings shall be field replaceable without removing the valve from service.

Each valve shall be hydrostatically tested at 400 PSI to the requirements of both AWWA and UL/FM.

All gate valves shall be of the mechanical joint type.

Valves shall open counter-clockwise (left) and shall be equipped with a 2-inch square AWWA operating nut.

A. Gate valves 16 inches and larger, installed horizontally in a horizontal line, shall be fitted with tracks, scrapers, and rollers to carry the weight of the disc and provide ease of operation. Provide bevel geared operators, gear cases and 2-inch square AWWA operating nut.

B. Bypass valves shall be provided on all gate valves 16 inches and larger.

C. Geared operation shall be provided for gate valves rated for 250 psi or more and for all gate valves 18 inches in size or larger.

D. Gate Valve sizes 4 inches through 18 inches shall be as manufactured by American Flow Control, Clow, Mueller, or Kennedy.

E. Approved Gate Valves are listed below:

Model	Manufacturer
2500 NRS	American Flow Control
Resilient Wedge Valve	Clow
A-2360-20	Mueller
Kenseal II	Kennedy

2.2.2 AIR AND VACUUM RELEASE VALVE

Air and vacuum release valve shall be Crispin, Val-Matic, Cla-Val, or approved equal Pressure Air and Vacuum Valves, with cast iron bodies, stainless steel floats, bronze trim and buna-n seats. Size and location shall be indicated on drawings. Valves shall be rated for working and corresponding test pressure as indicated on the drawings. These valves shall be suitable for a minimum 200 psi working pressure but shall be no less than the working pressure indicated on the drawings. The valves are to be designed to allow air to escape automatically while the main is in service and under pressure. The valves are to relieve large volumes of air as the lines are filled or emptied and also release small quantities of entrained air under pressure.

2.2.3 CHECK VALVES

All swing check valves shall be iron body; bronze mounted with either mechanical joint or flanged ends as noted on the drawings. Standard mechanical joint ends shall be furnished with bolts, glands, and rubber gaskets. Flanged ends shall be provided with bolts and gaskets.

Check valves shall be gravity operation unless otherwise noted on the drawings. Valves 2 ½ inches to 12 inches shall be designed for a 175-psi working pressure and shall have a minimum test pressure of 350 psi. Valves 14 inches to 24 inches shall be designed for a working pressure of 150 psi and a test pressure of 300 psi.

Flanged check valves shall meet the dimensional requirement of ANSI B16.1 and meet or exceed the requirements of AWWA C-508. The valve shall be tight seating and furnished with an easily replaceable resilient seat.

When more positive control is needed, either lever-and-spring or lever-and-weight may be specified.

All check valves shall be furnished with an arrow cast into the body indicating the direction of flow during system operation.

Approved check valves are the Mueller A-2600 Series or the Kennedy Swing Check Valve.

2.2.4 BUTTERFLY VALVES

Butterfly valves, for valve applications 20 inches and larger, shall meet AWWA C504, *AWWA Standard for rubber-seated butterfly valves*. Valves shall be rated for the pressure class or classes indicated on the drawings.

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

Valve operators shall meet the requirements of AWWA C504 and shall be of the traveling-nut type, sealed, gasketed, and lubricated for direct-bury underground service. Valve operators shall be sized for the pressure indicated on the drawings. 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.

Butterfly valve manufacturers shall be Mueller Company, American Flow Control, or approved equal.

Valves shall open counter-clockwise (left) and shall be equipped with a 2-inch square AWWA operating nut.

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

2.2.5 TAPPING SLEEVES AND VALVES

The tapping sleeve and valve shall be suitable for wet installation without interruption of water service.

A. **Tapping Sleeves**: The sleeve shall be all stainless steel construction and have a full circumference gasket for a watertight seal. The sleeve shall have a minimum working pressure of 250 psig. The sleeve shall be equipped with a test plug to allow for pressure testing of the seal prior to tapping. Tapping sleeves shall meet the requirements of AWWA C223 and be manufactured by Romac Industries, Smith-Blair, or Ford Meter Box Co.

B. **Tapping Valves**: Tapping valves shall meet the requirements of Gate Valves as specified above in Part 2- PRODUCTS, Gate Valves, paragraph 2.2.1 except that the seat openings shall be larger than nominal size and valve ends shall be mechanical joint.

Tapping valves shall be "O" ring type with mechanical joint and conforming to AWWA non-rising stem construction. Inlet flange end shall be Class 125 (ANSI B16.1).

Approved tapping valves are listed below:

Model	Manufacturer
2500 NRS	American Flow Control
F-5093	Clow
T-2360	Mueller
Kenseal II	Kennedy

2.2.6 FIRE HYDRANTS

See **Standard Detail 26.09**. Fire hydrants shall comply with AWWA C502, latest revision, UL 246 and FM1510. Approved fire hydrants including model and manufacturer are listed below:

		Pressure Zone	
Model	**Manufacturer**	**Std**	**High Press**
B-84-B	American Flow Control	X	X
Medallion	Clow	X	X
Super Centurion	Mueller	X	X
Guardian	Kennedy	X	X
Series 2780	AVK	X	X

Interior coating to be in accordance with AWWA C550. Minimum working pressure shall be 150 psi except use 250 working pressure in high-pressure zones. Nozzles shall have National Standard threads. Hydrants shall consist of the following:

A. Two 2½ -inch fire nozzles and one 4½ -inch pumper connection.

B. All nozzles shall be provided with caps with the cap retaining chains removed.

C. The hydrant valve opening shall be 5¼ inches.

D. Bronze to bronze threads shall be provided between the hydrant seat or seat ring and the seating attaching assembly.

E. All hydrants must include cast or ductile epoxy lined shoe, rubber drain seals and positive protective valve stop device.

F. Hydrants shall open left and shall have a 6-inch mechanical joint elbow.

G. The hydrant barrel shall be of sufficient length to provide a minimum bury of 3 feet.

H. Hydrants shall be of the compression type closing with line pressure and shall be of the traffic model breakaway type.

I. Hydrant cap and stuffing box shall be of unitized, one-piece design creating a watertight cavity without the use of gaskets. The combination of O-Rings to a crimped brass ferrule around the stem shall seal the cavity from contact with water. Hydrant caps shall have a means for providing periodic lubrication of the operating threads.

J. The operating nut shall be of one-piece bronze construction. A thrust washer shall be supplied between the operating nut and stem lock nut.

K. The main valve shall be of synthetic rubber reinforced with steel. The seat shall be of a bronze ring threaded to a bronze insert in the hydrant shoe, with O-Rings to seal the drain way and barrel from leakage of water in the shoe.

L. The hydrant drain hole shall momentarily force flush with each operation.

M. Hydrant body, bonnet, and nozzle caps shall be painted Reflective Silver, Davis Paint 68 Nu-Brite Aluminum except in lines where the working pressure exceeds 100 psi in which case the 2½-inch nozzle caps shall be painted Black Gloss, Davis Paint 54 Black.

N. If line is to be pressurized within 7 days, then 3000 psi high early strength concrete shall be used.

2.2.7 BLOW OFFS

See **Standard Detail 26.10**. Blow off assembly shall consist of a Ford A32-LL Lid with DFW plastic meter box (see **Standard Detail 26.15**). Blow-off hydrants shall be non-freezing, self-draining type with a depth of bury of 36 inches and lockable to prevent unauthorized use. Kupferle Foundry Company Mainguard #78 or approved equal.

2.2.8 CORPORATION STOPS, ANGLE VALVES, AND CURB STOPS

Corporation stops, angle valves, and curb stops shall be ball-type as manufactured by Ford, Mueller, or A. Y. McDonald.

2.3 MISCELLANEOUS APPURTENANCES

2.3.1 FLEXIBLE COUPLINGS

Flexible couplings shall be of a gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two steel followers, two rubber compounded wedge section gaskets and sufficient galvanized track head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping on which installed. Couplings shall be Smith-Blair Type 441, Ford FC-1 (2" through 12"), Ford FC-2A (14" through 24"), or Romac 501.

2.3.2 MISCELLANEOUS CONCRETE

Concrete Classes (VDOT) to Design Compressive Strength at 28 days (f'c):

Class A4.5	General	4,500-psi
Class A4	General	4,000-psi
Class A3	General	3,000-psi
Class B2	Massive or Lightly Reinforced	2,200-psi

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* All exposed concrete shall be air entrained. Concrete strength shall be as specified on standard details and drawings. Unless otherwise specified, all concrete shall be Class A3, minimum.

2.3.3 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specifications for Portland Cement*.

2.3.4 BEDDING: See Section 02220, *Trenching, Backfilling, and Compaction of Utilities*.

2.3.5 PRECAST CONCRETE STRUCTURES

Structures of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, latest revision ("O" ring joints), or AASHTO M-199 (gasketed joints). The standard joint shall be sealed with non-shrink waterproof grout meeting VDOT *Road and Bridge Specifications* Section 218. A rubber gasket or "mastic" joint seal may be used. The rubber gasket joint shall conform to the requirements of ASTM C443 *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.* Type Concrete used in the construction of the manholes shall have a minimum 28-day strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Structures shall not have steps.

2.3.6 MANHOLE FRAME AND COVERS

Standard Frames and Covers: Manhole frames and covers shall be manufactured from Class 30 gray iron, meeting the requirements of ASTM A48*, Standard Specification for Gray Iron Castings*. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on **Standard Detail 26.23** and shall have a minimum of 4 1-inch diameter holes in the flange of the frame. Minimum inside diameter of the opening shall be 24 inches. Manholes castings may be either bituminous coated or plain. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the words "Water." Approved castings are the US Foundry 710 ring and DP cover, East Jordan Iron Works 2027 frame and cover, Capitol Foundry, or approved equal.

2.3.7 PIPE SADDLE SUPPORT – ADJUSTABLE

Pipe saddle supports shall equal or exceed the *Standon* Model S92, as manufactured by Material Resources, Inc., or approved equal.

2.3.8 SERVICES

A. **Small Services: 3/4-inch and 1-inch Water Services**

Type K Copper; comply with ASTM B-88, *Standard Specification for Seamless Copper Water Tube*, FS WW-T-799 (2-inch and smaller pipe). Fittings to meet AWWA C800. See **Standard Details 26.12 A & B**.

A service saddle shall be used. Service saddles shall be painted ductile iron body with double steel U-bolts and a virgin NBR rubber gasket attached to the body. The saddle shall be Romac 202, Ford 202B, or approved equal. See **Standard Detail 26.14**.

See table below for specific approved manufacturers and models for small service line components.

Table 26.1			
Item	**A. Y McDonald**	**Ford Meter Box**	**Mueller**
3/4-inch through 2-inch Ball Style Corporation Stop	74701B	FB1000	B-25000
Ball Style Angle Valve – 3/4-inch and 1-inch	74642BY	BA94	B-24264/ B-24273
*Yoke Ell	74779Y	L94	H-14202/ H-1466-A
** Dual Check Valve	7112-3YT-33	HHA94-323	-
Expansion Wheel ¾-inch	14-2E	EC23	H-14234
Expansion Wheel 1-inch	-	EC4	-
Pack Joint Coupling 3/4-inch thru 2-inch	74758-22	C44/84	H-15403
Yoke Bar 3/4-inch	14-2	Y502	H-5020

*** For existing residential connection replacement only**
**** For new residential construction only**

B. **1 ½-inch and 2-inch Services**

Water service pipe for 1½-inch and 2-inch connections shall be type "K" soft copper. On these water services, the fittings shall be either flared or compression copper type brass fittings. The service saddle shall be painted ductile iron body with double steel U-bolts and a virgin NBR rubber gasket attached to the body. The saddle shall be Romac 202, Ford 202B, or approved equal (see **Standard Detail 26.14**).

Meter Setters shall be constructed from 85-5-5-5 Brass (AWWA C800) and copper tubing, and factory tested for water-tightness before shipping. Setter to include ball valves, brace pipe eyelets for 1 inch pipe, and bypass valve with padlock wings.

The Setter assembly shall conform to **Standard Detail 26.13**. Approved Manufacturers are A.Y. McDonald MFG Co. and Mueller. Other Manufacturers may be submitted for approval by the Department of Water Resources.

- AY McDonald 2" setter number 20R715WWFF 775
- AY McDonald 1.5 setter number 20R615WWFF 665

- *Mueller 2" setter number H-1423-99000
- *Mueller 1.5 setter number H-1423-99000
- *Mueller numbers are the same, specify meter size.

C. **Meters**

If contractor is required by City to provide meter, the following is a list of approved meters:

Table 26.3 Meter Selection Table				
Meter Manufacturer	**Size** inches	**Register-HRE LCD**		**Connection Type**
Displacement Meters AWWA C700				
Badger	5/8	M25		Twist
Badger	1	M70		Twist
Badger	1 ½	M120		Twist
Badger	2	M170		Twist
Turbo Meters AWWA C701 & C702				
Badger	1 ½	T160		Twist
Badger	2	T200		Twist
Badger	4	T1000		Twist
Badger	5	T2000		Twist
Badger	6	T3500		Twist
Sensus OMNI T2	1 ½ -6	Electronic Register 10 cubic feet		Splice
Compound Meters (domestic, non-fire service) **AWWA C701 & C702**				
Badger	2	Low Side M25/High Side MT1000		Twist
Badger	4	Low Side M70/High Side MT1000		Twist
Badger	6	Low Side M70/High Side MT1000		Twist
Sensus OMNI C2,	2- 6	Electronic Register 10 Cubic Feet		Splice
Combination Fire Meter Assembly AWWA C703 Type II & III Standard (single water line used for both fire & domestic service to a complex)				
Sensus OMNI F2	4 - 10	Electronic Register 10 cubic feet		Splice

All meter assemblies shall include a strainer, meter, check valve and by-pass meter. All meters shall have an Orion Cellular Transmitter Endpoint.

All meters shall read in cubic feet.

The City's Department of Water Resources will program the devices as needed.

Large Services

For services greater than 2 inches, the water service pipe shall be ductile iron pipe. Ductile iron fittings shall be used on these services. All taps will be made by using the appropriate size tapping sleeve and valve. On a dry line, the connection may be made with a tee and valve.

2.3.9 TIE-RODS

Tie rods shall be ASTM A307 Steel, zinc coated and of size and number as shown on **Standard Detail 26.03**. No duck lugs shall be allowed.

2.3.10 VALVE BOXES

Adjustable valve boxes shall be US made gray cast iron of the dimensions shown in **Standard Detail 26.16**. Lids shall have the word "water" cast into the lid. Provide cast-iron telescoping top section of length required for depth of burial of valve and bottom section with base of size to fit over valve. Valve boxes shall equal or exceed that as manufactured by U.S. Foundry, Capitol Foundry, or East Jordon Iron works.

2.3.11 WATER METER BOXES - NON-TRAFFIC BEARING

Plastic water meter boxes, with ½" walls, shall be as manufactured by DFW, Saginaw, TX as follows (See also **Standard Details 26.12, 26.13, & 26.15**).

Meter Box Size (by DFW)	Cover
18-inch dia. x 24-inch (MB-5)	Capital Foundry or Ford w/ 2-inch hole and plug provided
24-inch dia x 30-inch	EXT-1
30-inch dia x 30-inch	EXT-3

2.3.12 VAULT ACCESS HATCH

A. **Non-Traffic Areas**

The aluminum access frames and covers are manufactured with 1/4-inch thick, one-piece aluminum extruded frame, with a continuous concrete anchor as part of the one-piece extrusion. The door panels are 1/4-inch thick aluminum diamond plates, to withstand a live load of 150 lbs. per square foot, with a safety factor of 3.0. The doors are provided with stainless steel hinges with tamper-proof fasteners. All hardware is stainless steel. The doors open to 90 degrees and lock automatically in that position with a stainless steel positive locking arm and a stainless steel release handle. Doors are provided with a stainless steel lifting handle, stainless steel locking bar, or stainless steel snap-lock with removable key handle. Two key handles shall be provided with each door. The doors will close flush with the top of the frame, resting on a 1/2-inch wide lip around the entire inside of the frame for added support.

B. **Traffic Areas (Low Density Traffic H-20 Loading – 12,000 lb. wheel load on an 8 1/2-inch x 20 1/2-inch wheel area)**

The aluminum access frames and covers are provided with a 1/4-inch thick structural grade aluminum channel frame with the flanges acting as a continuous concrete anchor. The inside of the frame has a continuous door support angle that must be cast into the top slab of the vault. Door leaves shall be a minimum of 1/4-inch thick aluminum diamond plate with structural grade aluminum. Door reinforcing shall withstand an H-20 live load designation. The doors also have lifting aids of aluminum tubular construction with compression springs to assist in opening and closing of the doors. The doors are provided with heavy-duty stainless steel hinges with tamper-proof fasteners. All hardware is to be stainless steel. The doors open to 90 degrees and lock automatically in that position with a stainless steel positive locking arm and a stainless steel release handle. Doors are provided with a stainless steel lifting handle, stainless steel snap-lock with removable key handle. Two key handles shall be provided with each door. The door leaves extend to the outside perimeter of the frame for added support.

C. **Guarantee and Manufacturer**

The aluminum access frames and covers shall carry a 10-year guarantee against defects in materials and workmanship. The frame and cover shall equal or exceed the units manufactured by Halliday Products, Inc., The Bilco Company, or an approved equal.

2.3.13 VALVE BOX PRECAST SHOULDER SLABS

Precast shoulder slabs are to be constructed of a minimum of 3000 psi concrete reinforced with two annular #3 bars. See **Standard Detail 26.18** for the prescribed dimensions. Shoulder slabs shall be manufactured by Masonry Supply, Inc., Selma, NC, or approved equal.

PART 3 – EXECUTION

3.1 PIPE & FITTINGS

3.1.1 DUCTILE IRON PIPE

Water mains and fittings shall be installed with approved tools in accordance with the requirements of AWWA Standard Specification C-600, *Installation of Ductile Iron Water Mains and Their Appurtenances*, which is made a part of this specification by reference.

Construct piping to accurate lines and grades avoiding localized high points and support as required on drawings or described in specifications.

No more than 500 feet of trench is to be open at any time.

Due care shall be taken in the storing and handling of pipes, fittings and valves to avoid contamination with the ground and prevent foreign matter from entering pipe and fittings.

Pipe, fittings, and valves shall be carefully handled and lowered into the trench. Under no circumstances shall any pipe or fitting be dumped or rolled into the trench, or be allowed to drop against the pipe or fitting already in the trench. Great care shall be taken to prevent the pipe lining and coating from being damaged, and the Contractor shall not install any damaged pipe. The contractor shall be responsible for removal and disposal of damaged pipe.

The Contractor shall be required at the end of the day's work to keep the end of the line, under construction, plugged to prevent foreign matter from entering pipe and fittings.

Special care shall be taken to insure that the pipe is well bedded on a solid foundation, and any defects due to settlement shall be made good by the Contractor at his own expense. Bell holes shall be dug sufficiently large to insure the making of proper joints. Special precautions shall be exercised to prevent any pipe from resting on rock. A minimum of 6 inches is required between rock and the bottom of pipe.

Whenever a pipe requires cutting, to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe or liner. When the cut end is to be assembled in a bell, an adequately smooth (without sharp edges) bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. The methods of cutting pipe shall be in accordance with Manufacturer's recommendations. No welding, flame cutting or flame tapping will be allowed. Such cuts shall be made by the Contractor without extra compensation.

Mains shall be installed to the depth as indicated on the plans, but in no case with a cover of less than 36 inches below finished grade for mains 8 inches and smaller and 48 inches below finished grade for mains 10 inches and larger, as shown on **Standard Detail 26.01**. In the event site conditions prevent adherence to minimum cover requirements, approval of an alternate cover depth by City Engineer is required.

Maximum horizontal deflections for ductile iron pipe shall meet AWWA C600, latest revision.

A. **Installing Mechanical Joint Pipe**

1) Clean socket and plain end thoroughly, removing mud, oil, gravel, or any other foreign matter. Gaskets shall be lubricated. Paint the bell and the spigot with soap solution (half cup granulated soap dissolved in 1 gallon of water). Slip ductile iron gland on spigot end with the lip extension of the gland toward the end of the pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

2) 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 tight all nuts to torque listed below (excerpted from Table 2 of AWWA C600-99):

Bolt Size (Inches)	Torque (Ft. – Lbs)
5/8	45-60
¾	75-90
1	100-120
1 ¼	120-150

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

3) Restrained joint pipe shall be installed per Manufacturer's recommendations.

B. **Installing Push-On Pipe**

Clean the socket and 8 inches of the outside of the plain end thoroughly, removing mud, gravel, or any other matter that might cause the front of the gasket to protrude into the path of the entering spigot. Gaskets shall be lubricated. Flex rubber gasket and apply lubricant supplied with the pipe to the plain end and to the inside surface of the gasket before assembly. Insert gasket fully in the gasket recess of the socket, large end of the gasket entering first.

For assurance of proper gasket positioning, a thin automotive, blade-type feeler gauge can be used for quick and easy probing to confirm a properly installed gasket position around the joint. Start the spigot end of the pipe in to the socket with care. The circumferential stripe on the plain end provides a visual indication for checking the proper insertion of the joint. Homing of the joint shall be done with a forked tool or jack-type device.

Restrained joint pipe shall be installed per Manufacturer's recommendations.

3.2 CONNECTIONS TO EXISTING MAINS

The Contractor shall furnish all materials for connection to existing water mains where shown on the plans or as directed by the City Engineer.

In making connections to the existing distribution system, valves shall be set as shown on the plans or at such locations as directed by the City Engineer.

Request for operations of valves shall be made to the Department of Water Resources 48 hours in advance of operation of valve needs. Before shutting off any main, residents are to be notified by a City representative in writing at least 24 hours in advance of cut off.

The Department of Water Resources shall be the sole operator of all valves and fire hydrants.

If the connection to the existing mains requires a wet tap, such tap shall be done by a firm experienced and equipped to do this type of work. All materials and labor shall be provided by the contractor to include, but not necessary limited to the sleeve, valve, tapping machine, accessories, installation, and testing of such materials to complete the

work. The Water Resources (Utilities) Engineer shall have the right to accept or reject the firm or crew performing the work.

All connections to existing mains shall follow the Department of Water Resources, Standard Operating Procedure for Utility Line Maintenance, SOP-ULM-02-B, 'Preventing Contamination of Water Supply During Water Main Construction and Repair Made by Contractors'.

Work shall be scheduled at least 5 working days in advance and a crewman from the Department of Water Resources shall be present during the operation.

3.3 REMOVAL OF ASBESTOS CEMENT PIPE

The contractor is hereby advised that some of the pipe that is scheduled for removal or for connection to may contain asbestos. Modifications for connections to, removal, and disposal of asbestos cement pipe shall be performed in accordance with applicable EPA and OSHA regulations and applicable Federal, State and local regulations.

3.4 ABANDONMENT OF AN EXISTING WATER LINE

When an existing water line is replaced with a new water line, abandonment of the existing line is required once it is no longer in service. The line shall be abandoned at its source/main by cutting and removing a one-foot segment of the line. When abandoning mains 4-inch and less in diameter, the line shall be cut at the corporation stop on the main or as close to the main as possible and a one-foot segment of the line removed. In either situation, if a water control device is not located at the source, plugging of the branch at the source will be required. Location of abandonment shall be approved by the City's representative. All water control devices to be abandoned shall be closed and valve boxes removed to 6 inches below the surface.

3.5 STEEL ENCASEMENT PIPE

A. Where required, steel encasement pipe shall meet the length as shown on the plans and the thickness and diameter as shown on **Standard Detail 26.24**. The contractor shall submit to the City Engineer a complete plan and schedule for pipe installation prior to the commencement of such work. The submission shall include complete details of the sheeting, shoring and bracing for the protection of the roadbed and the materials and equipment pertinent to the boring operation. The contractor shall not proceed with the pipe installation until he has received approval of the plan and schedule from the City Engineer.

   Construction shall be executed in such a manner as to prevent settlement of the ground surface above the pipeline. The installation of the pipeline shall follow the heading or tunneling excavation as closely as possible.

   Installation shall be in accordance with Section 302.03 of the VDOT *Road and Bridge Specifications* or AREA, as applicable.

   The pipe shall be beveled and prepared for field welding at the circumferential joints. Joining of steel casing pipe shall meet the requirements of AWWA C206, *Standards for Field Welding Steel Water Pipe Joints*. Casing shall be installed by jacking, boring, or open cuts as indicated on the drawings.

   Encasement ends shall be enclosed as shown on **Standard Detail 26.24**.

B. **Manufactured Spiders**: Refer to **Standard Detail 26.24** for spider spacing.

3.6 TUNNELING METHOD

A. **General**

The contractor shall submit shop drawings to the City Engineer for approval prior to construction. All liner plates and ribs used in the tunnel shall be of one type. All material removed shall be disposed of off the site by the Contractor at his expense.

B. **Tunneling (Boring Method)**

1) Commence boring operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary. A steel pipe shall be jacked in place as a casing pipe.

2) After installation of the casing pipe, pull the carrier pipe in place a joint at a time. Each section of carrier pipe shall be supported by steel spiders strapped to the carrier pipe.

3) Close up tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain or daylight shall be provided.

C. **Tunneling (Hand Mining)**

1) Commence tunneling operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary.

2) Install the steel liner plates immediately after the excavated material has been removed, and remove the material not more than 24 inches ahead of the installed liner plates.

3) Grout all voids between the soil and tunnel liner plates. The maximum grouting pressure shall be 30 PSI. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grouted section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout shall not exceed 7 hours, without the approval of the City Engineer. Upon completion of grouting, fill grout plugs with provided grout hole plugs.

4) Smoothly pave the bottom of the tunnel with concrete: After installation of the tunnel liner plates, the contractor shall pour concrete pavement on the bottom quadrant (invert) of the tunnel, the surface of the pavement being

parallel to the inner plate, with screed rails embedded in it, on line and grade for the installation of pipe in the tunnel.

5) The periphery of the tunnel shall be trimmed smooth to fit the outside of the steel liner plate as nearly as is practical, so that the void outside the plates is a minimum.

6) After installation of the tunnel liner, pull the carrier pipe in place a joint at a time. Each joint of the carrier pipe shall be supported by steel spiders strapped to the carrier pipe.

7) Close up tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain or daylight shall be provided.

3.7 VALVES AND FIRE HYDRANTS

3.7.1 GATE VALVES

A. **Setting of Valves**: Valves shall be installed with stems in a vertical plane through the pipe axis and perpendicular to the pipe axis. The contractor shall clean the valves before installation and check for satisfactory operation. All valves adjacent to tees or bends shall be tied to the fitting with approved tie rods (see **Standard Detail 26.03** for number and diameter of tie rods required). Valve nut extensions shall not be installed unless approved by the City Engineer.

B. Valves without gearing or operators shall be installed with a 2-piece valve box with lid (see **Standard Detail 26.16**). Valve boxes shall be set in alignment with the valve stem centered on the valve nut. Boxes shall be set in a manner to prevent transmitting shock or stress to the valve with stone around pipe and under valve box. Valve box cover must be set flush with the finished ground surface or pavement. The contractor shall be responsible for keeping valve boxes clean and free of any foreign matter until acceptance of the project.

C. All valve boxes located outside the pavement shall be set to grade and a precast reinforced concrete shoulder slab shall be installed. See **Standard Detail 26.18**.

D. All valve box covers shall be painted with 2 coats of blue paint.

3.7.2 BUTTERFLY VALVES

Valves with gearing or operators shall be installed in a manhole. The manhole shall be constructed/set in such a way as to prevent transmitting any load or shock to the valve. It is also to be set in such a way that the packing, operator, and other parts of valve are readily accessible for minor repairs. Manholes shall be constructed in accordance with the **Standard Detail 26.07**.

3.7.3 TAPPING SLEEVES AND VALVES

A tapping sleeve and valve shall be installed in accordance with the manufacturer's recommendations or as directed by the City Engineer at locations as shown on plans. After installation of the tapping sleeve and valve and prior to

performing the tap, the assembly shall be hydrostatically tested at a pressure equal to the test pressure of the new line installed. Such pressure shall be maintained with no loss for a minimum time of 15 minutes.

3.7.4 AIR AND VACUUM RELEASE VALVES

Combination air and vacuum release valves shall be located as shown on the drawings. The valve shall be housed in a precast eccentric manhole and shall be installed in accordance with **Standard Details 26.11**. Air release valve locations shall be as shown on the plans and as otherwise directed by the City Engineer.

Galvanized steel fittings will not be accepted.

3.7.5 FIRE HYDRANTS

A. Fire hydrant locations shall be as shown on the plans or as otherwise directed by the City Engineer. Hydrants shall be set upon VDOT #57 stone in such manner as to preclude the possibility of settlement of hydrants. Place ½ cubic yard loose VDOT #57 stone around the hydrant elbow and wrap in non-woven filter fabric. See **Standard Detail 26.09**.

Hydrants are to be located at a distance from the curb or edge of pavement to provide ready access and minimize the possibility of damage from vehicles and set to the height prescribed by **Standard Detail 26.09** with the pumper nozzle facing or pointing to the street or fire access lane. Hydrants must be set with the stem vertical/plumb and the flange above grade. Traffic model fire hydrants are to be installed such that the breakaway flange is not less than 2 inches or more than 6 inches above finished grade. The Contractor is responsible for determining barrel length and ordering to meet conditions. Where adjustments in height are needed, extension kits shall be provided and installed. Extensions shall be no more than 1 foot per hydrant. Where hydrants are set behind guardrails, the pumper nozzle shall be set with its centerline a minimum of 12 inches above the top of the guardrail.

B. Install fire hydrant pad around all hydrants as shown on **Standard Detail 26.09**.

C. **Operation and Painting**: Hydrants, upon installation and prior to acceptance of the project, shall be painted and greased, and individually operated in the presence of the City Construction Coordinator to verify the hydrant is wet.

D. Place a black plastic bag or an *"Out of Service"* ring around steamer nozzle of newly installed fire hydrant until hydrant is placed in service and accepted by the City.

E. Install hydrant valve as close to the main as possible.

F. End of Line Hydrants are to be restrained by mechanical joints. Where hydrant branches are of considerable length, the City Engineer may require the rods to be attached to the valve and the valve to a thrust block behind the first full joint of pipe on the hydrant branch beyond the hydrant leg valve. If rodded, the hydrants are to be rodded to the valve and the valve to the main with approved ¾ inch diameter threaded rods as per **Standard Detail 26.08** Provide a minimum of two ¾ inch diameter rods for lines with static pressures up to 100 psi. For lines with

greater than 100-psi static pressure, use four ¾ inch diameter rods. Any rods, which have been cut, are to be coated liberally with hot asphalt or other acceptable rust inhibitor to protect steel from corrosion. If mechanical joint restraints are utilized, the system shall be designed as specified on the **Standard Detail 26.08.**

G. The Contractor shall paint the hydrant body, bonnet and nozzle caps the color specified in this section.

3.8 MISCELLANEOUS APPURTENANCES

3.8.1 SERVICES

A. Water service pipe for 3/4 through 2-inch connections shall be one continuous run from main to meter with no joints or couplings in between. No soldering allowed.

B. Copper service connections shall be installed so that the outlet is at an angle of 45 degrees above the horizontal. A bend or "gooseneck" in the service line shall be provided to insure flexibility. Service Saddles shall be used on all service connections. Service saddles and corporation stops are to be embedded in 1 cubic foot of VDOT #57 stone. Clean VDOT #57 stone shall be carried under and around the pipe to protect the corporation stop and saddle.

C. All services shall be pressure tested in conjunction with main.

D. All service taps on the main greater than that allowed by pipe manufacturer for a direct tap shall have a saddle type corporation. All 2-inch taps on 6-inch or 8-inch mains shall require installation of a saddle. Corporation stop for direct taps may be used on ductile iron pipe and shall have AWWA Standard tapered threads. See **Standard Detail 26.12**.

E. Meter boxes shall be set on 6 inches of clean VDOT #57 stone. Meter boxes shall be installed on the right-of-way side at the property line. Meter shall be centered in the meter box and angle valve shall be operational with above ground key. See **Standard Detail 26.12**.

F. The contractor shall set 2-inch and larger meters. Meters smaller than 2 inches will be provided by the City.

G. Meter box lids shall be cleaned with wire brush and painted with two coats of flat black paint.

H. If replacing an existing meter box, the contractor shall transfer the old service into the back of the new service, complete in place to include removal and disposal of the old meter box and assembly. If meter box does not require tying into existing service, pigtail shall be crimped.

I. Water services shall be abandoned by closing the corporation stop at the main and cutting out a section of the water service, 1 foot from the corporation stop.

J. All meters 3 inches and larger shall be installed in a vault provided by the developer as per **Standard Details 26.19** through **26.21**. Transmitter housings shall be mounted in the aluminum vault hatch flush with the exterior surface.

3.8.2 CONCRETE ANCHOR BLOCKS

Concrete anchor blocks shall be constructed in accordance with **Standard Detail 26.02**. Concrete anchors may be unformed but minimum dimensions must be maintained. All fittings and pipe shall be wrapped in plastic prior to installation of concrete. Concrete anchors shall bear against undisturbed earth.

3.8.3 VAULT CONSTRUCTION

Vault Construction shall be in accordance with **Standard Details 26.19** and **26.20**.

3.9 TESTING AND DISINFECTION

3.9.1 PREREQUISITE CONDITIONS FOR TESTING AND DISINFECTION

Prerequisite conditions for testing and disinfection shall be as follows.

All pipe has been laid and the trench backfilled.

Hydrants shall be properly located, operable and plumb and at correct elevation.

Valves shall be properly located, operable and at correct elevation. Valve boxes or manholes shall be centered over operating nuts and the top of the box or manhole shall be at proper elevation.

All services shall be installed.

All reaction anchors have had sufficient set of 7 days or high early strength concrete, 3000 psi or greater, may be used to reduce the number of days required.

Lines shall be properly vented where entrapped air is a consideration.

All visible leaks, broken or cracked pipe, valves, hydrants, etc. shall be repaired.

Air release valves shall be installed complete and in place.

All construction activities on the project, that requires trenching or excavation within the limits of the water location shall be completed.

3.9.2 ORDER OF OPERATIONS

A. After all prerequisites are met, fill the system with water at a velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. After filling, shut off system in order to prevent chlorinated water from flowing back in the line supplying the water.

B. Allow filled system to set undisturbed for a minimum of 24 hours, then begin flushing operations. Contractor shall utilize an RPZ device on the flushing

hydrant/blowoff. Flushing shall be a velocity of not less than 3.0 feet per second. The contractor shall be responsible for making adequate provisions for drainage of flushing water, at his expense. Any damages that may occur from this operation shall be the sole responsibility of the contractor. In conjunction with start of flushing operation, the City's Construction Coordinator will perform a high range chlorine concentration test. Chlorine concentration of 50 mg/l minimum must be provided. See paragraph 3.9.4, *Disinfection and Bacteriological Testing*.

C. After allowing the system to flush until the chlorine concentration is less than 1 mg/l or no higher than that generally prevailing in the source system, the first bacteria sample shall be collected at regular intervals not exceeding 1,200 feet and tested for bacteriological quality. See paragraph 3.9.4, *Disinfection and Bacteriological Testing*.

D. Provided that the bacteria sample has passed, a pressure test shall be scheduled with the City's Construction Coordinator performing the test 48 hours in advance. Testing shall be in accordance with paragraph 3.9.3, *Pressure Test*.

E. Following successfully passing the pressure test, subject the system to a final flushing until the chlorine concentration is less than 1 mg/l or no higher than that generally prevailing in the source system. Thereafter, a second bacteria sample shall be collected at regular intervals not exceeding 1,200 feet and at least 16 hours following the first bacteriological sample and tested for bacteriological quality.

F. Discontinue flushing and isolate lines being tested. If the second bacteria sample has passed, the system shall be placed in service.

G. After final flushing, flow all hydrants to confirm the valves are open.

3.9.3 PRESSURE TESTS & LEAKAGE

The contractor shall test completed sections of water line, including service lines, fire hydrants, and fittings with water. This testing, however, does 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. Testing shall be performed in the presence of the City Engineer or Representative.

A. **Pressure Test**: Subject the pipe system to a hydrostatic pressure test. Raise the pressure by pump to 150 psi, or 150% of static pressure, or test pressure as shown on the drawings, whichever is greater. Measure pressure at the low point on the system compensating for gauge elevation. Maintain this pressure (+ or – 5psi) for 2 hours. If pressure cannot be maintained using reasonable pumping rate, determine cause, repair, and repeat the test until successful. Contactor shall be responsible for all labor, materials, and equipment to perform the testing. Cost shall be included in other items bid.

B. **Leakage Test**: During the pressure test, subject the system to a leakage test. Leakage shall be defined as the quantity of water that must be supplied into the pipe to maintain the test pressure, after all air in the pipeline has been expelled and the pipe has been tested for a duration of 2 hours. Leakage shall not

exceed the quantity determined by table 6A (excerpted from AWWA C600-93), attached.

No leakage will be allowed for all welded steel pipe. If leaks are revealed by test, repair by rewelding. Peening of leaks will not be allowed. A certified welder must perform all welding.

If leakage exceeds allowances, the contractor shall be responsible for locating, repairing leaks, and retesting of line until successful, at the contractors expense.

AWWA C600 TABLE 6A
ALLOWABLE PRESSURE TEST LEAKAGE
(Allowable Leakage per 1000 ft. of Pipeline * in gph)

AVG. TEST PRESSURE PSI	NOMINAL PIPE DIAMETER-IN.																
	2	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450	0.29	0.43	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30	5.16	6.02	6.88	7.74
400	0.27	0.41	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05	4.86	5.68	6.49	7.30
350	0.25	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07	6.83
300	0.23	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32
275	0.22	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05
250	0.21	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77
225	0.20	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47
200	0.19	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16
175	0.18	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29	4.83
150	0.17	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97	4.47
125	0.15	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63	4.08
100	0.14	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24	3.65

*** For pipe with 18 ft. nominal lengths. To obtain the recommended allowable leakage for pipe with 20 ft. nominal lengths, multiply the leakage calculated from the table by 0.9. If the pipeline under test contains sections of various diameter, the allowable leakage will be the sum of the computed leakage for each size.**

**** This table is excerpted from AWWA C-600, Section 5.2 Table 6A**

3.9.4 DISINFECTION AND BACTERIOLOGICAL TESTING

Pipe Disinfection and Bacteriologic Testing: comply with AWWA C-651, *Disinfecting Water Mains*. The contractor shall disinfect water mains and accessories in accordance with the procedures listed below and meet the requirements of authorities having jurisdiction. Bacteriological testing shall comply with Section 5 of AWWA C651. All samples shall be tested for bacteriological (chemical and physical) quality in accordance the *Standard Methods for the Examination of Water and Wastewater*; and shall show the absence of coliform organisms and the presence of chlorine residual.

A. **Forms of Chlorine**

1) Calcium hypochlorite – Two forms are available – granular and tablets (both with 65% available chlorine). It will normally require 6.5 lbs. of Calcium Hypochlorite to produce a concentration of 50mg/L of available chlorine in 10,000 gallons of water.

2) Sodium hypochlorite – is supplied in strengths of 5.25% to 16% available chlorine. The required amount of sodium hypochlorite to produce a 50mg/L concentration of available chlorine in 10,000 gallons of water can be calculated from the following formula:

Gallons of Sodium Hypochlorite needed = 50 ÷ % of available chlorine

B. **Methods of Chlorine Application**

1) **Application for Tablet Method** – This method shall be the primary method of applying chlorine to a water distribution system unless nonpotable water or foreign materials have entered the mains or if the water temperature is below 5° C (41° F).

The tablets shall be placed in each section and in all appurtenances. Enough tablets shall be used to insure that a chlorine concentration of 50 mg/L is provided in the water. They shall be attached by an adhesive to the top of the pipe sections and crushed or rubbed in all appurtenances. The adhesive shall be approved for use in a potable water system. When filling, the velocity of the potable water in the main shall be less than 1 ft./sec. The water shall then remain in contact with the pipe for 24 hours. All valves and appurtenances shall be operated while the chlorinated water remains in the main.

2) **Application for Continuous Feed and Slug Method**

Taps will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. These taps shall be located in such a manner as to allow Chlorine solution to be fed into all parts of the line.

The Chlorine solution shall be circulated in the main opening of the control valve while systematically manipulating hydrants and taps at the line extremities. The Chlorine solution must be pumped in at a constant rate for each discharge rate in order that a uniform concentration will be produced in the lines.

a. **Continuous Feed Method** – Potable water shall be introduced into the pipe main at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is a least 50mg/L. The chlorinated water shall remain in the main at least 24 hours, after which, the chlorine concentration in the water shall be at least 10mg/L. All valves and appurtenances shall be operated while the chlorinated water remains in the main.

b. **Slug Method** – Potable water shall be introduced into the main at a constant flow rate. This water shall receive a chlorine dosage, which will result in a chlorine concentration of 100 mg/L in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the main are exposed to the 100mg/L chlorine solution for at least 3 hours. The chlorine residual shall be checked at regular intervals determined by the City Construction Coordinator but not exceeding 1,200 feet to insure that adequate residual is maintained. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfecting of these appurtenances.

C. **Bacteriologic Tests**: Before the water main is placed in service, all samples shall be collected at regular intervals not exceeding 1,200 feet and tested for bacteriologic quality and shall show the absence of both background growth (gram positives) and coliform organisms. The City will collect at least two samples; 1 taken prior to pressure testing and the second following the testing process, at least 16 hours apart. The samples shall be tested by the Department of Water Resources.

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. Results cannot be read until 24 hours after sample has been run by lab. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory. If laboratory results indicate background growth masking the detection of coliform bacteria, the sample will be considered unsatisfactory. The disinfecting shall be repeated until the samples are satisfactory. In the event that 2 successive bacteriological tests fail, the section of the main shall be re-chlorinated by the contractor and new tests performed prior to moving to the next section of main. The tablet method cannot be used in repeated disinfecting. Cleaning and disinfecting will be the responsibility of the contractor. The City will furnish water and operate all necessary valves for these operations. The contractor shall be responsible for loading, hauling and discharging of water.

Samples for bacteriological analysis shall be collected for each section of pipe between main line valves after flushing is completed.

Samples that are delivered to the College Hill Filter Plant, 525 Taylor Street, for testing shall be delivered no later than 2 PM Monday through Thursday. A chain of custody shall accompany the samples and both delivered to the plant.

Sampling will be allowed at hydrants if available to flush and sample the entire section of newly laid pipe. Otherwise, the contractor shall install a flushing and sampling tap consisting of a corportaion stop installed in the pipe with a temporary copper gooseneck assembly. Such additional work required for this shall be at the contractor's expense.

D. Pipe subjected to contaminating materials shall be treated as directed by the City Engineer. Should such treatment fail to cleanse the pipe, replacement shall be required. The City of Lynchburg shall bear no portion of any cost sustained by the contractor in meeting this specification.

E. Services shall be included in the main line disinfection process. The contractor shall have the same responsibility for laterals as for the mains in regard to bearing full cost of any corrective measures needed to comply with either the bacteriological test or other such requirements.

3.10 DECHLORINATION

Discharge of highly chlorinated water will require proper disposal and/or dechlorination at the discretion of the City Engineer. Discharge of highly chlorinated water into available sanitary sewer lines is preferred. If sanitary sewer lines are not available, dechlorination of the highly chlorinated water will be required. All water discharge must meet all applicable Federal, State, and local codes, regulations and guidelines.

END OF SECTION 02660

Back to Top