

SECTION 02665 - WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes water systems piping for potable water service and fire protection service outside of buildings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section 02200 "Earthwork" for installation procedures.
 - 2. Division 3 Section 03300 "Cast-in-Place Concrete" for cast-in-place concrete structures.
- C. Utility-furnished products include water meters that will be furnished to the site and ready for installation.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for water system piping.
 - 1. Underground Piping: 150 psig.

1.4 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract and Sections 01300.
- B. Product data, including pressure rating, rated capacity, and settings of selected models for the following:
 - 1. Valves.
 - 2. Fire hydrants.
 - 3. Backflow Prevention
 - 3. Identification materials and devices.
- C. Shop drawings for precast concrete pits. Include frames and covers. Include drains when indicated.
- D. Shop drawings for cast-in-place concrete valve and meter pits. Include frames and covers. Include drains when indicated.
- E. Record drawings at Project closeout of installed water system piping and products according to Division 1 Section 01700 "Contract Closeout." Record actual location of piping mains, valves,

connections and invert elevation. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

- F. Test reports specified in "Field Quality Control" Article in Part 3.
- G. Maintenance data for inclusion in "Operating and Maintenance Manual" specified in Division 1 Section "Project Closeout." Include data for the following:
 - 1. Valves.
 - 2. Fire hydrants.
 - 3. Backflow prevention.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of the Public Works Department. Includes tapping of water mains and backflow prevention.
- B. Comply with standards of North Carolina Building Code. Includes materials, hose threads, installation, and testing.
- C. Comply with standards of The State of North Carolina Division of Environmental Health, Public Water Supply Section. Include materials, installation, testing, and disinfection.
- D. Comply with NFPA 24 "Standard for the Installation of Private Fire Service Mains and Their Appurtenances" for materials, installations, tests, and flushing.
- E. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
 - 1. Valves: Manufacturer's name and pressure rating must be marked on the valve body.
- F. Product Options: Water systems specialties and accessories are based on specific types, manufacturers, and models indicated. Components by other manufacturers but having equal performance characteristics may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by OWNER'S REPRESENTATIVE. The burden of proof of equality of products is on Contractor. Refer to Division 1 Section 01631 "Product Substitutions."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, for shipping as follows:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends, flange faces, and weld ends.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. Storage: Use the following precautions for valves, including fire hydrants, during storage:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

- 2. Protect valves from weather. Store valves indoors and maintain temperature higher than ambient dew point temperature. Support valves off ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and piping specialties from moisture and dirt.
- G. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Verify that water system piping may be installed in compliance with original design and referenced standards.
- C. Site Information: Reports on subsurface condition investigations made during the design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). OWNER assumes no responsibility for interpretations or conclusions drawn from this information.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate connection to existing water main with The Public Work Department.
- B. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Water Service Saddle for 2" PVC:
 - a. Ford Meter Box Co., Inc. (Model S-70)
 - b. McDonald Mfg. Co. (Model 3801)
 - c. Mueller Co. (Model 13420)

2. Water Service Saddle for 1" & 2" taps on pipes 4" and larger:
 - a. Ford Meter Box Co., Inc. (Model FS-101, FS-202,)
 - b. Hays Division., Romac Industries. (Model 101S, 202S)
 - c. Rockwell. (Model 315.317)

3. Tapping Sleeves:
 - a. Mueller Mechanical Joint
 - b. Mueller Outlet seal
 - c. American Uniseal

4. Tapping Valves:
 - a. Clow Valve Co. Div., McWane, Inc.
 - b. Mueller Co.
 - c. American Darling Valve Div., American Cast Iron Pipe Co.

5. Gate Valves:
 - a. American Darling Valve Div., American Cast Iron Pipe Co.
 - b. Mueller Co.
 - c. Clow Valve Co. Div., McWane, Inc.

6. Valve Boxes:
 - a. Alabama Pipe Company
 - b. Chapman Valve Manufacturing Company
 - c. Columbian Iron Works, R.D. Wood Company

7. Dry-Barrel Fire Hydrants:
 - a. Mueller Co. (Model Centurion 200)
 - b. Clow Valve Co. Div., McWane, Inc. (Model Medallion)
 - c. Waterous Company

8. Drains:
 - a. Ancon, Inc.
 - b. Jones Manufacturing Co., Inc.
 - c. Josam Co.
 - d. Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
 - e. Wade Div., Tyler Pipe Subsid., Tyler Corp.

- f. Zurn Hydromechanics Div., Zurn Industries, Inc.
- 9. Backflow Preventer:
 - a. Febco 825Y** Febco 826YD
 - b. Watts 009M3QT**
 - c. Wilkins 975XL Wilkins 375DA; 375DAG; 375DAP
 - d. State approved from University or Southern California List.

2.2 PIPES AND TUBES

- A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube materials specified below are used. Certified test results are to be provided to the Engineer upon request.
- B. Ductile-Iron Pipe: AWWA C151, Class 200.
 - 1. Lining: AWWA C104, cement mortar, seal coated.
 - 2. Gaskets, Glands, and Bolts and Nuts: AWWA C111.
 - 3. Push-On-Joint-Type Pipe: AWWA C111, rubber gaskets.
 - 4. Mechanical-Joint-Type Pipe: AWWA C111, rubber gaskets, ductile- or cast-iron glands, and steel bolts and nuts.
- C. PVC Plastic, Fire-Service Pipe: UL 1285 and AWWA C900. Include elastomeric seal according to ASTM F 477.
 - 1. Pipe Marking: NSF 14
- D. PVC Plastic Pipe: ASTM D 1784, with marking "NSF-pw" according to NSF 14.
- E. PE Plastic Pipe: ASTM D 2239, of PE compound and with SIDR required for 160-psig minimum pressure rating. Include marking "NSF-pw" according to NSF 14.

2.3 PIPE AND TUBE FITTINGS

- A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube fitting materials specified below are used. The fittings shall be tested and the manufacturer shall provide certified test results when requested by the Engineer.
- B. Ductile-Iron and Cast-Iron Pipe Fittings: AWWA C110, ductile-iron, 250-psig minimum pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psig pressure rating.
 - 1. Lining: AWWA C104, cement mortar.
 - 2. Gaskets: AWWA C111, rubber.

- C. Polyvinyl Chloride (PVC) Pipe Couplings and Fittings: AWWA C900, shall be compression, twin gasket type in accordance with ASTM D-3139 for push-on joints and ASTM F-447 for elastomeric seals (gaskets).
- D. Polyvinyl Chloride (PVC) Plastic, Schedule 80, Socket-Type Pipe Fittings: ASTM D 2467.
 - 1. Pipe Marking: NSF 14, "NSF-pw" or "NSF-pvc cto only."
- E. Cast-Brass Fittings for Polyethylene (PE) Plastic Pipe: Compression fittings or flare fittings, made to PE pipe dimensions.
- F. All PVC pipe and fittings shall be manufactured to withstand 755 psi quick burst pressure tested in accordance with ASTM D-1599 and withstand 500 psi for a minimum of 1000 hour tested in accordance with ASTM D-1598.
- G. Ductile Iron fittings to PVC pipe shall be adequately supported on a firm trench foundation. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

2.4 JOINING MATERIALS

- A. Refer to Part 3 Article "Piping Applications" for identification of systems where joining materials specified below are used.
- B. Ductile-Iron Pipe and Ductile-Iron Fittings: The following materials apply:
 - 1. Push-On Joints: AWWA C111 rubber gaskets and lubricant. Install in accordance with AWWA C-600.
 - 2. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets. The mechanical joints shall be stuffing box type and shall conform to ANSI A21.11 for 3" pipe or larger. Install in accordance with AWWA C-600.
 - 3. Restrained Joints: Ductile Iron in accordance with ANSI A21.53 (AWWA C-153).
- C. Pipe Couplings: Iron-body sleeve assembly, fabricated to match outside diameters of pipes to be joined.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47, Grade 32510, or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.
- D. All ductile iron pipe and ductile iron-cast iron fittings shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104).
- E. Ductile Iron: When deemed necessary and requested by the Engineer, each joint of pipe and each fitting shall be inspected by an independent domestic testing laboratory, approved by the

Engineer, and certification shall be supplied to the Engineer by them that all pipe and fittings meet project specifications. In addition, the Contractor shall furnish to the Engineer a 6" test section from each lot of water pipe as per AWWA Specification ASA 21.4 to be used for additional test of the pipe lining by the Owner. Satisfactory results of this test must be obtained before acceptance of the pipe.

2.5 VALVES

- A. Gate Valves, 6 Inches through 24 inches: AWWA C-509-94, C-515, or appropriate AWWA standard as applicable. Cast-iron or ductile iron resilient wedge style vertical or horizontal. All resilient wedge style valves shall have internal and external epoxy coating. Cast-iron or ductile-iron body and bonnet.
- B. Gate Valves 12 inches and smaller shall be mechanical joint. Shall be "O" ring, open-left valves of the non-rising stem type. Minimum of 175 psi working pressure and 300 psi hydrostatic pressure with 2 inch operating nut. Valves shall be cast-iron or ductile iron.
- C. Valve Boxes: Shall be "slip-type" made of close-grained, gray cast iron metal painted before being shipped with one coat of first quality protective asphaltum paint with a minimum thickness of 3/16". Construction shall be in three pieces as follows: The lower of base pieces, which shall be beveled at the bottom to fit around the stuffing-box gland and rest on the valve bonnet or gear disc, as the case may be; the upper part which shall be flanged on the lower end, and of such size as to telescope over the lower part, the upper end being constructed in the form of a socket to receive the cap or cover; and the cover or cap shall have cast on the upper surface, in raised letters, the word "WATER". Valve box shall have a "hole drilled in the upper part to accommodate 1/4" x 1-1/2" Galvanized Bolt for securing tracer wire. Valve box protector rings shall be installed to protect valve boxes located outside pavements. The concrete shall be a minimum of 2500 psi, reinforced with two #3 reinforcing bars, and have an outer diameter of 24 inches. The top of the protector ring shall be set approximately 1/2 inch above grade. All castings must meet or exceed AASHTO H-20 load rating. All valve boxes shall be equal in quality and workmanship to the above mention manufacturers or approved equal.
- D. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
 - 1. Tapping Sleeve: Mueller mechanical joint, Mueller Outlet Seal, American Uniseal, Kennedy Square Seal, or Clow F5205 or F5207. 100% Stainless Steel may also be used provided all parts including bolts are 100 % stainless steel. Ductile Iron flanges may be included on sleeves or saddles. All sleeves shall have a minimum working pressure of 200 psi.
- E. Water Service Saddle and Corporation Stops: Complete assembly, including service clamp, corporation stop, and bolts and nuts. Use service clamp and stop compatible with drilling machine.
 - 1. Water Service Saddle: Shall be equipped with a standard AWWA C-110-98 flange connection. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of

the tapping saddle. Straps shall be of alloy steel and saddles may be used for taps one-half the size of the main or less.

2. Corporation Stops: Bronze body and ground key plug, with AWWA C800 threaded inlet and outlet matching service piping material.

- F. All valves shall be tested for leakage and distortion in strict accordance with the latest revision of AWWA Specification C-500. All valves shall be manufactured in strict accordance with the latest specifications of the American Water Works Association (AWWA). Certification shall be furnished to the Engineer by the manufacturer that all valves meet project specifications.

2.6 FIRE HYDRANTS

- A. General: All fire hydrants shall be the compression type with cast-iron body, compression-type valve, opening against pressure and closing with pressure, 6-inch hub-end or mechanical joint elbow.
- B. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with minimum 2/0 twist link, heavy duty, non-kinking machine chain.
- C. Operating and Cap Nuts: Pentagon 1-1/2 inch point to flat.
- D. Direction of Opening: Open hydrant valve by turning operating nut to the left, or counterclockwise.
- E. Finish: bronze-to-bronze seating, a minimum 3 ½ foot bury depth with a breakaway ground line flange and breakaway rod coupling. Interior of the hydrant shoe shall be coated with a 4-mil thickness FDA approved epoxy coating. Paint shall conform to the requirements of Federal Spec. TT-V-51 or Military Spec. MIL-C450 or equal. The prime coat from the ground up shall conform to Federal Spec. TT-P-86 (Type IV), Federal Spec. TT-P-636 or equal.
- F. Dry-Barrel Fire Hydrants: AWWA C502, two 2-1/2-inch and one 4-1/2-inch outlets, minimum 4 1/2-inch main valve, drain valve, and 6-inch mechanical joint inlet.
- G. All hydrants shall be able to deliver 1000 gallons per minute with a friction loss of not more than 5 pounds per square inch total head loss through the hydrant.
- H. Hydrants shall be suitable for working pressure of 150 psi and test pressure of twice the working pressure.
- I. All painting shall be done in strict accordance with the paint manufacturer's recommendations and shall be satisfactory to the Engineer.
- J. Schedule of colors and coating requirements are as follows: Acceptable dry mil thickness will be 4-6 for each coat. Bonnet of hydrant shall be Acrylic Enamel, Dark Green paint or approved equal. Fire hydrant barrel, caps, chain and other exterior surfaces shall be Quick Drying Acrylic Enamel Yellow Paint or approved equal.

2.7 Back Flow Preventer

- A. General: Backflow assemblies and devices are made of approved brass, stainless steel or fusion bond epoxy coated ductile iron.
- B. Waterline: 2" Reduced Pressure Principle Zone Assembly (RPZ)
- C. Fire line: 8" Reduced Pressure Principle Zone Assembly (RPZ)

2.8 ANCHORAGES

- A. Clamps, Straps, and Washers: ASTM A 506, steel.
- B. Rods: ASTM A 575, steel.
- C. Rod Couplings: ASTM A 197, malleable iron.
- D. Bolts: ASTM A 307, steel.
- E. Cast-Iron Washers: ASTM A 126, gray iron.
- F. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi.
 - 1. Cement: ASTM C 150, Type I.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.

2.9 IDENTIFICATION

- A. A continuous "detectable" wire of minimum 12 gauge THHN shall be buried along the pipe. The wire shall be "stubbed" into valve boxes and secured such that a "direct"/conductive metal detector may be used to trace the pipe location. Bolts or other approved methods shall be used to secure the detectable wire and the attachment location shall be readily available from finished grade without special equipment.
- B. The location inside the valve boxes or other similar structures shall be marked with an approved fluorescent paint for easy identification.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 2 Section 02300 "Earthwork."

3.2 SERVICE PIPING

- A. Extend water system piping and connect to water supply source and water distribution and fire protection systems in locations and pipe sizes indicated.

1. Terminate water system piping at existing water meters. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to water meters when water system piping has been tested, disinfected and accepted.
- B. Use restrained-joint pipe and fittings, thrust blocks, anchors, tie-rods and clamps, and other supports at vertical and horizontal offsets.

3.3 PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and inside building may be joined with flanges or couplings, instead of joints indicated, for grooved-end AWWA-size piping.
- B. Use pipe, tube, fittings, and joining methods according to following applications.
1. 1 Inch Service: ASTM D 2239, SDR11.5, polyethylene (PE) plastic pipe, ASTM D 2609 plastic fittings, and band or crimp-ring joints.
 2. 2-Inch NPS: PVC plastic, Schedule 80 pipe; PVC plastic, Schedule 80, socket fittings; and solvent-cemented joints.
 3. 4 Inches to 8 Inches: Class 200, ductile-iron pipe, ductile-iron compact fittings, and push-on or mechanical joints, as indicated.
 4. 4 Inches to 8 Inches: AWWA C900, Class 150 polyvinyl chloride (PVC) plastic pipe, AWWA C110 or AWWA C153, Class 150 minimum, ductile-iron or gray-iron fittings, and mechanical or push-on joints as indicated.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Valves 2-Inch: UL 262 OS&Y gate valves.
 2. Valves 3 Inches and Larger: AWWA, OS&Y gate valves.
 3. Blow-off assembly valves: Bronze body, curb stop type.

3.5 JOINT CONSTRUCTION

- A. Ductile-Iron Piping Gasketed Joints: Construct joints according to AWWA C600.
- B. Flanged Joints: Align flanges and install gaskets. Assemble joints by sequencing bolt tightening. Use lubricant on bolt threads.
- C. AWWA Polyvinyl Chloride (PVC) Piping Gasketed Joints: Use AWWA C900 joining materials. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
- D. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure. Refer to "Piping Systems - Common Requirements" Article for joining piping of dissimilar metals.

3.6 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Install piping as indicated except where deviations to layout are approved on coordination drawings.
- B. Install piping at indicated elevations.
- C. Install components having pressure rating equal to or greater than system operating pressure.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
 - 1. Install unions, in piping 2 inches and smaller, adjacent to each valve.
 - 2. Install flanges, in piping 2-1/2 inches and larger, adjacent to flanged valves.
 - 3. Install dielectric fittings to connect piping of dissimilar metals.

3.7 PIPING INSTALLATION

- A. Water Main Connection: Tap water main and provide 1 inch PE water service lateral with size and in location as indicated according to requirements of the Public Works Department.
 - 1. Install tapping sleeve and tapping valve according to manufacturer's installation instructions.
 - 2. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water service piping.
 - 3. Install water service saddle and corporation stops in size, quantity, and arrangement required by Public Works Director or Engineer's standards and according to manufacturer's installation instructions.
- B. Comply with requirements of NFPA 24 for materials and installation.
- C. Install ductile-iron pipe and ductile-iron and cast-iron fittings according to ANSI/AWWA C-110/A21.10.
- D. Install AWWA polyvinyl chloride (PVC) plastic pipe according to AWWA M23 and ASTM F645.
- E. Install ASTM, NPS polyvinyl chloride (PVC) plastic pipe according to ASTM D 2774.
- F. Bury piping at minimum depth of 36 inches below finished grade and not less than 18 inches below average local frost depth.
- G. Bell ends will face the direction of laying unless otherwise directed by the Public Works Director or Engineer. For lines on an appreciable slope, the Public Works Director or Engineer may also require that bell ends face upgrade.

- H. Protection shall be afforded to all underground and surface structures using methods acceptable to the Public Works Director or Engineer. This protection shall be furnished by the contractor at the contractors' own expense.
- I. Pipe, tubing and fittings shall be homogeneous throughout, and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.
- J. A minimum of 4 feet of cover is required without excessive displacement or misalignment for water mains.
- K. Boring and Jacking: Installation shall be by dry boring and jacking of smooth wall steel pipe true to line and grade under roadways, where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer. The Contractor shall notify the Owner's Representative 7 days prior to any contemplated work and securing any required permits.

1. The casing pipe shall be spiral welded or smooth wall steel pipe in accordance with ASTM A53, Grade B having a minimum yield strength of 35,000 psi.
2. The carrier pipe installed within the casing pipe shall be CL 50 Ductile Iron push-on joint 12" diameter or less and CL 50 Ductile Iron restrained joint for diameter greater than 12".
3. The casing pipe minimum size and minimum wall thickness shall be in accordance with the following chart unless indicated otherwise on the drawings:

Carrier Pipe	Casing Pipe (O.D)	NCDOT Wall Thickness
4"	8" and under	0.188
	12 3/4"	0.188
8"	16"	0.250
	18"	0.250
	20"	0.250
12"	24"	0.250
	30"	0.312
16"	36"	0.375
	42"	0.500
24"	48"	0.500

4. The contractor may substitute larger size casing pipe with the proper wall thickness. A manual steering head or other approved guidance system is recommended for casing pipe 30 inches and larger and/or bores exceeding 100 feet in length.
5. Installation shall be by dry boring and jacking of a smooth wall steel pipe true to line and grade under roadways, where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer. The Contractor shall notify NCDOT 7 days prior to any contemplated work for securing any required permits.
6. The boring operations shall be conducted at all times in such a manner so as not to create a hazard to nor impede the flow of traffic.

7. The Contractor will be responsible for any repair costs if any settlement or damage to the roadway resulting from the boring operation occurs within one year after completion of the work. The Contractor shall maintain proper insurance as required by the North Carolina Department of Transportation.
- L. All C-900 pipe shall be installed and embedded in strict accordance with ASTM D-2321.
- M. Where conditions are, in the opinion of the Regulatory Agency Inspector/Engineer, unsuitable for laying pipe because of weather or trench conditions, the contractor shall be required to cease work until permission is given by the Regulatory Agency Inspector/Engineer for work to commence again providing such conditions have been corrected.

3.8 ANCHORAGE INSTALLATION

- A. Anchorages: Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron Piping: According to AWWA C600.
 2. Gasketed-Joint, Polyvinyl Chloride (PVC) Piping: According to AWWA M23.
 3. Fire Service Piping: According to NFPA 24.
- B. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.9 VALVE INSTALLATION

- A. General Application: Use mechanical-joint-end valves for 3-inch and larger buried installation. Use threaded- and flanged-end valves for installation in pits. Use bronze corporation stops and valves, with ends compatible with piping, for 2-inch and smaller installation.
- B. AWWA-Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box.
- C. Valves shall be set and jointed to pipe in the manner heretofore specified for cleaning, laying and joining pipe. Stuffing boxes shall be tightened and the valve shall be fully opened and fully closed to insure that all parts are in working condition. A valve box or masonry pit shall be provided for every valve. The valve box shall be centered and plumb over the wrench nut of the valve. It shall not transmit shock or stress to the valve and shall follow manufacturer's installation instructions.
- D. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides or to undisturbed soil.
- E. All dead ends on new mains shall have 2" Blow-off assembly installed as indicated on the drawings.

3.10 FIRE HYDRANT INSTALLATION

- A. AWWA-Type Fire Hydrants: Comply with AWWA M17. Install with gate valve and provision for drainage as indicated.
- B. Hydrant installation shall be in accordance with the Ordinances or as directed by the Public Works Director.
- C. All Hydrants will have individual controlling valves no more than 15 ft from the hydrant.
- D. Hydrants shall be set plumb with pumper nozzle facing roadway and with the bottom flange of the hydrant at least 1-inch above existing ground, but no more than 3-inches as shown on the detail.
- E. The backfill around hydrants shall be thoroughly compacted to the finished grade line immediately after installation to obtain beneficial use of the hydrant as soon as practicable.
- F. Not less than 7 cubic feet of free draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to insure drainage.

3.11 IDENTIFICATION INSTALLATION

- A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 inches to 8 inches below finished grade, directly over piping.

3.12 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
 - 1. Hydrostatic test pressure shall be 200 psig for pipes with ID less than or equal to 8 inches and 200 psig for pipes with ID greater than 8 inches.
 - 2. Slowly increase pressure in 50-psig increments in each valved section until test pressure is achieved. Use hydrants, blow-offs, or provide taps to expel air in high sections. Conduct visual inspection of each joint between increments. Remake leaking joints as necessary. Hold at test pressure for two hours. Maximum allowable leakage is: 10 gallons/inch diameter/mile/24 hrs.
 - 3. Pressure test shall be conducted on the main and the laterals.
- C. Prepare reports for testing activities.
- D. Flushing and cleaning is contractor's responsibility. The contractor shall pump dry and dispose off all extraneous ground water and other sand gravel and foreign objects within the water main.
- E. Cracked or defective pipe, joints, fittings, hydrants, and valves discovered in consequences of the pressure test shall be removed and replaced with sound material, and test shall be repeated until the test results are satisfactory.

- F. All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to the Owner.

3.13 CLEANING

- A. Clean and disinfect water distribution piping as follows:
 - 1. Purge new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
 - 2. Use purging and disinfecting procedure prescribed by Owner or, if method is not prescribed by that authority, use procedure described in AWWA C651 or as described below:
 - a. Comply with NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - b. Fill system or part of system with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) system or part thereof and allow to stand for 24 hours.
 - c. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine; isolate and allow to stand for 3 hours.
 - d. Following allowed standing time, flush system with clean, potable water until chlorine does not remain in water coming from system.
 - e. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by authority shows evidence of contamination.
- B. Prepare reports for purging and disinfecting activities.
- C. Services shall be sterilized by methods acceptable to the Public Works Director or Engineer, and the contractor shall have the same responsibility for laterals as for mains in regard to bearing full cost of any corrective measures needed to comply with bacteriological or other requirements.
- D. Free residual chlorine after twenty-four hours shall be at least 10 ppm, or the Public Works Department or Engineer will require the lines be rechlorinated.
- E. The Public Works Department shall determine when flushing is allowable. The contractor shall advise the inspector prior to the chlorination and flushing so that the inspector can advise the Public Works Department of the construction location, size, and length of mains. All tests will be done in the presence of an inspector.
- F. All flush water shall be with fresh water from an approved water source until the chlorine solution is dispelled. During flushing period, each fire hydrant on the line shall be opened and closed several times.

- G. After flushing is completed, the Public Works Departments (or their designee) shall collect bacteriological analysis samples for each section of pipe between main line valves.
- I. In the event that two successive bacteriologic tests fail, that section of the main shall be rechlorinated by the contractor and new tests performed prior to moving to the next section of main.
- J. The contractor shall take all necessary measures to prevent downstream erosion caused by flushing lines. All erosion/damages shall be repaired at no additional expense to the owner.

END OF SECTION 02665