# SECTION 02670

# INSTALLATION OF WATER LINES AND SANITARY SEWER LINES BY HORIZONTAL DIRECTIONAL DRILLING (HDD) METHODOLOGY

## PART ONE - GENERAL

### 1.1 DESCRIPTION

A. Work included: Furnish all labor, materials, tools and equipment necessary to provide for installation of HDPE and/or restrained joint C900 PVC water pipe line and gravity sewer pipe line using current horizontal directional drilling technology in accordance with the Drawings and as specified herein.

B. General: This specification defines the approved method and material for the installation of water lines, sewer force mains and gravity sewer lines utilizing horizontal directional drilling technology.

C. Definition: Horizontal directional drilling (HDD) involves utilization of an electronically tracked bore-head to guide the borehole to a pre-designed configuration. The HDD process begins with boring a small, horizontal pilot hole with a continuous string of steel drill rod. When the bore-head and rod emerge on the opposite end of the crossing, a back reamer is attached to the drill rod string and pulled back through the pilot hole. The reamer serves to enlarge the pilot hole to allow the HDPE or restrained joint PVC pipe to be pulled through from the opposite end of the borehole. The size of the drilling equipment and required support equipment shall be determined by the CONTRACTOR based on the diameter and length of pipe to be installed.

### 1.2 QUALITY ASSURANCE

A. Qualifications of manufacturers: Products used in this Work shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of quality production acceptable to the OWNER.

B. Contractor Certification: CONTRACTOR shall be certified by the particular horizontal directional drilling manufacturer that CONTRACTOR is a fully trained user of the drilling equipment.

C. Qualifications of Personnel: HDPE pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the HDPE pipe. Training shall be performed by a qualified representative.

### 1.3 SUBMITTALS

A. General: All submittals shall be made in accordance with these Specifications. CONTRACTOR shall furnish engineering data covering design and installation. Submittal shall be made in a timely manner so that the project schedule can be met.

B. Shop drawings: As a minimum, the following data and shop drawing information shall be submitted to the OWNER for review and approval:

1. Before beginning work, CONTRACTOR shall submit to the OWNER for approval, the Vendor's shop drawings, catalog data and specific manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendations for handling, storage, and repair of pipe and fittings, which are damaged.

2. A certificate of "Compliance with Specification" shall be furnished for all materials supplied.

3. CONTRACTOR shall submit certification of workmen training for all personnel involved in installation of pipe.

4. CONTRACTOR shall submit a work plan to the OWNER for acceptance. Work plan shall address preparation steps required for pre-installation.

5. CONTRACTOR shall submit information to the OWNER for approval of the procedure and the steps to be followed for installation of the HDPE or restrained joint PVC pipe utilizing horizontal directional drilling technology, even if the process is named in the specification. Any proposed changes in installation procedures shall require submittal of revised procedures for acceptance by the OWNER.

6. CONTRACTOR shall submit to the OWNER for approval, full details about component materials and their properties, except those protected by trade secrets which may harm their claim to the product.

1.4 RESPONSIBILITY FOR MATERIALS

A. Material furnished by CONTRACTOR: CONTRACTOR shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing of all materials and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work.

B. Material furnished by OWNER: CONTRACTOR'S responsibility for material furnished by the OWNER shall begin at the point of delivery to CONTRACTOR. Materials already on site shall become CONTRACTOR'S responsibility on the date of the award of the Contract. CONTRACTOR shall examine all material furnished by the OWNER at the time and place of delivery to him and shall reject all defective material. Any material furnished by OWNER and installed by CONTRACTOR without discovery of such defects will, if found defective prior to final acceptance of the Work, be replaced with sound material by the OWNER. CONTRACTOR, however, shall at his own expense, furnish all supplies, labor and facilities necessary

to remove said defective material and install sound material in a manner satisfactory to the OWNER.

1.5 PRODUCT HANDLING

A. Handling of materials:

1. All materials furnished by the CONTRACTOR shall be delivered and distributed by the CONTRACTOR. Materials furnished by the OWNER shall be picked up by the CONTRACTOR at points designated by the OWNER and hauled to and distributed at the site.

2. Pipe, fittings, etc., shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

3. In distributing the material at the site of work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

4. Pipe shall be so handled that no damage shall occur. If any part of the pipe is damaged, CONTRACTOR shall replace damaged material at his expense in a manner satisfactory to OWNER.

B. Storage of Materials: CONTRACTOR shall be responsible for safe storage of material furnished by or to him, and accepted by him, and intended for the Work, until it has been incorporated in completed Project. Interiors of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

C. Damaged Material: Any material furnished by OWNER that becomes damaged by CONTRACTOR after acceptance shall be replaced by CONTRACTOR at his expense.

1.6 COMPLIANCE WITH UNDERGROUND UTILITY DAMAGE PROTECTION ACT

CONTRACTOR shall be responsible for notifying "Miss Utility" a minimum of 48 hours prior to any excavating operations. CONTRACTOR shall be aware of and comply with all provisions of the Virginia Underground Utility Damage Protection Act as enforced by the State Corporation Commission.

1.7 COMPLIANCE WITH VA DEPARTMENT OF TRANSPORTATION STANDARDS

CONTRACTOR shall be aware of and comply with all provisions of the Virginia Department of Transportation (VDOT) as contained in the latest editions of the VDOT Road and Bridge Specifications, VDOT Road and Bridge Standards, VA Work Area Protection Manual and VDOT Land Use Permit Manual.

1.8 WARRANTY

All equipment and materials supplied under this Section shall be warranted to be free from defects in materials and workmanship for a minimum of one (1) year following acceptance by the OWNER.

## PART TWO - PRODUCTS

2.1 MATERIALS:

A. HDPE Pipe: Polyethylene plastic pipe shall be high density polyethylene pipe which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, ASTM D1248, ASTM D3550.

1. Sizes of the pipe to be used for installation of water and sewer lines shall be as directed by the OWNER.

2. All pipe shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used.

3. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

4. Dimension Ratios: The minimum wall thickness of the polyethylene pipe shall be as follows:

   Gravity sanitary sewer line: SDR 17
   Sanitary sewer force main: DR-11
   Potable water line: DR-11.

5. For sewer installations pipe material color shall be white, black or whatever is specified with interior of pipe having a light reflective color to enhance viewing for television inspection.

6. Installation Method: HDPE pipe shall be continuously joined with a minimum length, which shall be that deemed necessary by the CONTRACTOR to effectively span the required distance from the inlet to the outlet of the respective pipe, unless otherwise specified. CONTRACTOR shall verify the lengths in the field before manufacturing.

7. Pipe Locator Wire: To facilitate future locating of HDPE water pipe and sanitary sewer force main, a 12 gauge copper wire shall be laid with pipe and in contact with all fittings and valves.

B. PVC Restrained Joint Pipe:

1. PVC pipe meeting the AWWA Specification C900 for dimension ratio (DR) 14, pressure Class 200, shall be used for water lines. DR-25 pipe may be used for gravity sewer pipe installations. SDR-21 or DR-14 pipe may be used for sanitary sewer force mains. Pipe shall be Certa-Lok C900/RJ restrained joint PVC pipe or approved equal. PVC pipe materials

shall be furnished by the OWNER and installed by the CONTRACTOR.

2. PVC pipe shall be installed according to the manufacturer's written instructions for installation by horizontal directional drilling. To facilitate future locating of PVC water pipe, a 12 gauge copper wire shall be laid with pipe and in contact with all fittings and valves.

3. Pipes shall be joined using non-metallic couplings, which have been designed with the pipe as an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating precision-machined grooves in the pipe and coupling to provide full, 360-degree restraint with evenly distributed loading at the joint. No external pipe-to-pipe restraining devices, which clamp onto or otherwise damage the pipe surface as a result of point loading shall be permitted. Solvent-weld cement joints shall not be allowed.

2.2 EQUIPMENT

A. Directional Drilling Machine:

1. Directional drilling equipment shall be self-powered and self-contained. Equipment shall be designed and manufactured with an electronically tracked bore-head so as to guide the borehole to a desired configuration, both horizontally and vertically.

2. Directional drilling equipment shall generate sufficient torque and thrust/pullback force to drill a pilot hole, enlarge the pilot hole by back reaming and pull the pipeline back through the enlarged hole.

3. CONTRACTOR shall comply with manufacturers specifications as to the machine size requirement for a given diameter and length of pipe, as well as parameters of the required size machine for percentage of upsize allowed.

B. Vacuum Excavation Unit:

1. Directional drilling operations shall be assisted by use of an adequately sized vacuum excavation system mounted on either a trailer or truck body.

2. Vacuum excavation system shall provide sufficient storage tank capacity and power pack to efficiently remove drilling fluid from the insertion pit during horizontal directional drilling operations.

3. Vacuum excavation system shall be equipped with a high-pressure water system designed to assist with “pothole” excavation operations.

C. Drilling Fluid Management System:

1. Directional drilling operations shall be assisted by use of a truck mounted drilling fluid mixing system.

2. Fluid management system shall include two mixing tanks to allow for flexibility in mixing, transferring and delivering drilling fluid.

3. Fluid management system shall have the capability to transfer between tanks while providing drilling fluid to the directional drilling machine.

2.3 SHIPPING & HANDLING

HDPE and/or PVC pipe materials and fittings shall be protected from kinking and gouging during shipping, handling, and storage.

2.4 MATERIAL TESTING

Tests for compliance with this specification shall be made as specific herein and in accordance with the applicable ASTM Specification. A certificate with this specification shall be furnished, upon request, by the manufacturer for all material furnished under this specification. Polyethylene plastic pipe and fittings may be rejected to meet any requirements of this specification.

## PART THREE - EXECUTION

3.1 HORIZONTAL DIRECTIONAL DRILLING OPERATION AND PIPE INSTALLATION

A. Access to the project site:

1. Access to the site of the project under construction shall be primarily by respective pipeline easement and/or existing State road rights-of-way. Access through private property will not be permitted without the explicit written permission of the property owner. Two (2) copies of such written permission shall be given to the OWNER for his review and records. At all locations where the CONTRACTOR desires to enter the easement from a state road, an access approach will be constructed. All construction within the State road right-of-way shall conform to the standards and requirements of the Virginia Department of Transportation.

2. Whenever such access approaches are in use, a flagman shall be posted at the State road. Whenever such access approaches are not in use, a barricade, a chain, fence or gate will be installed to prevent unauthorized and accidental entry to the project site.

3. CONTRACTOR shall not employ those portions of the pipeline easement, which have had pipe line construction completed by others, as an access route, without express permission from the OWNER in writing.

B. Pre-Installation Preparations: CONTRACTOR's work plan shall address the following minimum preparations/steps, unless approved otherwise by the OWNER.

1. **SAFETY**: The CONTRACTOR shall carry out operations under this section

in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be the CONTRACTOR's responsibility to comply with OSHA Standards and Regulations pertaining to all aspects of the work.

2. **DIVERSION PUMPING**: When required for acceptable completion of the directional drilling and pipe installation process, CONTRACTOR shall provide for continuous sewage flow around section(s) of pipe designated for pipe installation.

   a. By-passing of sewage flow shall be accomplished by use of a diversion pump and piping system. Diversion pump and bypass lines shall be of adequate capacity and size to handle the flow. All costs for by-pass pumping required during installation of the pipe shall be paid in conformance with the respective bid item.

   b. CONTRACTOR shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer during execution of the work.

   c. If sewage backup occurs and enters buildings, CONTRACTOR shall be responsible for clean-up, repair, property damage cost and claims.

C. Installation Procedures - General: All approved installation instructions and procedures submitted shall be carefully followed during installation. OWNER shall provide all grade profiles and field stakeout required for pipe centerline grade and offsets. Any proposed changes in installation procedures shall require submittal of revised procedures and acceptance by the OWNER.

1. Equipment used to perform the work shall be located as far away from buildings as possible. Provide enclosed, insulated power packs for all mechanical equipment to reduce machine noise, as required to meet local requirements.

2. CONTRACTOR shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing structures, and to protect the pipe from damage during installation. Lubrication shall be used as recommended by the manufacturer. Under no circumstances will the pipe be stressed beyond its elastic limit.

D. Pipe Joining of HDPE Pipe:

1. HDPE pipe shall be assembled and joined at the site using either the butt-fusion or electro-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by

personnel certified, as fusion technicians, by a manufacturer of polyethylene pipe and/or fusing equipment.

2. Butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the OWNER and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the OWNER. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the OWNER and/or his representative shall be discarded and not used.

3. Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp or equal. Butt gap between pipe ends shall not exceed one-half (½) inch. Also Unicore Plastic Fusion System, unicore can be used to butt fuse the sewer pipe material.

E. Connection of HDPE Pipe to Fittings: HDPE Pipe shall be joined to ductile iron fittings, valves and fire hydrants in strict compliance with manufacturer's recommendations.

1. HDPE Mechanical Joint adapters shall be either butt-fused or electro-fused to the HDPE pipe to provide a leak proof joint in compliance with Specification Section 02670-3.1-D. Ductile iron fitting, gate valve or fire hydrant shall be bolted to the M.J. adapter in compliance with the manufacturer's recommendations.

2. H.D.P.E. pipe may be joined directly to ductile iron fittings, valves and fire hydrants by the use of Mega-Lug joint restraints, or approved equal, in strict compliance with the manufacturer's recommendations. Stainless steel insert pipe stiffeners shall be used with all such connections.

3. Ductile iron fittings, valves and hydrants with integral H.D.P.E. stub-outs shall be either butt-fused or electro-fused directly to the H.D.P.E. pipe in compliance with Specification Section 02670-3.1-D. All gate valves with integral H.D.P.E. stub-outs of 4" or smaller size shall incorporate an H.D.P.E. valve foundation to prevent operating torque being transferred from the valve to the pipe connections.

F. Pipe Joining of Restrained Joint PVC Pipe:

1. Restrained joint PVC shall be assembled and joined at the site using non-metallic couplings designed with the pipe as an integral system. Pipe and coupling shall be restrained using high-strength, flexible thermoplastic splines inserted into mating precision-machined grooves in the pipe and coupling. Threaded or solvent-cement joints and connections shall not be permitted.

G. Field Testing of Sewer Pipe:

1. For sewer pipe installation pipe shall be internally inspected with a television camera and videotape as required. Finished tape shall be continuous over the entire length of the sewer between two manholes to be free from visual defects.

2. Defects, which may affect the integrity or strength of the pipe in the opinion of the OWNER, shall be repaired or the pipe replaced at CONTRACTOR's expense.

3. Service Reconnection:

a. Once installation of sewer pipe has been completed, CONTRACTOR shall reconnect existing live service connections. These services shall be reconnected by one of the approved methods listed in Paragraph D-3e below.

b. All sewer service connections shall be identified and located prior to pipe insertion operations to expedite reconnection. Upon commencement of pipe installation, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the OWNER and/or his representative. Upon completion of installation of new sewer pipe, CONTRACTOR shall expedite reconnection of services so as to minimize any inconvenience to customers.

c. Installed pipe shall be allowed manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines, sealing of the annulus or backfilling of the insertion pit. Sufficient excess length of new pipe, but not less than four (4) inches, shall be allowed to protrude into the manhole to provide for occurrence of pipe relaxation.

d. Following relaxation period, the annular space may be sealed. Sealing shall be made with material approved by the OWNER and/or his representative and shall extend a minimum of eight (8) inches into the manhole wall in such a manner as to form a smooth, uniform, watertight joint.

e. Sewer service connections shall be connected to new pipe by various methods that are compatible with the new HDPE sewer pipe. If a saddle is used, that saddle once secured in place, drill a hole full inside diameter of saddle outlet in pipe liner.

e1.) Mechanical saddles shall be made of polyethylene pipe compound that meets the requirements of ASTM D1248, Class C, have stainless steel straps and fasteners, neoprene gasket and backup plate. Mechanical saddles shall be Strap-On-Saddle Type as manufactured by Driscopipe or approved equal. (800-527-0662).

e2.) Inserta-Tee Connection by Fowler Manufacturing (503) 357-2110 shall also be allowed to be used. Also approved is the Unicore Plastic Fusion System (705) 876-6400 that uses butt-fusion to connect a tee or prefabricated polyethylene saddle or equivalent to sewer pipe material.

4. Finished Pipe

a. Installed sewer pipe shall be continuous along entire length of each pipe segment from manhole to manhole and shall be free from visual defects such as foreign inclusions, concentrated ridges, discoloration, pitting, and other deformities.

b. Pipe with gashes, nicks, abrasions, or any such physical damage, which may have occurred during storage and/or handling and which are larger/deeper than 10 percent (10%) of the wall thickness shall not be used and shall be removed from the construction site.

c. Sewer pipe passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by the OWNER. Installed sewer pipe shall meet the leakage requirements of the pressure test as specified. HDPE or PVC pipe within the manhole shall be neatly cut off at least a minimum of 4" away from manhole wall. The invert in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines, if any. Channel cross-section shall be U-shaped with a minimum height of half pipe diameter to three-fourths of pipe diameter for fifteen inch and larger. The side channels shall be built up with mortar/concrete to provide benches at a maximum of 1 in 12 pitch towards the channel.

d. All manholes shall be individually inspected for water migration, cutoffs, benches, and invert works.

5. Process Limitations:

Though installation process may be licensed or proprietary in nature, CONTRACTOR **SHALL NOT** change any material, thickness, design

values or procedural matters stated or approved in SUBMITTALS, without OWNER's prior knowledge and pre-approval.

3.2 TESTING OF SEWER PIPE

A. General: Testing will be required after the pipeline has been installed between manholes. Test shall consist of a low-pressure air test of the sewer pipe before any service connections to the new installed pipe have been made. The purpose of this test is to check the integrity of the pipe and to verify that the pipe has not been damaged during operations when pulling it through the borehole space created by directional drilling.

B. Plugging of Test Section: After a manhole-to-manhole section of sewer pipe has been lined, it shall be plugged at each manhole with pneumatic plugs. Design of the plugs shall be such that they will hold against the test pressure without requiring external blocking or bracing. One of the plugs shall have three air hose connections, one for inflation of the plug, one for reading of the pressure into the sealed line and one for introducing air into the sealed line.

C. Low Pressure Test:

1. Test section shall be pressurized to 4 PSI and held above 3.5 PSI for not less than two (2) minutes. Air shall be added if necessary to keep the pressure above 3.5 PSI. At the end of this two (2) minute stabilization period, the pressure shall be noted (must be 3.5 PSI min.) and the time period shall begin. If the pressure drops 0.5 PSI in less time than given in Table 2, the section of pipe shall have failed the test.

2. When prevailing groundwater is above the sewer liner pipe being tested, test pressure shall be increased 0.43 PSI for each foot that the water table is above the invert.

| **SEWER SIZE** (Inches) | **MINIMUM TEST TIME** (Minutes) |
|---|---|
| 8 | 4 |
| 10 | 5 |
| 12 | 6 |
| 15 | 7.5 |
| 18 | 7.5 |

3. If the time for the pressure to drop 0.5 PSI is 125% or less of the time given in the table, the line shall immediately be re-pressurized to 3.5 PSI and the test repeated.

4. Pressure gauges used shall be supplied by the CONTRACTOR and have minimum divisions of .010 PSI.

D. Post Televising of Completed Sections: CONTRACTOR shall provide to OWNER a color video tape showing the completed work, including condition of the restored

service connection. Video shall be taken by a pan and tilt radial viewing pipe inspection camera, that pans +/-275 degrees and rotates 360 degrees. Camera shall have an accurate footage counter, which shall display on the monitor the exact distance of the camera from the centerline of the starting manhole.

E. Restoration of Project Area: Upon completion of the installation work, testing, and televising, CONTRACTOR shall restore/clear the project area affected by his operations. No trash, rubbish, etc., shall be stored at any site whether the work is in progress or not.

3.3 TELEVISION INSPECTION OF SEWER LINE:

A. General: Television inspection of sewer pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit color television. Television inspection shall include the following:

1. Video tapes (post installation) to be submitted to the OWNER prior to processing of final invoice.

2. Videotapes to remain property of the OWNER; CONTRACTOR to retain second copy for his use.

3. All flows tributary to reach of sewer being inspected are to be completely by-passed around the reach during video inspection, if necessary and/or required by the OWNER.

4. Post construction videotape footage shall be taken upon completion of reconstruction of each reach of sewer with the voice description, as appropriate, and with stationing of service connections indicated. Data and stationing shall be indicated on video.

5. Should any portion of the inspection tapes be of inadequate quality or coverage, as determined by the OWNER, CONTRACTOR shall have the portion reinspected and video taped at no additional expense to the OWNER.

3.4 HYDROSTATIC TESTS FOR LEAKAGE

A. General:

1. All new water mains shall be tested, after backfilling to a hydrostatic pressure of not less than 100 psi above design water pressure for the system or 150 psi, whichever is greater. Allowable leakage shall be calculated by the following formula and is shown in columnar form in Table 6:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where: L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of pipe in inches
P = average test pressure during

leakage test in psi

## TABLE 6

**Allowable Leakage per 1,000 ft. (305 m) of Pipeline*--gph^**

| Average Test Pressure PSI (Bars) | NOMINAL PIPE DIAMETER - Inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3" | 4" | 6" | 8" | 10" | 12" | 14" | 16" |
| 200 (14) | 0.32 | 0.43 | 0.64 | 0.85 | 1.06 | 1.28 | 1.48 | 1.70 |
| 175 (12) | 0.30 | 0.40 | 0.59 | 0.80 | 0.99 | 1.19 | 1.39 | 1.59 |
| 150 (10) | 0.28 | 0.37 | 0.55 | 0.74 | 0.92 | 1.10 | 1.29 | 1.47 |
| 125 (9) | 0.25 | 0.34 | 0.50 | 0.67 | 0.84 | 1.01 | 1.18 | 1.34 |
| 100 (7) | 0.23 | 0.30 | 0.45 | 0.60 | 0.75 | 0.90 | 1.05 | 1.20 |

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

^To obtain leakage in liters/hour, multiply the values in the table by 3.785.

B. No water line shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of water mains shall only be done after installation of all valves, taps and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to hydrostatic pressure during the leakage test. Testing of water mains shall be observed and documented by the Inspector/Engineer.

C. All high points and service lines in portion of system under test shall be vented and all air expelled from system prior to beginning test. All fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.

D. After section of system under test has reached required pressure as stated above, said pressure shall be maintained for two (2) hours. At conclusion of pressure test, volume of makeup water required to refill pipeline shall be determined by measurement with displacement meter or by pumping from a vessel of known volume.

E. All joints or fittings at which leakage occurs shall be reworked to insure tightness. All visible leaks shall be repaired regardless of amount of leakage. If measured amount of leakage exceeds values for the appropriate size as found in AWWA Specification C600, Hydrostatic Testing (Table 6), pipeline shall be repaired and retested until leakage is within limit set by the referenced specification. Methods of repair prior to retesting will be done with PSA Director's approval and inspection. Repairs of new construction will be by adjustment or replacement of material only. The use of repair clamps or bell clamps will not be acceptable.

3.4 DISINFECTION OF WATER MAINS

A. General - After testing and before final inspection of the completed systems, water mains and service laterals shall be flushed and disinfected in accordance with

AWWA Specification C651 latest revision. Flushing shall be accomplished at a flow velocity of not less than 2.5 feet per second.

B. Disinfection Procedures:

1. Disinfection as described in AWWA C651 - "Placing of calcium hypochlorite tablets" shall be used. Five gram (5g) calcium hypochlorite tablets with 3.25 gram available chlorine per tablet shall be attached at the inside top of the pipe by an adhesive such as Permatex No. 2 or equal. The following number of tablets for the given pipe size shall be used for an initial dose of twenty-five (25 mg/1 (ppm) chlorine:

| Pipe Diameter | Number Tablets Per 18-20 Ft. Pipe Section |
|---|---|
| 6" | 1 |
| 8" | 2 |
| 10" | 3 |
| 12" | 4 |

or the number of tablets equal to $0.0012d^2L$ rounded to the next higher integer, where d is the inside diameter, in inches, and L is the length of the pipe section, in feet. Use of the continuous feed or slug method of disinfecting may only be used to re-chlorinate a water pipe after the initial disinfection or in other specific cases approved by the PSA Director.

2. Disinfection solution shall remain in pipe line for not less than twenty-four (24) hours, after which time a chlorine residual of 10 ppm at all parts of line shall be required.

3. Following chlorination, piping shall be thoroughly flushed. Water in the new main shall be proven comparable in quality, by testing, to the existing public water supply. The Virginia Waterworks Regulations require at least two consecutive satisfactory bacteriological samples from distribution system before system can be placed in service. CONTRACTOR shall pay all costs associated with disinfection and testing of installed facilities and any additional bacteriological samples required after first set.

3.5 CARE AND RESTORATION OF PROPERTY

A. All heavy equipment shall be operated with care to prevent damage to existing structures and/or wires.

B. On paved surfaces, the CONTRACTOR shall not use or operate tractors, bulldozers, or other power-operated equipment the treads or wheels of which are so shaped as to cut or otherwise damage such surfaces.

C. All surfaces which have been damaged by the CONTRACTOR'S operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations. Suitable materials and methods shall be used

for such restoration.

D. Restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

## 3.6 PROTECTION OF EXISTING STRUCTURES, PRIVATE PROPERTY, AND RIGHTS-OF-WAY

A. All existing pipes, poles, wires, fences, curbing, property-line markers, and other structures which, in the opinion of OWNER must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury by CONTRACTOR, and in case of injury, CONTRACTOR shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When the owners do not wish to make the repairs themselves, all damage shall be repaired by CONTRACTOR, or, if not promptly done by him, OWNER may have the repairs made at expense of CONTRACTOR.

B. The CONTRACTOR shall consult the OWNER or his representatives prior to removing or disturbing any tree, shrub, bush, fence, sidewalk, building structure, or improvement that may be encountered in the line of the sewer line or in the path of the easement, or right-of-way secured by the OWNER. Immediately upon completion of sewer line rehabilitation through each piece of private property, the CONTRACTOR shall replace the sod, lawns, bushes, shrubs, or whatever else may have been removed, disturbed or altered during the progress of the work.

## 3.7 PAYMENT

A. The installed pipe shall be paid for per linear foot of the size pipe specified and shall include all pipe bedding, backfill material, annulus sealing material and launching pits. Locating and reconstruction of services and all reconnections of services shall be paid for per each connection made, including fittings and pipe.

1. The work performed as prescribed by this item will be paid at the hourly rates for labor and equipment required to install water or sanitary sewer pipe installed by horizontal directional drilling for the specified pipe diameter and location, which price shall be full compensation for installation of the new pipe, placing of all materials, labor, tools, equipment, cleaning, and any other operations necessary to complete the project.

B. Television inspection and all relevant SUBMITTALS shall be paid based on the cost per linear foot to televise entire length of installed pipe.

C. The cost of any necessary by-pass pumping shall be paid based on the hourly rate submitted as part of the bid.

D. All costs for testing the pipe after installation shall be considered incidental to the cost of the project.

E. All other payments shall be made as per bid items. No payment shall be made for work considered incidental or complimentary to a pay item already in bid. The contractor shall clarify, for his own benefit, all work required for any item, incidental or otherwise, prior to bidding.

**- END OF SECTION -**