SECTION 801

WATER DISTRIBUTION SYSTEMS

I. GENERAL

1.1 DESCRIPTION OF WORK

The Contractor shall furnish all labor, supervision, material (except as herein provided), tools, equipment, supplies, and services; and, shall perform all Work necessary for the construction of water distribution systems less than or equal to 36-inch in diameter. All pipe greater than 16-inch diameter shall be ductile iron, unless modified by Special Provisions. The water distribution systems shall be constructed in accordance with the Contract Documents and the applicable laws, rules, ordinances, standards, and regulatory agencies.

1.2 SUBMITTALS

Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 and as described below:

A. Submit each manufacturer's and/or supplier's certification attesting that the pipe, pipe fittings, joints, joint gaskets, valves, and appurtenances meet or exceed the specified requirement. The following information is to be shown on each certificate:

1. Name and location of the work
2. Name and address of Contractor
3. Quantity and date or dates of shipment and/or delivery to which the certificate applies
4. Name of the manufacturing or fabricating company

B. Certification shall be in the form of a letter or company-standard form containing all required data and signed by an officer of the manufacturing, fabricating, or supplying company.

If requested by the Owner, all laboratory test reports shall be provided at no additional cost and shall show the following information:

1. Date or dates of testing. Test data should be the most current available and be within 5 years of the Bid Opening.
2. The specified requirements for which testing was performed
3. Results of the test or tests

C. Manufacturer's catalog cuts, technical data, operation and maintenance data, and/or Shop Drawings are required for the following water distribution system components (Shop Drawings shall be drawn to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work):

1. Pipe
2. Valves
3. Valve Boxes
4. Fittings, Sleeves, and Couplings
5. Hydrants
6. Pipe Restraints

7. Tapping Sleeves
8. Corporation Stops
9. Meter Boxes and Meter Setters, when required.
10. Meter and Valve Vaults
11. Gauges
12. Tracer Wire and Marking Tape

D. Flushing, testing and disinfection procedures

In those cases where the installation or procedure proposed is not detailed in the Contract Documents or in the Special Provisions or a significant modification is required; the Contractor shall submit procedures and equipment to be used for the pressure testing (including methods of temporary joint restraint), leakage testing, and disinfection testing. The Contractor shall submit his proposed methods for disposing of chlorinated water following disinfection of the main.

E. Reduction of Lead in Drinking Water Act

In compliance with Public Law 111-380, the Contractor shall not use, install or repair any pipe, fittings, fixture, solder or flux in the installation of any public water system that is not "lead free". Solders and flux shall not contain more than 0.2% lead; and pipes, fittings, and components shall not contain more than 0.25% lead based on a weighted average of the wetted surfaces. Fire hydrants, service saddles, and gate valves that are 2-inches in diameter and greater, are exempt. Products must comply with NSF/ANSI Standard 61 to include Annex G and shall bear the NSF 61-G Certification Mark.

F. Pipelines greater than 16-inch diameter

In addition to the above submittal requirements, pipe diameters in excess of 16-inches shall provide the following information:

1. Laying schedule

   a. Submit a tabulated laying schedule for approval which references stations and invert elevations as shown in the Contract Documents as well as all fittings, valves, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications providing complete details of all items;
   b. Show pipe class, class coding, station limits and transition stations for various pipe classes;
   c. The location of all pipes shall conform to the locations indicated in the Contract Documents;
   d. Each pipe supplied shall be identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe will appear on the marking drawings in the identified location for installation;
   e. Special fittings, bends, and appurtenances requiring specific orientation will be supplied appropriately marked with the words "TOP" in the correct position and in a consistent location;

2. Submit shop drawings for approval before manufacture and shipment including, but not be limited to:

a. The grade of material, size, wall thickness of the pipe and fittings and appurtenances;
b. The type of fittings and valves;
c. The type and limits of the lining, lining reinforcing and coating systems of the pipe and fittings.
d. Joint details, methods and locations of supports, and complete information concerning type, size and location of all welds. Shop welds (no field welding will be allowed) will be clearly differentiated and welds will be clearly detailed with preparation procedures for all pipe and parent material comprising each weld. Critical welding procedures will be identified along with methods for controlling welding stresses and distortions. Locations and proposed joint details will also be clearly identified; and,
e. All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings and related items.

3. Submit anticipated production and delivery schedule.

4. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.

5. Prior to shipment of pipe, submit:

a. Certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, including hydrostatic tests.
b. A certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

G. Work Plan for Tie-ins to Existing Systems

At a minimum the Contractor's Work Plan shall include the following:

1. Schedule:

a. Starting date.
b. Sequential listing of specific tasks required to complete the tie-in.
c. Anticipated duration for each task of the tie-in operation.

2. Testing procedures.

3. Identification of businesses and residences that may be impacted and will require notification.

4. Method of dewatering the existing water main and quantity of water anticipated in dewatering.

5. Method of handling constant flow if valves or line stops do not close completely. The Owner cannot guarantee that full stoppage of flow will be achieved.

6. Contingency plan for meeting a deadline for full traffic to be restored if a roadway is taken out of service or the capacity reduced during the tie-in and the completion schedule cannot be met.

7. Mobile phone contacts for Contractor and Owner personnel, and other identified key stakeholders, as appropriate.

8. List of equipment and number of crews to verify adequacy of Contractor's ability to work both ends of the tie-in simultaneously and continuously until connections are complete.

9. Stone and other backfill materials to be on-site if rain is forecast and used if a heavy rain event occurs during the tie-in backfill and compaction stage.

10. Confirmation of availability and scheduling of asphalt placement and proper cure time for tie-ins under existing pavement to restore traffic movement. Asphalt patch type to meet locality requirements.

II. EXECUTION

2.1. GENERAL

A. The Contractor shall furnish and install a complete piping system as shown in the Contract Documents and in accordance with the Contract Documents

B. The Owner reserves the right to reject defective material shipped to and/or stored on site, and to examine the same to determine if damage has occurred prior to installation.

C. The Contractor shall unload, handle, and store pipe and appurtenances in accordance with Section 200.

D. Proper implements, tools and facilities satisfactory to the Owner and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient execution of the Work. All pipe, valves, fittings, hydrants and accessories shall be carefully lowered into the trench in such a manner as to prevent damage to the water main materials and any protective coatings and linings.

2.2. PIPE INSTALLATION

A. Cleaning: All lumps, blisters and excess coatings shall be removed from the bell and plain ends of each pipe. The outside of the plain end and the inside of the bell shall be cleaned and dried, and shall be free from dirt, sand, grit, or any foreign materials before the pipe is installed.

B. Trenching, bedding, backfilling and compaction shall be in accordance with Section 303.2.2 and Special Provisions.

C. Pipe Laying:

1. Pipe shall be laid to a true, uniform line and grade. High points, other than those indicated in the Contract Documents where an air vent assembly is to be placed, shall be avoided.

2. Pipe laying shall be in accordance with the manufacturer's recommendations. Pipe laying shall proceed, bells ahead. Each section of pipe shall be laid to form a close concentric joint with the adjoining section and to prevent sudden offsets in the flow line. Each section of pipe, as it is laid, shall be backfilled as specified in the Contract Documents, at least up to the centerline, before the next joint is made.

3. As the Work progresses, the interior of the pipe shall be cleared of dirt and superfluous material.

4. Trenches and other excavations shall be kept free of water until backfilled. Concrete or masonry Work shall not be constructed in water, nor shall water be allowed to rise over the Work until concrete or mortar has had ample time to set.

5. When Work is not in progress, open ends of pipe and fittings shall be closed, to the satisfaction of the Owner, so that trench water, earth, and other substances will not enter the pipe or fittings.

6. Whenever a pipe requires cutting for the insertion of valves, fittings, closure pieces, or to bring it to the required location, the Work shall be performed in a satisfactory manner so as to leave a beveled end in accordance with the manufacturer's instructions or recommendations. Cuts shall be made at 90° with the centerline of the pipe so that a framing square placed against the side of the pipe will reveal not more than 1/4-inch variation across the diameter of the pipe in any direction. The pipe shall be cut with an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw or other equipment specifically designed for that purpose. The Contractor shall grind smooth cut ends and rough edges and for push-on connections, the cut ends should be beveled slightly. Pipe damaged by the Contractor in cutting shall be replaced at the Contractor’s expense

7. Laying of the pipe shall commence immediately after the excavation is started, and every means must be used to keep pipe laying closely behind the trenching. No more than 100 feet of trench may be open ahead of the pipe laying operation, unless otherwise specified. Holes shall be scooped out where the bells occur leaving the entire barrel of the pipe bearing on the pipe bed.

8. Pipe joint assembly practices and joint assembly materials such as lubricants, primers and adhesives shall be in accordance with the manufacturer’s recommendations and specifications, and in accordance with ANSI/AWWA C111.

9. Pipe shall not be laid on frozen bedding.

D. Alignment and Grade:

1. The Contractor shall not deviate from the line and grade indicated in the Contract Documents, except with approval of the Owner.

2. Where it is necessary to deflect pipelines to avoid obstructions, the amount of deflection shall not exceed ½ of that recommended by the manufacturer of the pipe. Where necessary to maintain the required line, short sections of pipe and fittings shall be provided.

3. The Contractor shall investigate the proposed location of the main far enough in

advance of the Work to determine where conflicts will occur and to determine joint deflections necessary to clear any obstructions.

E. Polyethylene Encasement:

1. Pipe shall be encased with polyethylene where specified in the Contract Documents

2. In the event that corrosive soils (as defined by Appendix "A" of ANSI/AWWA C105/A21.5) are encountered during excavation (and have not been identified as such in the Contract Documents), the Owner may direct that all, or a portion, of the pipeline be encased.

3. Materials and methods of installation shall be in accordance with ANSI/AWWA C105; Method A, B, or C may be used unless otherwise specified in the Contract Documents. Polyethylene shall be at least 4 mils thick, cross laminated, and shall conform to the requirements of ANSI/AWWA C105/A21.5.

4. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.

5. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.

6. Pull loose tube along pipe barrel up snugly around the pipe and fasten in-place with adhesive tape at 3 foot intervals.

7. Completely cover fittings and connections with film held snugly in place with point tape or strapping.

8. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement.

F. Tracer Wire:

All underground non-metallic pipe pressure systems shall be installed with continuous tracer wire, conforming to Section 200, attached every 10 feet to the piping system with plastic strapping. The wire shall terminate above ground at every valve box, tracer wire box, and air vent assembly. The wire shall be of sufficient length to allow the wire to be uncoiled and extended one (1) foot above the finished grade. The tracer wire installation will be considered complete and acceptable for service when the Owner can trace the wire using the locating equipment. Any breaks shall be repaired by the Contractor prior to project acceptance.

G. Subsurface Utility Tape:

All water mains shall be identified by a subsurface utility warning tape, conforming to Section 200, placed at an elevation not less than 6-inches, or more than 12-inches below the proposed finished grade, or directly under the roadway base material if the base material is greater than 12-inches.

2.3. VALVE INSTALLATION

A. Prior to installation, the Contractor shall inspect valves in the presence of the Owner for

direction of openings, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Valves determined to be defective by the Owner shall be replaced by the Contractor. The Contractor shall operate all valves greater than 3-inches once prior to installation to determine the number of rotations of the operating nut; this number of rotations shall be recorded on the record drawings.

B. The Contractor shall set and join valves to pipe in accordance with the manufacturer's requirements for the type and class of valve and pipe.

C. The valve box shall be centered and set plumb with the top of the box neatly to final grade, unless otherwise directed by the Owner. Shock and stress shall not be transferred from the box to the valve.

D. The top of the operating nut shall be less than 36-inches below the rim of the valve box (as measured from final grade). When the distance from the operating nut to the top of the valve box is greater than 36-inches, the Contractor shall install an approved valve stem extension device to result in a distance of 12- to 24-inches from the top of the operating nut to the rim of the valve box.

E. Valves shall be set vertical and embedded in accordance with the Standard Details, unless otherwise indicated.

2.4. HYDRANT INSTALLATION

A. Hydrants shall be installed as indicated in the Contract Documents and Standard Details.

B. The hydrant shall be plumb with the pumper nozzle facing the curb (or roadway). Nozzles shall be set 18- to 24-inches above the finished grade to the centerline of the nozzle, unless otherwise directed by the Owner.

C. Newly installed fire hydrants not yet in service shall be covered with a bag (or other Owner approved system), securely tied in place indicating that the hydrant is not usable.

D. Fire hydrants shall not be installed on water mains less than 6-inches in diameter.

2.5. APPURTENANT INSTALLATION

All appurtenances (fittings, air vent assemblies, blow-offs, meter settings) shall be installed in accordance with the manufacturer's recommendations and as indicated in the Contract Documents and Standard Details.

2.6. RESTRAINT

A. Fittings, valves, pipe joints and hydrants shall be restrained as indicated in the Contract Documents and in accordance with Section 200. Alternate methods of thrust restraint other than those specified herein may be used only with the written approval of the Owner.

B. All exposed piping, flanges, couplings, nuts and bolts shall receive a minimum of two coats of an approved protective coating as directed by the Owner.

2.7. CONNECTIONS TO EXISTING MAINS

A. The Owner and Contractor shall have a coordination meeting with the Owner's personnel at least 10 Days prior to the planned water main shutdown and provide a written Work Plan. The Owner shall review the Work Plan and either approve it or meet with the Contractor within 3 business days after receipt of the schedule to satisfactorily modify it.

B. It will be the responsibility of the Contractor to contact all residents, businesses, and fire department 72 hours in advance of interrupting service.

C. The Contractor shall notify the Owner at least 5 business days in advance of performing the offset/shutdown. Work can be delayed a maximum of 48 hours from the anticipated shutdown if due to inclement weather, and is approved or directed by the Owner. Otherwise, rescheduling and re- notification of customers will be required. Weather delays greater than 48-hours in duration shall require the Contractor to re-notify affected properties as hereinbefore specified.

D. The Contractor is required to schedule a meeting on site on the morning of a planned nighttime tie-in and shall notify the Owner. At the time of the meeting, the Contractor shall have all materials and equipment necessary for the tie-in on site and assembled for inspection by the Owner.

The following items will be reviewed and discussed at this meeting:

1. Site conditions
2. Weather forecasts / weather impacts
3. Work and contingency plans
4. Contact information
5. Emergency equipment

E. The Owner reserves the right to postpone the scheduled tie-in if:

1. The site or Contractor is not prepared as required in the Work Plan and as agreed upon at the pre-tie-in meeting.
2. The Owner has an emergency in another part of their system.

F. Shutdowns shall not begin until all required materials are on-hand and ready for installation and a written Work Plan has been submitted and approved by the Owner.

G. The Owner reserves the right to cancel scheduled shutdowns if conditions warrant.

H. A decision point will be established by the Owner for the Contractor to cut the active water main. This decision during the tie-in will be based upon the Contractor's progress leading up to the cutting into the active water main. Inadequate progress by the Contractor leading up to this critical decision point may lead to a postponement of the tie-in completion, backfilling the excavation, placing temporary pavement, and rescheduling the remainder of the tie-in work**.**

I. The Contractor shall provide a crew with equipment for each connection point so that multiple connections can be completed simultaneously.

J. At a time approved by the Owner, the shutdown period will commence and the Contractor shall proceed with the Work continuously, start to finish, unless otherwise noted, until the Work is completed and the system is tested and ready for operation. If the Contractor completes

all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back in service. If problems occur, the Contractor along with appropriate staff and equipment to remain on site to be an extension of the Owner's operational response until all operational issues have been resolved to the satisfaction of Owner.

K. The Owner's personnel shall operate all existing system valves unless otherwise indicated. The Owner shall make every effort to have a complete shutdown. Failure by the Owner to achieve a complete shutdown shall not entitle the Contractor to any additional compensation.

L. The Contractor is responsible for providing adequate support and restraint, against system pressure of the exposed piping prior to and during startup and final backfill.

M. The Contractor shall follow the procedures herein for any joints of the new water main and fittings that have not been previously hydrostatically pressure tested:

1. The Owner reestablishes services in the line.
2. One half hour will elapse, after air venting is complete by the Owner.
3. Joints will be visually inspected for signs of leakage by Owner.
4. Any leakage noted shall be corrected to the satisfaction of the Owner.
5. After satisfactory visual testing of exposed joints by the Owner and any corrective action, the Contractor shall wrap the pipe and/or fitting as required and immediately proceed to backfill the pipe and restore to grade conditions or for reestablishment of traffic if in a roadway. Soil backfill compaction tests may be specified by the Owner for work within roadway travel lanes.
6. If specified in the Contract Documents, utility warning tape shall be installed above the connection in accordance with the Bid Documents.
7. Any joints not inspected by the Owner will not be approved and shall be excavated for inspection.

N. Connection shall be made to the existing main through the installation of a tee in the existing main or by tapping sleeve and valve, as indicated in the Contract Documents. Taps shall be sized based on manufacturer's recommendations, but in no case shall the taps be of equal or larger size than the main.

O. Careful attention shall be given to the depth of new pipelines at points where tie-ins to existing mains are to be made. The existing main shall be uncovered in the presence of the Owner and the new pipeline set to proper elevation to provide for a perpendicular and level tie-in.

P. The allowable duration of the water service interruption shall be approved by the Owner prior to the execution of the Work. Restoration of service due to the Contractor taking too much time to complete the connection or the Contractor's lack of proper equipment, personnel, or materials, shall not entitle the Contractor to any claim for additional time or compensation.

Q. The Contractor shall be responsible for ascertaining the exact location, depth, and joint pattern of existing mains prior to making connections. Prior to cutting into any water mains the Contractor shall have on site all required fittings, pipe, tools, personnel and equipment, and shall satisfy the Owner through field measurements, that his fittings will properly join the existing line. Obstructions within the tie-in length may require special offsets by the Contractor.

1. Other than as specified herein or in the Special Provisions, all materials shall be

installed in accordance with the manufacturer's recommendations including, but not limited to alignment, torque requirements, and tolerances.

2. All materials shall be thoroughly disinfected prior to installation, including the tapping machine.

3. Connections shall only be made in the presence of the Owner.

4. Tie-ins to existing mains shall only be performed after the new main has been satisfactorily pressure tested and chlorinated. The Contractor may not tie-in the new main to the existing main until after the results of the bacteriological tests have been completed and approved by the Owner.

R. Tapping Existing Mains Under Pressure:

1. Tapping sleeves and valves shall be utilized for connecting to existing mains where indicated in the Contract Documents.

2. It shall be the Contractor's responsibility to verify the actual outside diameter of the existing main at the location of the proposed tap in order that the tapping sleeve or couplings to be provided can be properly installed.

3. The centerline of the tapping sleeve and valve assembly shall be located the following minimum distances from existing pipe joints:

Size of Tapping Sleeve	Minimum Recommended Separation from Existing Joint
4-, 6- & 8-inch dia.	3-1/2 feet
10-, 12- & 16-inch dia.	5-1/2 feet
Greater than 16-inch dia.	See Special Provisions

4. In cases where the horizontal alignment as indicated in the Contract Documents would result in a "sleeve to joint" distance less that the minimum stated above, the Owner may direct the Contractor to substitute a MJ x MJ x Flange tee connection using acceptable sleeves and pipe sections.

5. In addition to pressure testing of newly installed pipelines in accordance with Paragraph 2.8 of this Section, the Contractor shall test each tapping sleeve and valve assembly prior to making the tap. Water shall be injected into the body of the sleeve, to a pressure of 150 psig, through the test plugs. If test plugs are not provided in the sleeve, a tapped mechanical joint plug shall be assembled to the valve for testing purposes. Pressure shall be maintained for a one-hour period without evidence of leakage. Upon obtaining a satisfactory test (which shall be witnessed by the Owner), the tapping operation may commence.

6. All installed tapping sleeves shall be restrained in accordance with the Drawings, or as otherwise noted.

7. Upon completion of the tap the Contractor shall save the pipe coupon to show the Owner.

S. Sleeve-In of Straight Pipe:

1. Sleeve-in connections shall be as indicated in the Contract Documents.

2. Upon completion of the tie-in the connected pipelines shall be thoroughly flushed to remove heavily chlorinated water, assure clarity and air removal. One sample for bacteriological examination shall be collected by the Contractor from the point of discharge of the flushing water.

T. Offsets to Existing Water Main:

1. The Contractor shall comply with the above procedures for connections to existing mains.

2. Prior to performing an offset or cut-in, a trial shutdown will be performed to determine the working conditions to be encountered when the Work is performed.

3. All bends, valves, sleeves, pipe, and fittings shall be fully restrained with retainer glands.

4. The Contractor shall perform cut-in or offset Work at night, unless otherwise indicated. Under most circumstances the hours of operation will be from 12:00 midnight to 6:00 A.M. The excavation for the Work shall be completed no later than 3:30 P.M. on the day the offset or cut-in is to begin to allow for inspection by the Owner.

5. Offsets will not be subjected to pressure testing unless specified in the Contract Documents. After installation and connection to the existing mains, the offset shall be placed in service and left uncovered for visual inspection for at least 2 hours. Visible leaks shall be repaired to the satisfaction of the Owner prior to acceptance of the offset.

6. The materials to be installed and the tools to be used shall be assembled and ready for inspection no later than 3:30 P.M. on the day installation of the Work is to commence. The inside of all water system pipe and fittings to be installed shall be cleaned and swabbed with a chlorine solution of 50 mg/l and ends of lines capped until the time of installation. All visible dirt and foreign materials shall be removed from the interior of the pipe and fittings. Immediately prior to installation of the assembly, the pipe and fittings shall again be swabbed with 50 mg/l chlorine solution. The Contractor shall review in detail his plan of operation with the Owner at the time the excavation and pipe Work are inspected for readiness.

7. Excavation around the existing pipe shall be sufficient to allow the Work to be performed without requiring additional excavation during installation of the offset or cut-in. Excavation shall be of sufficient depth to accommodate a minimum of 8-inches uniform depth of VDOT #57 stone, which shall be placed by the Contractor over the entire bottom of the excavation. In addition, there shall be a minimum of 12-inches clearance between the bottom of the pipe and the top of the VDOT #57 stone.

8. The Contractor shall clean and mark the locations on the existing pipe where the pipe cuts are to be made by 3:30 P.M. on the day the offset or cut-in is to be installed. The Contractor shall measure the outside diameter of the pipe to be cut-in to be sure the proposed pipe and fittings are compatible with the existing pipe to be cut. All

measurements shall be double checked in the presence of the Owner just prior to cutting of the existing pipe.

9. All spoil material not used as backfill shall be removed the same day as excavated. Approved suitable material to be used as backfill shall be stockpiled in the vicinity of the excavation.

10. The Contractor shall have sufficient crews and equipment on hand to perform the Work for each offset. All equipment to be used during the Work, including pump, backup pump, backhoe, at least two pipe saws, fuel, tools, generators, light towers, and similar equipment shall be test run and determined to be in proper running order prior to cutting of the existing pipe. If the Contractor fails to provide adequate equipment in proper running order, the Owner will cancel the Work and the Contractor shall request rescheduling when the deficiencies have been corrected.

11. The Contractor shall have on hand at the site of the cut-in or offset two full circle stainless steel repair clamps and two DIMJ plugs or caps as necessary for each size of pipe to be cut. If plugs or caps are used, appropriate thrust restraint shall be provided by the Contractor.

12. After a cut-in or an offset has begun, the Contractor shall make continuous progress toward restoring the water line to full service. The Contractor shall maintain sufficient crews, equipment, and supplies and shall not leave the work site until the water main Work has been completed and restored to complete operation. The Contractor shall direct his pump discharge in such a manner as to insure drainage away from the excavation so it will not flood streets or adjacent private property.

13. When weather forecasts call for freezing temperatures the night of the cut-in or offset, the Contractor shall have on site sufficient coarse granular sand to spread over all paved areas, sidewalks, and bike paths wetted by the discharge of his pumps and any areas wetted from hydrants flushed to remove air and sediment from the system. During freezing weather, the Contractor shall minimize wetting of paved areas, sidewalks, and bike paths.

14. When bends are used in offsetting around obstructions, a 1-inch corporation stop shall be installed on each side of the offset to provide air release.

2.8. TESTING AND INSPECTION

A. General:

1. All flushing, pressure testing and disinfection procedures shall conform to this Section and the applicable sections of the Virginia Department of Health Waterworks Regulations.

2. The Contractor shall provide the Owner at least 72 hours (3 working days) notice prior to scheduled testing and inspection. The Owner shall be present to witness all testing and inspection procedures.

3. Before a Contractor request is made to witness the pressure test, the Contractor shall present a written tie-in plan to the Owner for approval. The tie-in plan shall include a schedule and details of how, where, and what will be done to prepare piping for tie-in.

The plan shall include, as a minimum, pressure testing, flushing, disinfection, sampling, and tie-in details. Details shall include the Contractor's proposed location and method to tie the new pipe to the existing system; the location of the pump, backflow prevention device and gage for the pressure test; the application point, method, injection point, location of the backflow prevention device and the sampling points for disinfection; and, the method and the location of feed water, the location of backflow prevention device, and the sample point locations for the bacteriological sampling.

4. Only properly functioning and clean equipment shall be used for flushing, pressure testing and disinfecting water mains. All gauges used in the pipe testing will have active calibration dates and have been calibrated in accordance with the Contract Documents.

5. Valves in the existing water system shall be operated only by or in the presence of the Owner.

6. See the Special Provisions for potential testing modifications, if any, for the specific locality.

B. Pressure Test:

1. New water mains shall be pressure tested in accordance with ANSI/AWWA C600-Section 5.2, except as herein provided. Water mains shall be filled with clean water and subjected to a pressure of 1.5 times the expected working pressure or 150 psig, whichever is greater, measured at the highest point along the test section. The pressure test shall be of at least two hour duration and any damaged or defective pipe, fittings, valves, or hydrants that are discovered during the pressure test shall be replaced by the Contractor and retested. The Contractor shall furnish all necessary equipment, materials and labor for making the tests as specified. Before applying the specified test pressure, air shall be slowly expelled completely from the pipe, valves, and hydrants. The pressure test shall not be performed against an active valve. Hydrants shall be tested with the main line.

2. The Contractor shall test the line prior to contacting the Owner for the formal pressure test.

3. Water for the pressure test shall be obtained through a fully valved manifold, with an approved backflow preventer, as indicated in the Standard Details.

4. The Contractor shall furnish all pumps, fittings, and gauges as necessary to fill the line with potable water, dispel air from the system, and pressurize the pipeline for the tests.

5. The Owner reserves the right to test gauges to determine their accuracy.

6. The Contractor shall coordinate with the water system owner for water to be used for the pressure testing.

7. The test pressure shall not vary by more than +/- 5 psi for the duration of the test.

8. Testing allowance shall be defined as the quantity of makeup 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 pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure. No pipe installation will be accepted if the amount of makeup water is greater than that determined by the allowable leakage formula, in Section 2.8.C, or as specified in the Special Provisions. There shall be no leakage in heat-fusion joined HDPE pipe or fPVC pipe.

9. The Contractor shall provide all necessary temporary restraint and support for testing apparatus during testing at no additional cost to the Owner.

10. The Contractor will be responsible for providing proper safety measures during pressure testing operations.

11. In addition, heat-fusion joined HDPE pipe pressure testing shall be in accordance with ASTM F2164 and shall also comply with the following:

    a. Before testing, heat fusion joints are to be completely cooled.

    b. All parts of the test section shall be restrained against movement. Temporarily remove, restrain, or isolate expansion joints and expansion compensators before starting.

    c. Observe all safety precautions identified in ASTM F2164.

    d. To compensate for expansion, add make-up water during the initial expansion phase. The quantity of water needed to fill the pipe test section and accommodate expansion (and possible leakage at non-fusion joints and seals) is estimated using:

    $$V_{gal} = 1.015 \times 0.04 \times (ID_{in})^2 \times L_{ft}$$

    where:

    V_{gal} = pipe section volume, gallons
    ID_{in} = pipe inside diameter, inches
    L_{ft} = test section, feet

    e. Allow the test section and the test liquid to equalize to a common temperature.

    f. Initial Expansion Phase:

        (1) When the test section is completely filled and purged of air, gradually increase the pressure to the required test pressure identified in paragraph 2.8.B.1 above.

        (2) Add make up water as necessary to maintain the maximum test pressure for 4 hours.

    g. Test Phase:

        (1) Reduce the test pressure by 10 psi and monitor pressure for 1 hour. Do not increase the pressure or add make up water.

(2) No visible leakage shall be observed and the pressure shall remain steady (within 5% of the test phase pressure) for the 1 hour test phase period for a passing test.

h. Retesting - If retesting is necessary, depressurize the test section per ASTM F2164 and correct any faults/leaks. Allow the test section to "relax" for at least 8 hours before repressurizing and repeat the Initial expansion and test phases as indicated above.

C. Leakage Test:

1. The leakage test shall be conducted concurrently with the pressure test. New water mains shall be tested for leakage in accordance with AWWA Standard C600-Section 5.2. Allowable leakage shall not exceed ANSI/AWWA C 600. No leakage shall be allowed for heat-fusion joined HDPE pipe or fPVC pipe. No pipe installations will be accepted if the leakage is greater than the values determined as follows:

The allowable leakage value shall be determined using the equation below, or Table 801-1:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

Where:
L = Allowable leakage, in gallons/hr.
S = Length of pipe tested, in feet
D = Nominal diameter of the pipe, in inches
(P) ½ = Square Root of average test pressure during leakage test, in psig

TABLE 801-1
Leakage Testing Allowance per 1,000 feet of Pipeline (Gallons per Hour)
(Pipe diameters 16-inches and less)
Based on AWWA C600, Table 5A

Avg. Test Pressure psi	Nominal Pipe Diameter, inches							
	3	**4**	**6**	**8**	**10**	**12**	**14**	**16**
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32

2. The Contractor shall, at its expense, locate and repair any defective material or workmanship until the excess leakage is reduced below the allowable limits.

3. If a water main or section fails to meet the specified test requirements or has to be repaired, it shall be retested at no additional cost to the Owner.

4. All joints, not subjected to pressure testing, shall be visually inspected under pressure for not less than 30 minutes for leakage.

D. Disinfection:

New, relocated, or repaired water mains shall be disinfected in accordance with AWWA Standard C 651-14, latest revision. The disinfection procedure shall be carried out after completion of construction and immediately before the mains are placed into service. During construction, precautions shall be taken to protect pipe interiors, fittings, and valves against contamination. Cleaning and swabbing of the interior of the pipe may be required if contamination cannot be removed by ordinary flushing and disinfection procedures. The cleaning and swabbing shall be performed with a 5% hypochlorite disinfecting solution, or other disinfecting agent as approved by the Owner. The Contractor shall be responsible for properly treating the discharge during disinfection, testing, and flushing activities in accordance with all environmental regulations required by the locality.

1. Preliminary Flushing:

a. Water lines shall be flushed every 2,000 feet unless the Owner gives the Contractor written permission for flushing longer lengths of pipeline. No more than 4,000 feet of pipeline shall be flushed at any one time, under any circumstances.

b. All water mains shall be flushed with potable water prior to disinfection. The flushing velocity shall not be less than 3.0 feet per second (FPS). No site for flushing shall be used unless adequate and satisfactory drainage is present, available and operational. It shall be noted that under no circumstances will preliminary flushing be considered a substitute for preventive measures taken before and during water main construction to minimize contamination. Estimated flow rates to achieve the required 3.0 FPS are as follows:

TABLE 801-2
Minimum Flushing Rate (FR) to Achieve 3.0 FPS
(Pipe diameters 16-inches and less)

Pipe Diameter (in.)	Flow (GPM)
6	260
8	470
10	730
12	1060
16	1880

2. Disinfection Methods

a. Tablet/Granular

The tablet method consists of placing calcium hypochlorite granules or tablets in the water main during the installation and then filling the main with potable water to create a chlorine solution. This method may be used only if, in the opinion of the Owner, the pipes and appurtenances have been kept clean and dry during construction. This method may not be used on mains less than 24 inches in diameter nor on solvent-welded plastic pipe.

b. Continuous-Feed Method

The continuous–feed method consists of completely filling the main with potable water, removing air pockets, then flushing the completed main to remove particulates, and refilling the main with potable water that has been chlorinated to 25 mg/l. After a 24-hour retention time in the main, there shall be a free chlorine residual of not less than 10 mg/l.

c. Slug Method

The slug method consists of completely filling the main to eliminate air pockets; flushing the main to remove particulates; and then, slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/l. The slug shall pass through the main at a slow rate of flow allowing all parts of the main to be exposed to the highly chlorinated water for at least 3 hours.

d. Spray Disinfection Method

The spray disinfection method consists of spraying a 200 mg/l free chlorine solution on all interior surfaces of the main. After 30 minutes the main shall be filled with potable water. This method should only be used on very large diameter mains, where personnel and equipment may safely enter the pipe.

TABLE 801-3
Disinfection Methods Summary

Disinfection Method	Main Diameter Size	Initial Free Chlorine Concentration, mg/l	Min. Contact Time, Hours	Min. 24-Hour, Free Chlorine Residual, mg/l
Tablet/Granular	Less than 24- inches	25	24	0.2
Continuous Feed	General	25	24	10
Spray	Large	200	0.5	----
Slug	Large	100	3.0	50

Acceptable disinfecting solutions shall include chlorine in a liquid form, in calcium hypochlorite granules or in sodium hypochlorite solutions. All hypochlorite shall conform to AWWA Standard B 300, latest revision.

In water distribution systems using chloramines as the disinfectant, water from the distribution system no longer has a free chlorine residual, but instead has a combined chlorine residual. The combined chlorine will exert a free chlorine demand of approximately 5 ppm. Thus, the make-up water (if supplied from the water distribution system) will neutralize approximately 5 ppm of free chlorine. This 5 ppm free chlorine demand must be taken into account in determining the amount of chlorine necessary to achieve a 50 ppm free chlorine residual.

3. Final Flushing:

After the retention period, the heavily chlorinated water shall be flushed from the main

until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the existing system or less than 1 ppm. In water distribution systems using chloramines as the disinfectant, the heavily chlorinated water shall be flushed until all traces of free chlorine are absent (i.e. free chlorine residual = 0.0 ppm). The flushing shall be conducted in the presence of and only with the approval of the Owner.

4. Point of Discharge:

The Contractor shall discharge the chlorine solution from the water main through available outlets, or through taps in the main installed at the Contractor's expense. The environment to which the chlorinated water is to be discharged shall be inspected by the Contractor. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water as it is wasted to thoroughly and completely neutralize the chlorine residual in the water. (See Table 801-4, Amount of Agent Required to Neutralize Various Residual Chlorine Concentrations.) Dechlorination shall be performed in accordance with ANSI/AWWA C655-09. Where necessary, federal, state, and local regulatory agencies should be contacted by the Contractor to determine special provisions for the disposal of heavily chlorinated water.

TABLE 801-4
Amount of Agent Required to Neutralize Various Residual Chlorine Concentrations for 100,000 Gallons of Water

Residual Chlorine	Sulfur Dioxide (SO_2)	Sodium Biosulfate	Sodium Sulfite	Sodium Thiosulfate
ppm	LB	LB	LB	LB
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

To estimate the minimum flushing time and the amount of neutralizing agent needed, use the following, where:

L = length of pipe being chlorinated, feet
t = estimated minimum flushing time, seconds
FR = flow rate, from Table 801-2, as function of pipe diameter, GPM
V = flushing discharge volume, gallons
N = estimated amount of neutralizing agent as function of concentration, from Table 801-3, pounds

a. Determine the estimated minimum flushing time, t, in seconds:

$$t = L/2.5$$

b. Determine the estimated minimum flushing discharge, V, in gallons:

$$V = \frac{t + 300}{60} \times FR$$

c. Determine the estimated amount of neutralizing agent, N, in pounds:

$$N = \frac{V}{100{,}000} \times \text{(Table 801-4 value for given residual chlorine and type of neutralizing agent)}$$

5. Bacteriological Tests:

After final flushing and before the water main is placed in service, the Contractor shall collect samples and have the samples tested for bacteriological quality by a State Health Department approved laboratory. The samples shall be collected in sterile containers. Chlorine residual measurements shall be taken and recorded at the time each sample is collected.

For new mains, one of the following two options for the bacteriological testing of total coliform analysis may be used:

Option A – The Contractor shall take an initial set of samples and then resample after a minimum of 16 hours using the sampling site procedures outlined in AWWA C 651-14. Both sets of samples must pass before approval may be granted.

Option B – The Contractor shall allow the main to sit for a minimum of 16 hours without any water use/withdrawals prior to sampling. The Contractor shall then collect, using the sampling site procedures identified in AWWA C 651-14 and without flushing the main, two sets of samples a minimum of 15 minutes apart while the sampling taps are left running. Both sets of samples must pass before approval may be granted.

For new mains, sets of samples shall be collected every 1,200 feet, plus one set from the end of the new main and a minimum of one set for each branch greater than one pipe length.

6. Re-disinfection:

If the initial disinfection produces positive results for coliform, the main shall be re-flushed and the sampling procedure repeated. If these samples are positive for coliform, then the main shall be re-chlorinated and the sampling procedure repeated until satisfactory results are achieved.

7. Supervision:

The disinfection and testing procedure shall be carried out by the Contractor under the supervision of the Owner. Water mains shall be placed in service only after final approval has been issued by the Owner contingent upon test results.

III. MEASUREMENT FOR PAYMENT

A. Water Main, installed

Measurement of the water main will be made along the centerline of the pipeline based upon the linear footage of each size pipe and material type installed and satisfactorily tested, complete in place. No depth measurement will be made for trench excavation and native material backfill. Pipe will be measured through fittings, valves, and casings.

The unit price bid will not include the cost of valves. Payment will include the cost of the following:

1. Backfilling, compacting, and compaction testing
2. Bedding, as detailed in the Contract Documents
3. Coatings
4. Corporation stops
5. Dewatering
6. Disinfection
7. Disposal of surplus material
8. Excavation
9. Heat fusion equipment and any specialized technical operational support required
10. Restoration in right-of-way and easements (not including curb and gutter restoration or pavement restoration, unless otherwise noted)
11. Sampling and flushing
12. Service saddles
13. Shoulder restoration
14. Temporary seeding and stabilization
15. Temporary sheeting and bracing
16. Testing
17. Thrust restraint
18. Tracer wire and marking tape
19. Water main and appurtenances, including fittings.

B. Fire Hydrant, installed complete in place.

Payment will be made at the unit price bid for each fire hydrant (Type I, II, or III) installed and satisfactorily tested and will include the cost of the following:

1. All appurtenances required for satisfactory operation
2. Backfill, compacting and compaction testing
3. Bedding material
4. Blocking, where required
5. Burlap bag
6. Disposal of surplus material
7. Culvert Pipe
8. Dewatering
9. Excavation
10. Extension spools
11. Fire hydrant assembly, including valve, valve box, valve box frame and cover, pipe, and fittings as indicated on the Standard Details
12. Painting
13. Right of way restoration
14. Shoulder restoration
15. Stone
16. Temporary seeding and stabilization
17. Temporary sheeting and bracing
18. Testing
19. Thrust restraint.

C. Water Sampling Stations, installed complete in place.

Sampling stations, when required, shall be at the unit price bid.

D. Gate or Butterfly Valves, installed complete in place.

Payment will be made at the unit price bid for each size gate or butterfly valve installed, complete in place, and satisfactorily tested, and will include the cost of the following:

1. Backfill, compacting and compaction testing
2. Bedding material,
3. Coatings and linings
4. Disposal of surplus material,
5. Excavation,
6. Right of way restoration,
7. Shoulder restoration,
8. Stem extensions,
9. Temporary seeding and stabilization,
10. Temporary sheeting and bracing,
11. Testing,
12. Thrust restraint,
13. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents,
14. Valve wrench.

E. Tapping Sleeve and Valve (TS&V), installed complete in place.

Payment will be made at the unit price bid for each size TS&V installed, in place, and satisfactorily tested, and will include the cost of the following:

1. Backfill, compacting and compaction testing,
2. Bedding material,
3. Coatings and linings,
4. Disposal of surplus material,
5. Excavation,
6. Pressure testing,
7. Right of way restoration,
8. Shoulder restoration,
9. Stem extensions,
10. Tapping sleeve assembly and appurtenance,
11. Temporary seeding and stabilization,
12. Temporary sheeting and bracing,
13. Testing.
14. Thrust Restraint,
15. Valve, valve box, with frame and cover for each size in accordance with the Contract Documents,
16. Valve wrench.

F. Blowoff Assembly, installed complete in place.

Payment will be made at the unit price bid for each blowoff assembly installed and satisfactorily tested and will include the cost of furnishing and installing the blowoff assembly and all required appurtenances, in accordance with the Standard Details, including tap to proposed water main to provide satisfactory operation in accordance with the Contract Documents.

G. Manual Air Vent Assembly, installed complete in place.

Payment will be made at the unit price bid for each manual air vent assembly installed and satisfactorily tested and will include the cost of furnishing and installing the manual air vent assembly in accordance with the Standard Details and all required appurtenances in accordance with the Standard Details, including tap to proposed water main to provide satisfactory operation in accordance with the Contract Documents.

H. Type K Copper (Single or Dual) Service Lines and Meter Box (Jack and Pull Construction), installed complete in place.

Payment will be made at the unit price bid at a unit price for each single or dual service, as indicated on the Bid form, and will include the cost of the following:

1. Backfill, compaction, and compaction testing
2. Clean up and restoration
3. Dewatering
4. Disinfection
5. Excavation of jacking and receiving pits
6. Jack and pull operation
7. Sampling and flushing
8. Temporary sheeting and bracing
9. Testing
10. Type K Copper service lines and all fittings to connect to water main including tapping saddle, curb stop, angle meter valve or meter yoke assembly (as shown on the Standard Detail), for each separate service
11. Meter box and all required appurtenances
12. Reconnections made to existing private water service lines at the meter box.

I. Type K Copper (Single or Dual) Service Lines and Meter Box (Open Cut Construction), installed complete in place.

Payment will be made at the unit price bid for each single or dual service, as indicated on the Bid form, and will include the cost of the following:

1. Backfill, compaction, and compaction testing,
2. Clean up and restoration,
3. Dewatering,
4. Disinfection,
5. Excavation,
6. Meter box and all required appurtenances,
7. Pavement repair, unless paid under another Bid item,
8. Reconnections made to existing private water service lines at the meter box,
9. Sampling and flushing,
10. Temporary sheeting and bracing,
11. Testing, and
12. Type K Copper service lines and all fittings to connect to water main including tapping saddle, curb stop, angle meter valve or meter yoke assembly (as shown on the Standard Detail), for each separate service.

J. Private Service Relocations

Measurement and payment will be performed in the same manner as “public” service lines in

the right of way on a unit price bid for each private service, as indicated on the Bid form, and will be installed in accordance with the International Plumbing Code.

K. Polyethylene Encasement installed complete in place.

Payment will be made at the unit price bid per linear foot for polyethylene pipe encasement satisfactorily installed.

L. Connections to existing water mains, complete in place

Connections to existing water mains will be paid for assemblies installed and satisfactorily tested. Payment will include:

1. Backfilling,
2. Bracing,
3. Compaction,
4. Compaction testing,
5. Coordination (including written work schedule and customer notification),
6. Dewatering,
7. Disinfection,
8. Disposal of surplus material,
9. Excavation,
10. Materials,
11. Other site restoration and cleanup as shown in the Contract Documents,
12. Restoration of right of way,
13. Shoulder restoration,
14. Stabilization,
15. Temporary seeding,
16. Testing,
17. Thrust restraint,
18. Temporary sheeting, and
19. Work Plan and all notifications to include re-notifications as necessary.

M. Plugging Existing 2-Inch Water Mains

Plugs for existing 2-inch water mains shall be paid based upon the number of excavations made for plugging. The unit price bid shall include the cost and installation of:

1. Backfilling with suitable material,
2. Compacting,
3. Coarse aggregate fill,
4. Couplings,
5. Cutting the existing main as shown in the Contract Documents, and indicated on the Bid form,
6. Disposing of surplus material,
7. Excavating,
8. Other site restoration and cleanup,
9. Pavement replacement,
10. Plugs,
11. Seeding,
12. Thrust restraint, and
13. Top soiling.

N. Offset of Existing Water Main

Offsets of existing water main shall be paid for at the contract unit price per foot. The unit price shall include:

1. Backfilling with suitable material,
2. Compacting and compaction testing,
3. Connections to existing mains,
4. Coordinating line shutdown,
5. Cutting of existing line,
6. Dewatering,
7. Disinfecting,
8. Disposing of surplus materials,
9. Excavating,
10. Fittings,
11. Furnishing and installing the pipe,
12. Other site restoration and cleanup
13. Pipe bedding,
14. Removing and disposing off-site of old line,
15. Seeding,
16. Temporary sheeting and bracing,
17. Testing,
18. Thrust restraint,
19. Top soiling, and
20. Work Plan and all notifications to include re-notifications as necessary.

O. Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches)

Cutting in of Tees, Crosses, and Valves into Existing Mains (larger than 2-inches) shall be paid based upon the number of each tee, cross, or valve cut in. The unit price bid shall not include pipe or valves and valve boxes, which shall be paid for under their respective unit price.

The unit price bid shall include:

1. Backfilling with suitable material,
2. Coarse aggregate fill,
3. Compacting,
4. Cutting-in of any valves at or near the tee or cross,
5. Dewatering,
6. Disposing of surplus material
7. Excavating,
8. Furnishing and installing all fittings such as tees, bends, reducers, sleeves, plugs, as well as other appurtenances,
9. Other site restoration and cleanup,
10. Pavement replacement,
11. Seeding,
12. Temporary sheeting and bracing,
13. Testing,
14. Thrust restraint, and
15. Top soiling.

P. Tracer Wire Box

Payment will be made at the unit price bid for each tracer wire box installed and will include the cost of furnishing and installing the box, lid, riser pipe, aggregate base material, backfilling, compaction, topsoil (if required), and all required appurtenances, in accordance with the Standard Detail.

End of Section