

# TECHNICAL SPECIFICATIONS FOR WATER SYSTEM MATERIALS AND INSTALLATION



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# TECHNICAL SPECIFICATIONS FOR WATER SYSTEM

## MATERIALS AND INSTALLATION

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### PART 1 - GENERAL

#### 1.1 QUALITY ASSURANCE

All water mains, appurtenances and construction methods shall adhere to the following standards where applicable:

A. Standards:

1. American National Standards Institute
  - a. ANSI A21.10 ductile cast iron fittings
  - b. ANSI A21.11 ductile cast iron fittings
  - c. ANSI 21.4 ductile cast iron pipe cement lining
  - d. ANSI A21.51 ductile cast iron pipe
  - e. ANSI A21.6 ductile cast iron pipe dimensions
  - f. ANSI A21.8 ductile cast iron pipe dimensions
  - g. ANSI B16.1 ductile cast iron fittings
  - h. ANSI B16.b ductile cast iron fittings
2. American Society for Testing and Materials
  - a. ASTM A48 cast iron butterfly valve body
  - b. ASTM A126 cast iron butterfly valve body
  - c. ASTM A252 encasement pipe
  - d. ASTM A339 ductile cast iron fittings
  - e. ASTM A436 cast iron butterfly valve disc
  - f. ASTM C33 crushed stone
  - g. ASTM D1598 pipe tests
  - h. ASTM D1599 pipe tests
  - i. ASTM D1784 PVC pipe
  - j. ASTM D2152 pipe tests
  - k. ASTM D2241 PVC pipe
3. American Water Work Association
  - a. AWWA C110 cast iron fittings
  - b. AWWA C111 cast iron fittings
  - c. AWWA C151 ductile cast iron pipe
  - d. AWWA C301 pipe gaskets
  - e. AWWA C500 gate valves
  - f. AWWA C502 fire hydrants
  - g. AWWA C504 butterfly valves
  - h. AWWA C515 gate valves
  - i. AWWA C600 pipe installation
  - j. AWWA C900 PVC pipe

4. American Association of State Highway Transportation Officials
  - a. AASHTO T99 compaction of backfill
  - b. ASTM 698 Soil Density
  
5. Federal Specifications
  - a. WW-P-42 IB
  - b. WW-P-421C ductile cast iron pipe joints
  - c. WW-P-4211 pipe gaskets
  
- B. Soil Testing
  1. Retain the services of a testing laboratory to perform all density tests required at the project site. In areas of fill and back fill, field density tests shall be performed in sufficient numbers to insure that the specified density is obtained.
    - a) All defective work of material shall be repaired and/or areas in which testing indicates compaction below the specified density shall be reworked, or removed and replaced until specified compaction is obtained.
  
- C. Soil Erosion Control
  1. Siltation, sedimentation, and erosion shall be kept to a minimum at all times during construction. The Contractor shall employ sedimentation and erosion control methods during construction in order to comply with the requirements of the N.C. Sedimentation Pollution Control Act of 1973, and to plan requirements.
  
- D. Material Testing
  1. Material shall be tested in accordance with the General Conditions of these Specifications and the following:
    - a. Pipe: Each joint of pipe shall be subjected to successfully meet a hydrostatic proof test in accordance with AWWA requirements for each type. Cast iron pipe shall be tested prior to lining. Certified test results shall be furnished to the Owner, for each shipment of pipe.
  
    - b. PVC Pipe: PVC pipe shall be given the Quick Burst Test in accordance with ASTM D1599; Sustained Pressure Test in accordance with ASTM D1598; Acetone Immersion Test in accordance with ASTM D2152; Vise Flattening Test (compress 2" long ring in less than 1 minute to 100% flattening without evidence of splitting or shattering); and Drop Impact Test C. (Single impact load from a free-falling missile having a 2" diameter rounded, 1" long nose compacted on a 6" long horizontal specimen. No shattering or splitting shall occur at the following energies 12" nominal size - 24 ft-lb, 2" - 57 ft-lb, 4" - 86 ft-lb, and 6" 100 ft-lb).
  
    - c. Pipe Fittings: Pipefittings shall be subject to inspection and testing in accordance with standard manufacturing practice.
  
    - d. Gaskets: Gaskets shall be tested, if required, in accordance with Section 3-4 of AWWA C301, and ANSI A21.11.

- e. Valves: Valves shall be tested to double the design working pressure and test results submitted to the Owner upon request.
- f. Other Material: Other material shall be subject to such testing as the Owner may require should its acceptability be questioned.
- g. System Testing:
  - 1) Pressure Test:
    - a) After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 150% the working pressure at the point of testing or 150 psi whichever is greater.
    - b) Test Pressure Restrictions: Test pressures shall be:
      - (i) 150 PSI
      - (ii) Not exceed pipe or thrust restraint design pressures.
      - (iii) Be of at least 2-hour duration.
      - (iv) Not vary by more than plus or minus 5 psi.
      - (v) Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.
      - (vi) Not exceed the rated pressure of the valves if resilient-seated butterfly valves are used.
    - c) Pressurization: Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe.
    - d) Air Removal: Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged, or left in place.
    - e) Examination: All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory.

- 2) Leakage Test: A leakage test shall be conducted concurrently with the pressure test.
- a) Leakage Defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
  - b) Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = S \times D \times (P/\text{square root})/148,000$$

L - the allowable leakage in gallons per hour

S - the length of the tested section, in feet

D - the nominal diameter of the pipe, in inches

P - the average test pressure during the leakage test, in pounds per square inch gauge

- c) When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.
- d) When hydrants are in the test section, the test shall be made against the hydrant.
- e) Acceptance of Installation: Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified by the leakage test requirements of this Section, the Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance.
- f) All visible leaks are to be repaired regardless of the amount of leakage.
- g) Should any test disclose leakage greater than that allowed above, the Contractor shall, at his own expense, locate and repair the defect until the leakage is within the specified allowance.

- 3) Sterilization:
  - a) Before any potable water main is placed in service, it shall be flushed out and sterilized with chlorine or calcium hypochlorite. The sterilizing solution shall be introduced at one end of the main as water is being withdrawn from the other end, in such proportion as to give 50 ppm of free chlorine throughout the main. The solution shall remain in the pipe for 24 hours, at which time it shall have residual chlorine of 10 ppm throughout the main, or the process shall be repeated. The line shall be flushed out and bacterial analyses shall show negative results, if necessary, the process shall be repeated. Furnish all chemicals required.
  - b) Furnish all necessary pipe or hose extensions or transportation to the point of use and shall exercise care in the use of water. The maximum flow rate that can be extracted from the Owner's system is 200 gallons per minute. A higher flow rate for flushing large diameter lines will be allowed at certain times of the day and week as approved by the Owner.
  - c) Upon completion of sterilization, the water line shall be refilled with water. Generally, a sample will be taken every 2,000' for distribution lines and every 4,000' on transmission lines. Samples may be taken at new service connections, at air valve stations, or through any other connection to the line 1" or smaller in diameter. Samples shall not be taken at fire hydrants. The samples shall be taken in standard sterilized bacteria sample bottles marked with the project name and sample location. Bacteriological samples collected following new water main disinfection should be performed by a North Carolina State Certified Laboratory, per Rule .1001 of the *Rules Governing Public Water Systems*. Results of the analysis shall be furnished to the Owner.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General:
  1. All materials and appurtenances shall meet the following minimum standard requirements below;
  2. Pipe shall comply with all applicable AWWA Standards at each type and to the following:
    - a. Trench width for buried pipe design shall be considered as the outside diameter of the pipe plus 2', from the bottom and up to 1" above the top of the pipe.

- b. Buried pipe shall be designed for laying condition "C" (flat bottom trench-tamped backfill) to withstand all internal pressures and external loads with a minimum depth of cover of 3', for pipelines 8" and smaller in diameter, and 3'-6" for lines 10" and larger in diameter, and greater depths of cover where required by the Plans, plus an H-20 live load in accordance with A.A.S.H.T.O. Specifications.
- c. Design pressure shall consist of 150-psi working pressure plus 100-psi surge allowance unless noted differently.
- d. Pipe diameters shown or called for shall be the minimum net inside diameter of the pipe after any required lining is placed, with a maximum tolerance of 3" on minus side, for sizes through 36" diameter.
- e. Pipe fittings shall be of the size, configuration and type called for in the Plans. All fittings shall be of at least the same class as the pipe with which they are used. Ductile or gray cast iron fittings shall be used with all ductile and gray cast iron pipe, asbestos cement pipe, and PVC pipe (4" or larger in diameter).
- f. All valves shall have standard mechanical joint ends, except where flanged or other type ends are specifically required. Flanges, where required shall be 125 lb. ANSI standard unless otherwise indicated. All valves shall be furnished with operating nuts, or hand wheels as necessary, except in instances where other operating devices are specified or shown. All valves shall be of at least the same class of the pipe with which they are used. A cast iron valve box and cast iron cover marked "WATER" shall be provided for each underground valve except where shown differently on the Plans. Cast iron rings and covers shall be provided for all air valves and concrete vaults as detailed.

## 2.2 DUCTILE CAST IRON PIPE

- A. Ductile cast iron pipe shall be centrifugally cast of ductile cast iron having a minimum tensile strength of 60,000 psi, minimum yield strength of 42,000 psi, and a minimum elongation of 10% (Grade 60-42-10). It shall be designed, manufactured, and shall conform to the requirements of ANSI A21.50 and A21.51, for a minimum 150 psi operating pressure plus a minimum allowance of 100 psi for surge.
- B. Nominal laying lengths shall be 18' or 20' nominal maximum of 20% of each size for each order being as much as 24" shorter than the nominal laying length and an additional 10% as much as 6" shorter than nominal laying length.
- C. Pipe joints shall be either Type II or Type III in accordance with Federal Specification WW-P-42 IC except where flanged ends are specifically required.
- D. Dimensions shall conform to the requirements of ANSI LA21.6, ANSI A211.8, ANSI A21.11, and WW-P-42 IC, as applicable. Dimensions shall be gauged at sufficiently frequent intervals to assure dimensional control. Insides of sockets and outside of spigot ends shall be tested with circular gauges.



- E. Minimum nominal wall thicknesses and allowable depths of cover shall be as follows:

Maximum Depth Cover	Pipe Diameter (inches)									
	4	6	8	10	12	14	16	20	24	30
5	0.26	0.25	0.27	0.29	0.31	0.33	0.34	0.36	0.38	0.30
8	0.26	0.25	0.27	0.29	0.31	0.33	0.34	0.36	0.38	0.39
12	0.26	0.25	0.27	0.29	0.31	0.33	0.34	0.39	0.44	0.44
16	0.26	0.25	0.27	0.29	0.31	0.36	0.37	0.42	0.50	0.51

Ductile iron pipe shall be minimum Class 50.

- F. Tolerances below the standard thickness of pipe and bell shall not exceed:

Size	Allow. Minus Tolerances (inches)
4-8	0.05
10-12	0.06
14-12	0.07

- G. All pipes shall be tested at the factory in accordance with AWWA requirements for each type.
- H. Underground pipe shall be coated on the outside with asphaltic coating per ANSI A21.51. The coating shall be continuous, smooth, and strongly adherent to the pipe and shall not become brittle from cold or sticky from the heat.
- I. Interior surfaces of each pipe, for water service, shall be cement lined in accordance with ANSI, 21.4, with minimum thickness of 1/16" for 3" to 12" pipe and 3/32" for 14" to 24" pipe, and 1/8" for 30" to 48" pipe.
- J. Each pipe shall be weighed prior to placing of the inside lining. Weight, nominal thickness, sampling period, and class of pipe shall be shown on each pipe. The manufacturer's year of production and the letters DI or Ductile shall also be cast or stamped on the pipe. All markings shall be clear and legible and on, or near, the bell end.

### 2.3 POLYVINYL CHLORIDE PIPE

- A. PVC pipe shall be rigid polyvinyl chloride with integrally formed, factory-fabricated bell, for rubber type joint rings. It shall be suitable for all conditions imposed by Plan locations and for a maximum working pressure of 150 psi, plus 100 psi surge allowance at 73°F. Pipe shall be Type 1, Grade 1, made from clear virgin material

and shall conform to the requirements of Commercial Standard C5 256, ASTM D1784, ASTM D2241 and with standard dimension ratio C900 DR 18 PVC pipe. All pipes shall bear the National Sanitation Foundation Seal of Approval for potable water, the manufacturer's name, and class of pipe.

- B. Pipe color shall be blue.

#### 2.4 DETECTABLE TAPE

- A. A detectable tape for protection of underground water lines shall be used above all water lines. The tape shall be an inert, bonded layer plastic with a metalized foil core and shall be highly resistant to alkalis, acid, or other destructive chemical components likely to be encountered in soils. The tape shall be brightly colored to contrast with soil and shall bear an imprint identifying the type of line buried below. The tape shall be a minimum of 2" wide.
- B. The tape shall be buried a maximum of 12" below the ground surface directly above the water line with printed side up. The Contractor shall take necessary precaution to insure that the tape is not pulled, distorted or otherwise misplaced in completing the trench backfill. The tape shall be Terra Tape as manufactured by Griffolyn Co., Inc., or an approved equal.
- C. Tracer wire is required in addition to Detectable Tape. Tracer wire shall be 12 gauge THHN or better.
- D. Tracer wire for Horizontal Directional Drilling shall be Copperhead Solo Shot Extreme, or Equal. All wire connections are required to be direct bury connectors. Two wires are required to be pulled on each drill shot.

#### 2.5 WATER SERVICE MATERIALS

- A. See details on plans for water service materials.

#### 2.6 STEEL ENCASUREMENT PIPE

- A. Steel encasement pipe shall be bituminous coated inside and outside. Bituminous coating shall be 6 mil. Minimum thickness. Steel encasement pipe shall have a minimum thickness as indicated in the plans for bores under highways and shall meet ASTM specifications A252 with a minimum yield strength of 35,000 psi. Wall thickness of steel encasement pipe shall comply with the latest North Carolina Department of Transportation regulations.

#### 2.7 DUCTILE CAST IRON FITTINGS

- A. Ductile cast iron fittings shall conform to the requirements to ANSI Specification A21.10, with mechanical joint ends conforming to ANSI Specification A21.11, except that material and manufacturer shall conform to ASTM Specification A339, Grade 80-60-3 and compact fittings shall conform to ANSI/AWWA C 153/A21.53. All fittings shall be bituminous coated and cement lined as required for pipe. Where flanged ends may be required, flanges shall conform to applicable requirements of ANSI B16.1 and ANSI B16b. Minimum class shall be equal to class pipe used.

2.8 PVC FITTINGS

- A. PVC fittings and adapters shall conform to the same requirements as for pipe and shall be the same class as the pipe.

2.9 TAPPING SLEEVES AND SADDLES

- A. Tapping sleeves shall be mechanical joints or caulked type with 125 lb. ANSI Standard outlet flange, suitable for 150 psi. Tapping Saddles shall be banded type, with two (2) bands for ductile iron pipe and hinged type for PVC pipe, suitable for bolting in place on the pipe to be tapped. Sleeve shall have a single rubber gasket cemented in place on the inside of the sleeve body. Sleeve shall meet all the requirements of ANSI/AWWA C110/A21.10 and C111/A21.1.
- B. Tapping sleeves greater than 2" diameter shall be stainless steel with carbon steel flanged outlet, and conform to the following:
  - 1. Body, straps and UNC threaded studs are made of 18-8 Type 304 stainless steel. Flange can be either ASTM A240 Type 304 stainless steel or ASTM carbon steel.
  - 2. All sleeves shall be fully passivated for corrosion resistance.
  - 3. Tapping sleeves shall be rated for 250 psi working pressure on 2" – 12" lines.
  - 4. Outlet gasket shall be Buna-N rubber per ASTM D2000.
  - 5. Sleeve shall be UL Classified to ANSI/NSF Standard 61.
- C. Tapping saddles are not allowed when connecting main diameter is 50% or larger than existing main to be tapped. An InsertaValve must be used if 25 or more customers will be affected by the outage.

2.10 JOINT MATERIAL

- A. Gaskets for pipe and fittings shall be continuous ring of rubber material compounded to resist deterioration and of a texture to assure a permanent and watertight seal. They shall have smooth surfaces, free from pitting, blisters, porosity or any other defects. Gaskets shall conform to the requirements of AWWA Specification C301 and Federal Specification WW-P4211.
- B. Gasket lubricant shall be a potable hydrogenated vegetable oil, insoluble in cold water, non-toxic, shall not support the growth of bacteria, and shall not impart taste or odor to the water. It shall not contain detergents soaps, organic solvents or other deleterious ingredients and shall have no deterioration effects on the gaskets. The lubricant shall be semi-paste, easily applicable, readily adherent to the inside of the bell and shall remain in a usable state throughout the range of temperature in which pipe is normally installed. Lubricant shall be delivered to the job site in unopened containers bearing the manufacturer's name and trade name or trademark, NSF approved.

2.11 GATE VALVES

- A. Gate valves (2" through 12") shall be iron body or resilient seat, non-rising stem and provided with suitable stem seals. They shall comply with AWWA C515, and be designed for an operating pressure of 150 psi. All valves shall open left (counter clockwise). Buried valves shall have a 2" square operating rest. Extension stems shall be furnished where depth of bury places operating nut in excess of 4' below finished

grade. No extra compensation for extension stem will be forthcoming. Gate valves shall be as manufactured by American-Darling Valve and Mfg., M&H Mueller Co., Dresser, Allis Chalmers, Clow Valve, or approved equal.

- B. Sixteen inch (16") valves and larger shall be equipped with bevel gear operator and bypass line with valve. The bypass line and valve shall be 3" diameter for valves under 24" and 4" diameter for valves 24" and larger. The gear mechanism shall be totally enclosed with watertight gear case, suitable for underground installation. The valves shall be designed for installation in a horizontal position and shall be equipped with track, scrappers, and rollers or trunions. Valve interior coating shall be the industry standard unless otherwise specified. Buried valves shall be bituminous or asphalt coated as specified in this section. Valves for non-buried service shall have the exterior prime coated only. Gate valves shall be as manufactured by American- Darling Valve and Mfg., M&H Mueller Co., Dresser, Allis Chalmers, Clow Valve, or approved equal.

## 2.12 BUTTERFLY VALVES

- A. Butterfly valves shall be tight closing, rubber-seated valves, conforming to the class required by use and location as shown on the Plans. Valve bodies shall be of heavy-duty cast iron. ASTM A126, Class B or ASTM A436, Type 1, with stainless steel seating edges. Valve shafts shall be one-piece straight through, or stub shaft, Type 304, or Type 316, 18-8 stainless steel and or sufficient size. Valve shafts may also be solid one-piece high tensile strength carbon steel, with 304 stainless steel journals at places where corrosion resistance is required. Bearings shall be of bronze, Teflon, or other material acceptable to the Owner, and valve seats shall be of rubber, neoprene, or other acceptable material. Valves shall provide 90 closures and shall be bubble tight after installation, when subjected to twice the design working pressure. Valve seating shall be continuous uninterrupted 360.
- B. Each valve shall be equipped with a suitable underground type, totally enclosed, 2" nut operator designed to hold the valve disc in any intermediate position, between fully open and fully closed, without creeping or fluttering. Manual operator shall be the worm and gear, traveling nut, or lead screw type and shall be self locking. All valves shall open left (counterclockwise).
- C. Valves and operators shall be satisfactory for frequent operation and for application involving operation after long periods of inactivity. Valve coatings shall be as specified in this Section.
- D. Butterfly valves for water transmission mains shall be as manufactured by Allis Chalmers, B.I.F., Henry Pratt Company, Dresser Industries, American-Darling, Mueller, Clow Valve, or approved equal.

## 2.13 PRESSURE AIR VALVES

- A. Valve interior and exterior coatings shall be the industry standard unless otherwise specified. Pressure air valves shall be either Crispin Pressure Air Valves as made by Multiplex Manufacturing Company, or APCO valves as made by Valve and Primer Corporation, or valves of equal characteristics. The valves may be compact in size and shall be designed for at least 150 psi pressure. Vaults to house Pressure Air Valves shall be concrete and conform to details.

## 2.14 FIRE HYDRANTS

- A. Fire hydrants shall be of the compression type, dry top, and traffic model of cast iron and shall conform to the requirements of AWWA C502. They shall have 6" mechanical joint connections with a minimum 5 ¼" main valve. Connection of valve seat to drain ring shall be bronze-to-bronze threads. Each hydrant shall have two 2½" hose nozzles and one 4 ½" pumper nozzle, with washers. Barrel lengths shall be generally for 4½' to 5' trench, except where other lengths are necessitated by the hydrant location. The threads, operating nuts and direction of opening shall be identical to that of existing hydrants or are of the types desired by the Owner.
- B. The hydrant barrel shall be made in two sections joined together a few inches above the ground line by a watertight coupling, or break ring, so designed that if a break occurs, it will occur at this point. Breakaway bolts are not acceptable. The ring shall be of ample strength for ordinary service, and be easily and cheaply replaceable. The valve stem shall be in two sections, joined by a special coupling at the same point as the break ring, so designed that if the hydrant is broken, the coupling will break and the valve not be disturbed. All working parts shall be removable without disconnecting the hydrant. Fire hydrants shall be as manufactured by Clow Medallion (with stainless steel stems), and EJ 5CD250 with Pender County options 981, or approved equal.
- C. The hydrant leg shall be C900 DR 18 PVC pipe.
- D. Fire hydrants shall be painted with a reflective two-tone color scheme; red hydrant with silver caps and bonnet. The hydrants shall be cleaned, primed, and painted with a minimum of a two-coat system. The fire hydrant top and all caps shall receive the reflective paint.
- E. One fire hydrant repair kit shall be provided for every ten (10) fire hydrants installed. Provided to Inspector at the end of project.
- F. Fire hydrants that have been installed but are not ready for service shall be bagged/covered until such time the hydrants are placed into service.

## 2.15 BLOW-OFFS

- A. Blow-offs shall conform to plan details and shall be of the type shown. The valve shall meet the requirements for other gate valves and shall be suitable for the anticipated pressure. Blow-offs shall be furnished with concrete valve markers.

## 2.16 VALVE MARKERS

- A. Valve markers shall be as shown on the plans and of concrete, reinforced as shown. Concrete shall be of a mix designed to produce a 3000-psi compressive strength at 28 days. They shall be marked with recessed letters, MV, AV, or BO as appropriate and installed facing item to be located.

## 2.17 VALVE BOXES

- A. Adjustable 2-piece valve boxes shall be gray cast iron in conformance with ASTM A48, Class 30. Lids shall be heavy-duty traffic weight with the word "WATER" cast into the lid. Provide cast-iron screw type top section of length required for depth of burial of

valve and bottom section with base of size to fit over valve. Valve boxes shall be coated inside and out with asphalt. Acceptable valve boxes are: Sigma Corporation Model V-8459, Capitol Foundry of Virginia, Inc., Model VB-FCWA #3435, or equal.

## 2.18 CRUSHED STONE

- A. Crushed stone for pipe foundation shall meet ASTM C33 #67 stone graded 2" to 1".

## 2.19 CONCRETE

- A. Concrete for protection and thrust blocks shall be composed of Portland Cement, sand; coarse aggregate, water, and such admixtures as may be allowed, in such proportions as to provide in minimum compressive strength of 3,000 psi.

# PART 3 - EXECUTION

## 3.1 LOCATIONS

- A. Ensure that all rights-of-way, permits, or other legalities are in order. All work shall be confined to rights-of-way or permit limits.

## 3.2 RELATION OF WATER MAINS TO SEWERS

- A. *Lateral Separation of Sewers and Water mains:* Water mains shall be laid at least 10 feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-ft lateral separation in which case (1) the water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or (2) the water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.
- B. *Crossing a Water Main over a Sewer:* Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
- C. *Crossing a Water main Under a Sewer:* Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

## 3.3 BORED ENCASUREMENT INSTALLATION

- A. Pipelines installed through steel encasement shall meet the specifications herein described and all Department of Transportation or Railroad specifications and guidelines for installing pipelines through steel encasement pipe. Upon insertion of the pipeline through the encasement pipe, the ends of the pipe shall be sealed per the detail. The seal shall be such to withstand hydrostatic pressure from ground water and

backfill loads. Provide means to prevent water line from floating within the encasement pipe. Grouting procedure will not be allowed.

- B. Casing pipe and joints shall be of leak proof construction, capable of withstanding railway or traffic loading. The diameter of the casing pipe shall be at least 2" greater than the largest outside diameter of the carrier pipe, joints, or couplings for carrier pipe less than 6" in diameter and at least 4" greater for carrier pipe, 6" in diameter and greater, unless indicated differently on the detail. Further, the casing pipe shall be of great enough diameter to allow the carrier pipe to be removed without disturbing the case pipe.
- C. Each section of carrier pipe within the encasement pipe must have a minimum of two spacers/supports.

### 3.4 DIRECTIONAL DRILLING

#### PART 1 – GENERAL

##### 1.1 QUALITY ASSURANCE

###### A. Requirements

- 1. Requirements of Regulatory Agencies:
  - a) Comply with North Carolina OSHA Standards, Underwriter Laboratories and all other authorities having jurisdiction.
- 2. Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications.

###### B. Reference Standards

- 1. Comply with applicable provisions and recommendation of the following, except as otherwise shown or specified.
  - a) AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution
  - b) AWWA M55 – Measures to resist the contractive Poisson Force effects of HDPE pipe being filled
  - c) ASTM D3261 - Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
  - d) ASTM D3350 - Standard Specifications for Polyethylene Plastic Pipe and Fittings Materials
  - e) PPI TR-3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
  - f) PPI TR-4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds

- g) NSF Standard #14 - Plastics Piping Components and Related Materials

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Material shall be high-density polyethylene pipe, SDR 9, Class 200.
- B. Pipe shall be butt heat fusion welded.
- C. The outside diameter of the HDPE pipe may be either iron pipe size or ductile iron pipe size. Contractor shall furnish and install all necessary transition couplings or fittings to connect to the main pipe for a complete and acceptable installation.

**2.2 PIPE**

- A. Polyethylene pipe shall be manufactured in accordance with AWWA C906.
- B. Permanent identification of piping service shall be provided by co-extruding longitudinal blue (water main) or green (sewer line) stripes into the pipe's outside surface. The striping material shall be the same material as the pipe material except for color. Stripes printed or painted on the pipe outside surface shall not be acceptable.

**2.3 FITTINGS**

- A. Polyethylene fittings shall be made from material meeting the same requirements as the pipe. Polyethylene fittings shall be molded or fabricated by the manufacturer of the pipe.
- B. Where applicable, fittings shall meet the requirements of AWWA C906.
- C. Molded fittings shall be manufactured in accordance with ASTM D3261 (butt fused) and shall be so marked.
- D. Mechanical fittings used with polyethylene pipe shall be specifically designed for, or tested and found to be acceptable for use with polyethylene pipe. Mechanical fittings designed for other materials shall not be used unless authorized by the mechanical fitting manufacturer. Special precautions may exist with certain mechanical fittings or additional components may be required--consult the manufacturer of the fitting prior to its use.

**2.4 TESTING**

- A. Pipe shall be pressure tested and leak tested in accordance with Water System Materials and Installation specifications.
- B. On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12" or 30 times the wall thickness in length (minimum) and 1" or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.



- C. Owner's representative shall be available during the testing.

**2.5 STORAGE AND HANDLING**

- A. Handle all pipe and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks. Do not otherwise drop, roll or skid pipe. Materials cracked, gouged, chipped, dented or otherwise damaged will not be approved.
- B. Pipe and appurtenances shall be unloaded opposite to or as close to the place where they are to be laid as is practical to avoid unnecessary handling. Interiors shall be kept completely free from dirt and foreign matter.
- C. Contractor shall be responsible for the proper support of the piping to ensure that the pipe is not over stressed or damaged.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

**A. General:**

- 1. The Directional Drill Technique shall perform the work. In general, the Work will proceed as follows:
  - a) Drill a pilot hole from one side of the crossing to the other. The pilot hole follows the design centerline of the pipe with the path recorded and controlled using a specially designed instrument package situated behind the drill bit.
  - b) A wash over pipe is rotated over the pilot drill string behind the pilot drill bit and exits with the drill bit on the other side of the crossing.
  - c) The drill bit and drill string is withdrawn back through the wash over pipe, leaving the wash over pipe in place.
  - d) A series of tools are connected between the end of the wash over pipe and the main. A fly cutter widens the drilled hole to its final diameter. A barrel reamer smooths the wall of the hole and directs bentonite to the fly cutter for transport of cuttings to the surface. A swivel is installed between the barrel reamer and the main to ensure that no torque is transmitted to the pipe main.
  - e) After the tools are connected between the wash over pipe and the main, the drill rig will rotate and pull the wash over pipe along the drilled path, with the pipe following slowly behind.
  - f) After the pipe is in place, it shall be pressure and leak tested.

**B. Drill Path Geometry**

- 1. Contractor is responsible for horizontal and vertical alignment of the pilot drill and final installed pipe. The pilot drill should conform to the pipeline alignment as shown on the Contract Drawings. Contractor shall submit all proposed

changes to the vertical alignment shown on the Drawings to the Owner for approval prior to commencing work. Under no circumstances shall installed pipe be at a higher elevation than that shown on the Contract Drawings or vary by more than 2 ½ feet from the horizontal alignment shown on the Contract Drawings.

2. The accuracy of the drill exit point shall be within a 2-½ foot horizontal radius of the design exit point.
3. Entry and exit points shall be located as shown on the Contract drawings.
4. Contractor shall map the location of each pilot drill string joint to a minimum horizontal and vertical scale of 1 inch equals 20 feet. The map shall be provided to the Owner.
5. Should the Contractor exceed the limits described above, a new pilot drill shall be performed at the expense of the Contractor and at no cost to the Owner.
6. If requested by the Owner, Contractor shall provide full explanation of details regarding any technical means, methods or equipment necessary to accomplish the work described herein.

**C. Job Conditions**

1. Existing Utilities: The Contractor shall be responsible to field locate existing underground utilities in the areas of Work.
  - a) Should uncharted or incorrectly charted piping or utilities be encountered during the work, consult piping or utility owner immediately for instructions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
  - b) Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
  - c) Coordinate with utility companies for shut-off of services, if required and the lines are active.
2. Use of Explosives: Do not bring explosives onto site or use in the Work. Use of explosive materials is specifically prohibited.
3. Dust Control: Contractor shall conduct all of his operations and maintain area of his activities, including sweeping and sprinkling of roadways, so as to minimize creation and dispersion of dust.

**D. Installation Specialist:**

1. Contractor shall provide the full time services of a competent installation specialist during the Directional Drilling to assist in technical matters relating to the Work. He shall advise the Owner on matters to include but not limited to

drilling, pipe support, mapping of the pipe location, quality assurance of the Work, safety or other items as necessary.

E. Completion of Work

1. Interior of all pipe and fittings shall be inspected and all dirt, gravel, sand, debris, or other foreign material shall be completely removed from pipe interior. A bulkhead shall be attached to the end of the pipe prior to attaching the swivel and barrel reamer to ensure inside of pipe remains clear during pullback operation.
2. Install all pipes accurately to line and grade shown on the Contract Drawings.
3. A watertight cap shall close the open ends of pipe any time that pipe work is not actively in progress.
4. Field cutting pipe, where required, shall be made with a machine specially designed for cutting piping. Cuts shall be carefully done, without damage to pipe, so as to leave a smooth end at right angles to the axis of pipe. Cut ends shall be tapered and sharp edges filed off smooth.
5. At completion of installing pipe, the pipe shall be stubbed two feet above grade at both ends and capped with watertight cap.

3.2 ENVIRONMENTAL CONTROLS

A. Disposal Site:

1. The drilling mud cannot be disposed of on the project site.
2. Off-site disposal of the drilling mud is the Contractor's responsibility.
3. Contractor shall comply with all applicable laws and regulations regarding the transport and off-site disposal of the drilling mud and all excess excavated materials.
4. All costs for proper transport and disposal of drilling mud and all excess excavated materials shall be included in the price bid for the Work.

B. All operations involving drilling mud shall be controlled and monitored by the Contractor to ensure containment.

1. The Contractor shall establish bermed or sandbagged pits of sufficient size to accommodate the volume of drilling mud anticipated plus a two-foot freeboard. The bermed areas shall be maintained and designed by the Contractor to ensure containment and prevent loss of drilling mud.
2. Transportation of the disposal materials off-site by public roads shall meet all North Carolina Department of Transportation requirements.

A. Transportation of materials by barge or scow shall be in accordance with the Corps of Engineers and U.S. Coast Guard requirements. No bottom open vessels shall be allowed.

### 3.5 TRENCH EXCAVATION

- A. Trenches for pipe shall be dug true to line and grade and to the following requirements: Depth of cover shall not be less than 3'-0" for pipe up to 8" in diameter and 3'-6" for pipe 10" and larger in diameter, measured to the top of pipe.
- B. Sides of trenches shall be kept as nearly vertical as possible. They shall be at least 12" and not more than 18" wider at the top of the pipe than the outside diameter of the pipe, plus sheathing where it is necessary. Where paving is to be cut, it shall be cut in advance of trenching 1' wider than the specified width of the trench.
- C. Where soil conditions prohibit vertical walls, the trench width at the bottom and at 1' above the top of the pipe shall be as specified above with the remainder being held to the least possible width greater than that specified. Where soil conditions prevent ditch excavation without excessive widths a suitably reinforced steel trench box shall be employed.
- D. Trench bottoms shall be hand graded to provide uniform and continuous bearing for the pipe along its entire length, with bell holes being dug for pipe bells. No ridges, sags, or undercutting will be allowed. Excess excavating below grade shall be backfilled at the Contractor's expense with suitable material, which shall be thoroughly tamped.
- E. Where the material at grade is unstable, soft, and incapable of supporting the pipe, the trench shall be excavated below grade, and refilled to grade with crusher-run stone or gravel to form a firm foundation for the pipe. Stone shall be compacted and graded to provide a stable foundation and a uniform bearing for pipe. Bell holes shall be provided as in other types of foundations.
- F. Dispose of material excavated from the trench that is unsuitable for backfill material. Provide in place select borrow material to replace unsuitable material for backfilling the trench as directed.
- G. Should ground water be encountered in the bottom of the trench, causing the trench bottom to be unstable, the material shall be excavated below grade sufficiently to allow a bed of crushed rock or gravel to be placed in which to bed the pipe. The work shall be done as for unstable foundations. The depth of cut below grade shall be only the minimum amount to accomplish the purpose.
- H. Whenever necessary, the side of the trench shall be braced and rendered secure and either open or closed sheeting; such sheeting and bracing to be left in place until the trench is refilled to a safe limit, not less than 2' above the top of the pipe. The top portion may then be cut off, but the lower portion shall remain undisturbed. In lieu of sheeting, suitable trench boxes may be employed. All sheeting, bracing, trench boxes, and trench construction methods shall conform to the latest Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970.
- I. At all times take necessary precautions in preventing gutters, catch basins, ditches and other drainage facilities from being clogged that might cause flooding conditions and damage to public or private properties.

### 3.6 PIPE INSTALLATION

- A. The pipe shall be carefully handled to prevent damage. Mechanical hoists or other approved methods shall be used in the handling. Depth of cover shall not be less than 3'-0" for pipes 8" in diameter or 3'-6" for pipes 10" and larger in diameter, measured to the top of pipe.
- B. Pipe and appurtenances shall be kept clean and open ends securely plugged when pipe and bell and spigots shall be thoroughly inspected and cleaned prior to lowering into the ditch and care shall be exercised after the pipe is in place to prevent dirt or other extraneous material from getting into the pipe or bells and into the spigot.
- C. Spigots shall be fully seated in the bells and the pipe shall be uniformly bedded on the bottom of the trench for its entire length with bells lying in previously dug bell holes sufficiently large to allow proper bedding and jointing. After joining, a reasonable amount of deflection may be made in the joint. Such deflection shall not exceed the allowable amount specified by the manufacturer for each size of pipe.
- D. Cast iron pipe shall be laid in accordance with the manufacturer's instructions, applicable portions of AWWA Specification C600, and the following:
  - 1. For mechanical joint pipe, Type II, the rubber rings shall be properly lubricated and spigots and bells cleaned before assembling the joint. Units of bolted joints shall be tightened with special torque limiting wrenches set to provide the proper strain on the bolt, and all nuts tightened to that limit.
  - 2. Rubber ring joints, Type III, shall be assembled in accordance with the manufacturer's instructions. The bell and spigot shall be absolutely clean prior to the seating of the gasket. The gasket shall be wiped clean, flexed and properly inserted into the socket and seated evenly and properly. Care shall be taken to eliminate any bulges, which might interfere with the proper entry of the spigot. A thin film of lubricant shall be applied to the inside surface of the gasket. Forcing the spigot into the bell until it makes contact with the bottom of the gasket shall then complete the joint. This shall be done by use of a pipe jack and assembly.
- E. PVC pipe shall be installed to all applicable portions of requirements for other pipe material and to the exact instructions of the manufacturer. Adapters shall be furnished and installed as necessary when connections are made to other types of pipe.
- F. Fittings shall be handled and installed in the same manner as the pipe and all shall be well blocked as hereinafter specified.
- G. Valves shall be carefully handled, cleaned, and checked for operation prior to backfilling. Care shall be taken to insure that no dirt, rock, or other obstacles that would interfere with the valve operation are left in the valve.
- H. A valve box shall be installed with each underground valve. They shall be carefully set, centered exactly over the operating nut and truly plumbed. The base shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be furnished where depth of bury places operating not in excess of 4' beneath finished grade.

- I. Fire hydrants shall, in general, be set well back of the curb or ditch line, with the break ring approximately 2" above the finished ground or pavement elevation. A minimum of **four** cubic feet of stone shall be placed under and around the bottom of each hydrant to facilitate its drainage. Hydrants shall be well blocked with concrete and connected back to the main with tie rods as hereafter specified. Each hydrant shall be painted, after installation, with an acceptable paint and of color(s) selected by the Owner. After installation and prior to being placed into service, each fire hydrant shall be covered with a plastic bag to indicate the fire hydrant is not in service.
- J. Valve markers shall be installed for each valve and blow-off. They shall be carefully set with the letters facing the valves and shall be plumb.
- K. Concrete for blocking and protection shall be poured in accordance with the following requirements: All fittings, bends, dead ends, fire hydrants, etc., shall be acceptably blocked with concrete having bearing on undisturbed earth in the side and/or bottom of the trench. No concrete shall be poured or splattered on fitting bells, glands, or bolts.

### 3.7 BACKFILLING

- A. All trash, forms, debris, and other foreign material shall be cleared from around all pipes and structures before backfilling.
- B. Backfilling of trenches shall be completed after the installation of each section of pipe. Backfilling shall be kept up with the pipe laying.
- C. Backfilling around the pipe and to a depth of at least 1' above the top of pipe shall be placed by hand in layers of not over 6". Only select material containing no rocks or other objectionable material shall be used for this portion of the backfill. As fast as the material is placed, it shall be cut under the haunches of the pipe with a shovel and thoroughly compacted with mechanical tamps for the full width of the trench to provide support for the bottom and sides of the pipe. Filling shall be carried up evenly on both sides.
- D. The balance of the backfill shall be placed and tamped to prevent excessive settlement. If the trench backfill is located under miscellaneous paved areas, areas to be paved, or unpaved streets, the trench shall be backfilled with suitable material free from large stones or clods in 8" layers (loose measurement) and thoroughly tamped and compacted to 95% of maximum as established by AASHTO Specification T99, Method A, with mechanical tampers, so as to avoid future settlement. Where applicable, the compaction shall be acceptable to the Department of Transportation. For trenches located in streets and highways, trench backfill shall be in accordance the Cutting and Replacing Pavement section.
- E. For pipe outside street right-of-way limits, compaction shall be at least 90% of maximum as established by AASHTO Specification T99, Method A.
- F. Excess material shall be promptly removed from the site, and the pavement or road surface cleaned of objectionable material. The pavement and/or road surface shall be cleaned daily with a mechanical broom and/or washed if requested by the Department of Transportation officials.

- G. In unpaved streets and shoulders of roads, the top 6" of trench shall be filled with stone for unpaved streets and well-compacted topsoil for shoulders. In paved areas, the top of the trench shall be filled with the specified base for pavement, well mixed and compacted. Any settlement of backfill below finish grade shall be promptly corrected.
- H. All final subsidence of all trenches and shall leave the same flush with the original ground after all settlement has taken place. Trenches must be protected against scour due to surface drainage. Correct any future settlement within the warranty period.

### 3.8 DUST CONTROL

- A. Control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project. Dust control shall not be considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property.

### 3.9 CUTTING AND REPLACING PAVEMENT

- A. Where pavement is to be cut for installation of pipe or other utilities, the Contractor shall cut it neatly in advance of trenching and shall replace the pavement with base and new pavement.
- B. All pavements shall be neatly cut to a straight edge in advance of trenching. Pavement shall be cut 12" wider than the excavated area on each side. Ragged or irregular edges will not be allowed and work completed with barred edges shall be redone. Concrete pavement shall be sawed with suitable concrete saw cutting equipment.
- C. Trench backfilling shall be done in layers not over 6" thick and thoroughly compacted. Compaction shall be such as to prevent future settlement. Rolling with rubber tired vehicles or track-type equipment will not be allowed. Compaction shall be at least 95% of maximum as established by AASHTO Specification T99, Method A.
- D. Base for pavement shall be crusher run stone for all non-NCDOT maintained streets, HB binder for all secondary highways, and reinforced concrete for all primary highways. All base shall be placed in accordance with the details and/or encroachment permit.
  - 1. Crusher run stone shall be well mixed and compacted by tamping and rolling. Compaction shall be to such degree as to preclude settlement. Crusher run base material shall be placed at the same time that the trench is backfilled. Backfilling to top of the ditch, to be cut out and replaced with base material at a later date, will not be allowed.
  - 2. Crusher run base for highway pavement and adjacent drives shall be 8" of stone, stabilized with 5% Portland Cement. It shall be thoroughly mixed prior to compacting.
  - 3. Crusher run base for non-highway pavement and drives shall be 8" of stone without the addition of cement.
  - 4. Binder base for secondary roads shall be a minimum of 6" HB binder conforming to the Department of Transportation specifications.

5. Concrete base shall consist of 8" of concrete, reinforced with #4 reinforcing steel bars placed at 8" on center in the transverse direction and #4 tie bars in the longitudinal direction. Concrete shall be designed to produce a compressive strength of 3000 psi at 28 days.
6. Pavement shall be replaced with the same type of pavement that exists prior to cutting and shall consist of either bituminous surface course (double treatment), 2" of hot plant mix asphaltic concrete, or 8" of Portland Cement concrete; all conforming to specifications of the Department of Transportation for each type.
  - a) All pavements shall be repaired within the same week that it is cut.
  - b) For asphalt pavement or bituminous surfacing, the entire area to be resurfaced (including edges of existing pavement) shall be primed with an acceptable asphalt prime coat just prior to placing new pavement.

### 3.10 REMOVING AND REPLACING SIDEWALK

- A. Where pipe is to be placed under existing concrete sidewalk, the concrete shall be removed in construction units unless their length is more than 10', in which case the concrete shall be cut as specified in this section. The backfill shall be thoroughly compacted for the entire depth of the trench.
- B. The sidewalk shall be replaced with 3000 psi concrete, 4" thick, except for driveways where it shall be 6" thick. The concrete shall be placed monolithic and dressed off with a wooden float, brush and edging tool. Where pipe is to be placed under concrete walk it shall be done by tunneling.

### 3.11 CONNECTIONS TO EXISTING MAINS

- A. Wet taps, using tapping sleeves and valves, shall generally be made; except as otherwise approved in which case the main shall be cut and the connections made with fittings and valves. In no case shall the water be shut off or the fire hydrants or gate valves operated in the existing systems without the expressed permission of the Owner.

### 3.12 INSPECTION AND ACCEPTANCE

- A. All work shall be subject to inspection and approval prior to final acceptance and payment. Final acceptance shall be contingent upon the following:
  1. All pressure and leakage tests shall yield satisfactory results.
  2. All bacteria samples shall be negative.
  3. Final cleanup will be satisfactorily performed and all defects in trench settlement, pavement patches or other deficiencies will be promptly corrected.



4. All complaints are satisfactorily resolved.
5. Receipt of a NC licensed Professional Engineers certification in writing that construction has been completed according to plans and specifications previously submitted and approved by the State.
6. Receipt of as-built drawings of the project in the form of CAD file, hard-copy and PDF sealed by the engineer.
7. Receipt of Affidavit, Deed of Dedication, and 18-Month Warranty.

**END OF SECTION**