

## **Section VI – Technical Specifications**

### **ITEM IV – WATER LINES**

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#### **4.01 DESCRIPTION**

The Contractor shall furnish all labor, materials, and equipment necessary for a complete and fully operational installation. Materials shall include pipe, fittings, valves, services, and other appurtenances required as shown on the plans or specified. Work shall include all clearing, grubbing, excavation, shoring, backfilling, bedding, ditching, diking, pumping, bailing, draining, flushing and testing or similar task required to install water lines. Work shall include all provisions necessary to protect and maintain roads, buildings, fences, culverts, storm drains, underground utility lines or any other existing structures. Work shall include the furnishing of traffic control measures acceptable to SCDOT or the Owner of the affected street. Work shall include clean-up, restoration, and grassing.

#### **4.02 QUALITY ASSURANCE**

- A. Perform work in accordance with all applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. All material or products which come into contact with drinking water shall be third party certified as meeting the specifications of the American National Institute/National Sanitation Foundation Standard 61, Drinking Water System Components – Health Effects. The certifying party shall be accredited by the American National Standards Institute. PVC piping shall bear the approval of the National Sanitation Federation (NSF).
- D. All pipe, fittings, packing, jointing materials, valves and fire hydrants shall conform to Section C of the American Water Works Standards (AWWA).
- E. Where water mains which have been previously used for conveying potable water have been authorized by the Engineer for reuse, they must meet applicable criteria from AWWA Section C, ANSI/NSF 61, and ASTM D1785 or D2241. The mains must be thoroughly cleaned and restored practically to their original condition.
- F. Asbestos cement pipe shall not be used in potable water systems except in the repair of existing asbestos cement lines.
- G. Thermoplastic pipe shall not be used above grade.
- H. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, setting meters or valves, or other appurtenances which will expose the material to the water.
- I. Lubricants which will support microbiological growth shall not be used for slip-on joints.

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- J. The use of vegetable shortening is prohibited.
- K. The use of solvent-weld PVC pipe and fittings in water mains 4-inches and larger is prohibited.
- L. All pipe material, solder and flux shall be lead-free (less than 0.2 percent lead in solder and flux and less than 8.0 percent lead in pipes and fittings).
- M. All standards cited in this specification shall refer to the latest revision of that standard under the same specification number or to superseding specifications under a new number.

**4.03 DELIVERY, STORAGE, AND HANDLING**

- A. Inspect materials delivered to the site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store PVC piping and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
- B. Deliver and store valves in shipping containers with labeling in place.
- C. Handle pipe, fittings, valves, hydrants, and other accessories in such manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings of pipe and fittings. Damaged materials shall be repaired or replaced. Do not leave rubber gaskets and plastic piping that are not to be installed immediately out in the sunlight, but store under cover of direct sunlight.

**4.04 WATER PIPE**

- A. Ductile Iron Pipe: Ductile iron pipe shall be in accordance with ANSI A21.50/AWWA C150 and conform to the requirements of A21.51/AWWA C151, latest standards. Push-on, and restrained joint pipe shall have a minimum rated working pressure of 150 psi. The minimum pressure class of all buried pipe shall be as follows unless the pipe manufacturer recommends a thicker wall for depth of bury and bedding shown on the drawings

<u>Pipe Diameter (in.)</u>	<u>Pressure Class</u>
4” – 12”	350
14” – 20”	250
24”	200
30” – 64”	150

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All ductile iron pipe shall have cement lining complying with AWWA C104. Provide bituminous exterior seal coat for buried piping. Exposed pipe shall be furnished with an exterior coating of red primer in order to facilitate painting by the Contractor.

1. Fittings: Mechanical joint ductile iron, 250 psi pressure rated fittings complying with ANSI A21.10/AWWA C110 or ANSI A21.53/AWWA C153. All fittings shall have cement lining complying with AWWA C104. The use of compact fittings is acceptable.
  2. Joints:
    - a. Mechanical or Push-On Type complying with ANSI A21.11/AWWA C111 for general buried service.
    - b. Flanged joints complying with ANSI A21.15/AWWA C115 for exposed service unless approved otherwise; bolts and nuts shall conform to ANSI A21.11/AWWA C111.
    - c. Provide mechanically restrained joints where indicated on drawings and at all creek crossings. All other areas may use thrust blocking as shown on drawings. Restrained joints shall be Fast-Grip, as manufactured by American Cast Iron Pipe Company, or Equal.
  3. Tracing Wire: #12 Copper Conductor with Blue Insulation
- B. Copper Tubing: ASTM B88, Type K, annealed:
1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
  2. Joints: Compression connection or AWS A5.8, BCuP silver braze.
  3. All pipe material, solder and flux shall be lead-free (less than 0.2 percent lead in solder and flux and less than 8.0 percent lead in pipes and fittings).
- C. PVC Pipe: 2" Through 3"- ASTM D-2241 Class 200, SDR 21 bearing the seal of approval of the National Sanitation Foundation (NSF)
1. Fittings: PVC, Class 200, IPS with Push On Bells conforming to ASTM 3139 and gaskets conforming to ASTM F477.
  2. Joints: ASTM D3139 compression gasket ring also conforming to ASTM F477. Joints shall be integral bell and spigot
  3. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters.

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- D. PVC Pipe: 4" Through 12"- AWWA C900 Class 150, SDR 18 bearing the seal of approval of the National Sanitation Foundation (NSF).
1. Fittings: Ductile Iron as specified above under Ductile Iron Pipe.
  2. Joints: ASTM D3139 compression gasket ring.
  3. Detection Tape: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters.
  4. Tracing Wire: #12 Copper Conductor with Blue Insulation
- E. PVC Pipe: 14" Through 48"-AWWA C905 PR 235, DR 18 bearing the seal of approval of the National Sanitation Foundation (NSF).
1. Fittings: Ductile Iron as specified above under Ductile Iron Pipe.
  2. Joints: ASTM D3139 compression gasket ring.
  3. Detection Tape: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters.
  4. Tracing Wire: #12 Copper Conductor with Blue Insulation

### **4.05 GATE VALVES - 2 INCHES AND OVER**

- A. AWWA C509, Iron body, bronze trim, non-rising stem with operator, single wedge, resilient seat, mechanical joint ends, All interior and external ferrous surfaces including the interior of the gate, shall be coated with a protective coating conforming to AWWA C550, latest revision, control rod, extension box , and protective concrete collar. Valves shall be rated at 200 psi working pressure. Buried valves shall have a square nut operator and valve box with extension stems if necessary to extend the valve operator to within 4 feet of the top of the ground, unless otherwise noted. Non-buried valves will be supplied with flanged ends and a handwheel.

### **4.06 HYDRANT**

- A. Manufacturers:
1. Mueller Company " Centurian "
  2. American Valve and Hydrants Model " B-62-B Quick Fix "
  3. U. S. Pipe and Foundry Model " H-205 "

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4. Kennedy Valve Company " Guardian "
- B. Hydrant: AWWA C502, UL 246, working pressure 150 psi. Each hydrant shall have a 6 inch hub connection. Hydrants shall be of the size commercially recognized as five inch hydrants with a 5 1/4 inch valve opening. Hydrants shall be furnished with the proper extensions to bring the hydrants to the proper finish grade.
- C. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- D. Hose and Streamer Connection: Match sizes with utility company, two 2 1/2 inch hose nozzles, one 4 1/2 inch pumper nozzle.
- E. Finish: Primer and two coats of enamel Special coating in color required by utility company.
- F. Hydrant Tees: All hydrants shall be installed with the use of hydrant tees and valves.

### **4.07 WATER MAIN - TAPPING SLEEVES AND SADDLES**

#### A. Manufacturers:

1. Rockwell
2. Ford
3. Clow

#### **B. FOR EXISTING LINES 4" OR LESS AND TAP SIZES 3" AND SMALLER:**

Saddles: Ford Model H-10488 or Rockwell #313 Double strap saddles with epoxy coating and 304 Stainless Steel Straps and Nuts suitable for 200 psi working pressure.

#### **C. FOR EXISTING LINES 6" AND LARGER AND TAP SIZE 4" AND LARGER:**

Sleeves: Cast iron Split sleeve required for all same size taps. Rockwell Model 622-XXXXXXXX-031 - Fabricated Steel Sleeves with Epoxy Coating and 304 Stainless Steel Bolts and nuts will be acceptable for all reducing size taps. All Sleeves shall be suitable for 150 psi working pressure. Valves shall be supplied to integrally fit to the sleeve and provide connection to the existing water main without any interruption of service.

### **4.08 VALVE BOXES**

- A. Each valve buried in the ground shall be provided with an approved valve box and cover. The boxes shall be adjustable screw type made of close-grained gray cast

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iron, in three pieces, comprising of the lower base piece which shall fit around the stuffing box gland and rest on the valve bonnet, the upper part which shall screw onto the lower part and have a socket to receive the cover. The cover shall have the word "WATER" cast on the upper surface in raised letters. All castings shall be thoroughly cleaned and heavily coated with asphalt or coal-tar varnish.

- B. Each valve box shall be provided with a concrete valve marker and protector as detailed on the plans.
- C. Each valve box shall be fitted with an extension stem for use with the buried service non-rising stem valves. The stem shall be of metal and used to extend the position of the 2" operating nut to within 4 feet of grade, unless otherwise noted. Each stem shall be fitted with a self centering disk below the operating nut to keep the stem aligned in the valve box and minimize the amount of grit that can enter the valve box.

**4.09 AIR RELEASE VALVES**

A. Manufacturers:

- 1. APCO
- 2. Crispin
- 3. Golden Anderson

B. Air release valves shall be designed for a minimum of 200 psi pressure and sized as shown on the drawings. Air release valves shall be provided at high points in water mains as shown on the drawings. Automatic air release valves shall not be used in situations where flooding of the manhole or chamber may occur.

C. Chambers, pits, or manholes containing valves, blow-offs, meters, air release valves, or other appurtenances to the distribution system, shall not be connected directly to any storm drain or sewer.

**4.10 BORING AND JACKING MATERIALS**

A. Steel Encasment Pipe: Shall be smooth wall steel pipe, meeting or exceeding ASTM A-139 Grade B 35,000 PSI minimum yield strength and coated or cathodically protected with the following minimum wall thicknesses:

Steel Encasment Pipe Size	Wall Thickness (In.)	Carrier Pipe Size
12"	0.188	4"
16"	0.188	6"
20"	0.188	8"
24"	0.250	10", 12", & 14"

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30”

0.312

16” & 18”

- B. Carrier Pipe Supports within steel casing: Shall be heavy duty two piece type 304L stainless steel bands of a minimum width of 12 inches with a minimum of four abrasion resistant dielectric runners. All bolts shall be made of 304L stainless steel. The spacer shall serve as a stable, effective skid during installation of the carrier pipe, compressing the clooar against the carrier pipe. Casing spacers shall be placed at intervals no greater than 10 feet. Casing spacer shall be as made by APS or engineer approved equal.
- C. Carrier pipe shall be restrained joint Ductile Iron.
- D. Carrier pipe shall be sealed on each end with a wrap around synthetic rubber seal with type 304 stainless steel banding straps. The seal shall be made of 1/8” synthetic rubber with excellent chemical resistant characteristics. The wrap around rubber shall be supplied with two pressure sensitive butyl mastic strips to seal the joint overlap. The casing end seals shall be as manufactured by APS or other Engineer approved equal.

### **4.11 WATER SERVICE CONNECTION MATERIALS**

- A. Corporation Stops: Shall be of brass, domestic manufacture and of the proper size for the service on which they are installed. Where dictated by the tapping angle, eighth or quarter bend couplings shall be provided. Suitable brass adapters for coupling the corporation stop to the service pipe shall be provided.
- B. Tapping Saddles: Shall be of malleable galvanized iron with flat double straps. The straps and nuts shall be type 304 Stainless steel. The top plates shall have a thick boss to permit full engagement of threads. The seal between the pipe and the top plate shall be provided through a neoprene gasket, permanently cemented to the underside of the clamp body. Saddles shall be a Rockwell #313 or approved equal.
- C. Curb Stops: Shall be brass, domestic manufacture and of the proper size for the service on which they are installed.
- D. Service Pipe: Shall be polyethylene tubing, AWWA C901, Polyethylene (PE) pressure pipe (Class 160), DR=7
- E. Meter Boxes: Shall be cast iron top and bottom with solid cast iron lid as shown on the plans. A cast iron yokebox by Ford or equal shall be used for 3/4” or 1” meters.

### **4.12 PIPE INSTALLATION-GENERAL**

- A. Verify existing conditions.
- B. Verify that municipal utility water main size, location, and invert are as indicated.

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- C. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- D. Remove scale and dirt on inside and outside before assembly.

### **4.13 PIPE BEDDING**

- A. Excavate pipe trench to depth shown on drawings. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. A continuous and uniform bedding shall be provided in the trench for all buried pipe as shown on the drawings.
- C. Form and place concrete for pipe thrust restraints at any change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraint bearing on subsoil as indicated on the plans.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent.
- E. Stones, other than crushed bedding, shall not come in contact with the pipe and shall not be within six (6) inches of the pipe.

### **4.14 INSTALLATION – PIPE**

- A. Maintain separation of water main from sewer and storm drain piping in accordance with " Ten States Standard " code and the latest approved version of Section R61-58.4D(12) of SCDHEC's State Primary Drinking Water Regulations as duplicated herein.

#### South Carolina State Primary Drinking Water Regulations - Section R61-58.4D(12)

1. Parallel installation - Water Mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, the Department of Health and Environmental Control may allow a deviation on a case by case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.
2. Crossings - Water mains crossing sewers shall be laid to provide a minimum vertical separation of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is either above or below the sewer line. Whenever possible, the water main shall be located above the sewer line. Where a new water main crosses a new sewer line, a full length of pipe shall be used

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for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other. Where a new water main crosses an existing sewer line, one full length of water pipe shall be located so both joints will be as far from the sewer line as possible. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the water main.

3. Special Conditions – When it is impossible to obtain the distances specified in R.61-58.4(D)(12)(a) and (b) the Department may allow an alternative design. Any alternative design shall:
  - a. maximize the distances between the water main and sewer line and the joints of each;
  - b. use materials which meet the requirements R.61-58.4(D)(1) for the sewer line; and,
  - c. allow enough distance to make repairs to one of the lines without damaging the other.
4. Force Mains - There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18 inch vertical separation at crossing as required in R.61-58.4(D)(12)(a) and (b).
5. Sewer Manholes - No water pipe shall pass through or come in contact with any part of a sewer manhole. Water lines may come in contact with storm sewers or catch basins if there is no other practical alternative, provided that ductile iron is used, no joints of the water line are within the storm sewer or catch basin.
6. Drain-fields and Spray-fields – Potable water lines shall not be laid less than 25 feet horizontally from any portion of a wastewater tile-field or spray-field, or shall be otherwise protected by an acceptable method approved by the Department.
7. Above-water Crossings - The pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.
8. Under-water Crossings - A minimum of two (3) feet of cover shall be provided over the pipe. When crossing water courses that are greater than fifteen (15) feet in width, the following shall be provided:
  - a. The pipe material and joints shall be designed appropriately;
  - b. Valves shall be located so the section can be isolated for testing or repair; the valves (on both sides of crossing) shall be easily accessible and not subject to flooding.

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- c. A blow-off shall be provided on the side opposite the supply service sized in accordance with SCDHEC R61-58.4(D)(7). Direct away from streams, over ground.
- d. Use DIP with mechanical joints for any lines being installed in rock.
- B. Installation of water mains and appurtenances shall be conducted in accordance with Section C of the AWWA Standards and/or manufacturer's recommended installation procedures.
- C. Install pipe to indicated elevation to within tolerance of 1 inch.
- D. Install ductile iron piping and fittings to AWWA C600.
- E. Route pipe as shown on the plans.
- F. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- G. Install access fittings to permit disinfection of water system.
- H. Slope water pipe and position air release valves at high points.
- I. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- J. Establish elevations of buried piping to ensure not less than 3 ft of cover.
- K. Install trace wire continuous over top of all pipe. In addition, install metallic location/detection tape buried 12 inches above pipe line over all PVC pipe. All mains shall be detectable within three (3) feet with electronic locating equipment.
- L. Backfill trench as shown on the drawings.
- M. No flushing device, chambers, pits or manholes containing valves, blow-offs, meters, air relief valves, or other such appurtenances shall be directly connected to any storm drain or sewer.
- N. Water mains shall be located out of contaminated areas, unless using pipe materials that will protect (i.e., DIP with chemical resistant gaskets) the mains from contamination. Re-route the water line if possible.
- O. There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contamination materials may be discharged or drawn into the system.

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- P. Cross connection devices must be installed in accordance with current SCDHEC State Primary Drinking Water Regulations.
- Q. Hydrant drains shall not be connected to or located within 10 feet of sewer system.

### **4.15 THRUST BLOCKING**

- A. All tees, bends, and plugs on lines 2.5 inches in diameter and larger; and all post hydrants on lines 3 inches in diameter and larger; and all hydrants on lines 6 inches in diameter and larger shall be provided with concrete thrust blocking or mechanical restraints to prevent movement. Thrust blocking shall be installed per the plans and approved by the Engineer prior to backfilling.
- B. Concrete minimum 28-day compressive strength for thrust blocking shall be 3000 psi. Concrete shall not be poured over bolts or block access to mechanical restraint fasteners. Thrust blocking shall not block weep holes. Hydrostatic testing shall not be performed on the pipe line system until thrust blocking has been properly installed.

### **4.16 INSTALLATION - VALVES AND HYDRANTS**

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway. All hydrants shall be setup using hydrant tees and valves to allow for removal of hydrant without allowing the valve to slip from the water main.
- D. Set hydrants to proper grade.
- E. Locate control valve 3 feet away from hydrant.
  - D. Paint hydrants in accordance with this section.

### **4.17 INSTALLATION - TAPPING SLEEVES AND SADDLES**

- A. Clean existing water main and remove all foreign matter from pipe. Bolt saddle or sleeve as specified into the existing line. Attach tapping valve to saddle or sleeve. Pressure test the saddle/sleeve and valve connections prior to tapping the line. Tap the line using an approved tapping machine and bit of the size specified.

### **4.18 INSTALLATION – BORING AND JACKING STEEL CASING**

- A. Boring and tunneling operations shall be performed in accordance with all requirements of the state department of transportation or the railroad, as applicable, including insurance, inspection, temporary work, watchmen, flagmen, protection of personnel and

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property, work restrictions, work scheduling and blasting. Unless otherwise specified or directed, the Contractor shall pay for all costs in connection with meeting these requirements. The Contractor shall be responsible for repair or replacement of all existing structures and facilities, including settlement of roadments, damaged or disturbed as a result of the work, at no additional cost to the Owner and department of transportation or railroad, within a period of one year after completion of boring and tunneling operations. All work shall be completed to the full satisfaction of the department of transportation or railroad.

- B. Insurance requirements for the railroad are specified in the General Conditions, and as specified hereinafter.
- C. Inspection: Boring and tunneling operations will be subject to inspection by the Engineer and by the department of transportation or railroad, as applicable. The department of transportation or railroad inspector will have full authority to stop work if, in his opinion, it may cause damage to the highway or railroad or endanger traffic.
- D. Railroad Right-of-Way: For all work on railroad right-of-way, the Contractor shall notify the railroad at least 72 hours prior to beginning construction.
- E. Blasting:
  - 1. Department of Transportation: No blasting will be done without prior written approval of the department of transportation. If requested, the Contractor shall furnish the department of transportation with details of the proposed blasting method. Blasting shall comply with all federal, state and local regulations pertaining to the use of explosives.
  - 2. Railroad: No explosives or blasting will be permitted in connection with boring and tunneling operations without prior written approval of the railroad. When requesting approval to blast on railroad right-of-way, the Contractor shall provide the following at no additional cost to the Owner and as necessary to comply with railroad requirements.
  - 3. Certificate of Insurance (in the amount required by the railroad) with proof that explosion, collapse, and underground coverage is provided. The certificate shall show that insurance coverage is provided for the contractual liability assumed by the Owner in his encroachment agreement with the railroad.
  - 4. Blasting procedure (including load, drill and shooting pattern) shall be submitted. If the railroad engages the services of an independent blasting expert to monitor blasting, the cost of this expert will be paid by the Owner. All other costs in connection with blasting shall be paid by the Contractor.
- F. Experience: Before starting boring or tunneling operations, the Contractor shall submit to the Engineer an experience record of the proposed boring and tunneling

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subcontractor. Such record shall include a list of equipment and personnel to be used, and a list of at least five previous successful similar installations under highways or railroads within the past five years. Failure to submit an experience record or submittal of a record not meeting these requirements will be cause for rejection of the boring and tunneling subcontractor.

- G. Unless otherwise specified or directed, encasement up through 48-inch diameter shall be welded steel pipe installed by boring and jacking, and encasement larger than 48-inch diameter shall be steel liner plate installed by tunneling. Contractor shall submit complete drawings, details and other data of the proposed method of construction, materials and equipment to the Engineer and department of transportation or railroad for review. No open excavation will be allowed within the limits of the encasement without the Engineer's approval. All sheeting, shoring and bracing shall be provided as necessary for the satisfactory and safe performance of the work, and will be subject to the approval of the Engineer and in accordance with the requirements of the department of transportation or railroad. All work areas shall be maintained in a suitable dry condition at all times, with methods of dewatering, draining, pumping and disposal of water subject to approval of the Engineer and department of transportation or railroad.
1. Boring: Encasement pipe shall be installed by boring and jacking welded joints, to the required lines and grades. The Contractor shall bear the cost of any corrective action required to meet the line and grade requirements shown on the plans. Welding shall conform to the requirements of the American Welding Society and the American Railway Engineering Association for this type of work. The distance to which boring is carried ahead of the pipe shall be not more than is absolutely necessary for installation purposes, and will be subject to approval of the Engineer. The work shall be performed so that no voids occur in the earth surrounding the pipe and so that ground settlement adjacent to and within the limits of the pipeline crossing is eliminated. If voids occur or are encountered outside the pipe, grout holes shall be drilled at 10-foot centers in the top of the encasement pipe and the voids filled with 1:3 Portland cement grout. Abandonment procedures shall be completed prior to moving to another boring location. All costs in connection with an abandoned bore, including the construction cost shall be the Contractor's expense and capping and filling costs.
  2. Tunneling: The completed tunnel liner shall consist of steel liner plates with bolted connections installed to the required lines and grades and in accordance with the manufacturer's instructions. All voids and spaces between the outside of the liner plate and the tunnel wall shall be pressure grouted. Shoring and bracing shall be removed so as to avoid collapse and to allow proper backfill.

Grout shall consist of 1:3 Portland cement grout, placed under sufficient pressure to completely fill all voids. The grouting operation shall never be further than 25 feet from the head or front end of tunnel construction. At the end of each day's work, the space outside all installed liner plates shall be grouted whether 25 feet or less. Grout shall be forced into each grout hole provided in the liner plates. If grout from one hole flows along the liner plates and plugs the next hole, the plugged hole shall be opened

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by punching through the grout so that the hole can be used for grouting. Grouting shall be continued at each hole until all spaces outside the liner plates are filled and grout stops flowing.

- H. Carrier pipe shall be installed in a manner to provide proper line and grade. Carrier pipe shall be adequately anchored to prevent movement, including flotation by the use of properly sized casing spacers as specified herein. Contractor shall submit his proposed method of installation and details of anchorage to the Engineer prior to installation.
  - 1. After the carrier pipe is installed, each end of the encasement or tunnel shall be sealed with casing seals as specified above and as shown on the drawings.
- I. Appurtenances: Vents and drains shall be provided where indicated on the plans. Vents shall consist of pipe as noted, and shall be located so as not to interfere with highway maintenance nor to be concealed by vegetation. Drains shall be provided at the lower end and shall consist of stone as noted on the plans.

### **4.19 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Flush and disinfect system in accordance with AWWA Standard C651 and all SCDHEC requirements. An Engineer approved Water Treatment Firm (three years documented experience required) shall provide and attach the required equipment to perform the water system testing. In general, one approved disinfection method referred to as the “continuous feed method” is as follows:
  - 1. All pressure testing should be completed (with the system passing the test) before disinfection.
  - 2. Before being placed into service, all new mains shall be thoroughly flushed then chlorinated with not less than twenty-five (25) milligrams per liter of available chlorine. Water from the existing distribution system or other approved source of supply shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. Chlorinated water shall be run through the main until the twenty-five (25) milligrams per liter free chlorine comes out the furthest end of the line. Flush all hydrants and valves along the way to insure contact. Inject chlorine within 10 feet of the beginning of the new main.
  - 3. Maintain disinfectant in system for 24 hours. After 24 hours, check that the chlorine residual is not less than 10 mg/L. If the residual drops below 10 mg/l, the line shall be re-disinfected.
  - 4. Flush, circulate, and clean with municipal water of satisfactory bacteriological quality until required cleanliness is achieved. Prior to sampling, the chlorine residual must be reduced to normal system residual levels or be non-detectable in those systems not chlorinating.

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5. The Owner shall collect a minimum of two (2) samples from each sampling site for total coliform analysis. The number of sites depends on the amount of new construction but must include all dead-end lines, be representative of the water in the newly constructed mains, and shall be collected a minimum of every 1,200 linear feet.
  6. The water samples must be collected at least twenty-four (24) hours apart and must show the water line to be absent of total coliform bacteria. The chlorine residual must also be measured and reported.
  7. If the membrane filter method of analysis is used for the coliform analysis, non-coliform growth is greater than eighty (80) colonies per one hundred (100) milliliters, the sample result is invalid and must be repeated. All samples must be analyzed by a State certified laboratory.
  8. Replace permanent devices removed for disinfection.
- B. Disinfection report shall include:
1. Type and form of disinfectant used.
  2. Date and time of disinfectant injection start and time of completion.
  3. Test locations
  4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
  5. Date and time of flushing start and completion.
  6. Disinfectant residual after flushing in ppm for each outlet tested.
- C. Bacteriological report shall include:
1. Date issued, project name, and testing laboratory name, address, and telephone number.
  2. Time and date of water sample collection.
  3. Name of person collecting samples.
  4. Test locations.
  5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
  6. Certification that water conforms, or fails to conform, to bacterial standards of DHEC.

### **4.20 SERVICE CONNECTIONS**

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with by-pass valves and sand strainer.
- B. Provide bronze ball valve or ball valve curb stop on discharge side of reduced pressure backflow preventer. Provide approved valve box for ball valve or curb stop.

Section VI – Technical Specifications

**4.21 FIELD QUALITY CONTROL**

- A. Compaction testing will be performed in accordance with one of the following sections. ASTM D1557, ASTM D698, AASHTO T180, ASTM D2922, ASTM D3017.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- C. Frequency of Tests: The frequency of tests shall be determined solely by the Engineer.
- D. Pressure Test: All pressure/leakage testing shall conform to the hydrostatic testing requirements of the latest approved version of AWWA C600. The Contractor will be required to test each section of line between valves at a pressure of 150 pounds per square inch or 1.5 times the **maximum working pressure** at the point of testing, whichever is greater. This pressure shall be maintained for not less than two hours or as long as the Engineer may require in order to detect any leakage or defective material. Any makeup water required shall be carefully measured and the leakage shall not exceed the requirements of AWWA C600-93. Any visible leakage shall be corrected. The Contractor shall use an oil filled 0 - 160 PSIG gage to determine the test pressure unless noted otherwise. Allowable leakage is determined by the following formula:

$$L = [SD(P)^{1/2}] \div 133,200$$

Where,

- L* = allowable leakage (gals/hr)
- S* = length of pipeline tested (feet)
- D* = diameter of pipe (inches)
- P* = average test pressure (psig)

END OF SECTION