

SECTION 02660

WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide water distribution system as shown on the Drawings, specified herein, and needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Part I of these specifications.
 - 2. Section 02220 – Trenching Backfilling for Utilities.
 - 3. Section 02615 – Removing and Replacing Pavements.
 - 4. Section 02780 – Casing Pipes for Utilities.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. All materials in this Section are to be manufactured in the United States.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 10 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section;
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01640.
- B. Storage of PVC pipe:
 - 1. Store in unit packages as received from manufacturer until just prior to use.
 - 2. Stack units in such manner as to prevent deformation to pipe barrel and bells.
 - 3. Protect from direct sunlight by covering with opaque material if storage period will exceed six weeks.
- C. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Use any pipe material and associated fittings as specified herein, except where use of a particular material is indicated on the plans, or specified herein.

2.2 PIPE AND FITTINGS

A. General:

- 1. Pipe 4" and larger diameter:
 - a. Use ductile iron unless otherwise indicated. No asbestos cement pipe allowed.
 - b. Plastic pipe (C900) may be used for pipe sizes (4" – 12") as approved by the Owner.
- 2. Pipe smaller than 4" in diameter: Use HDPE unless otherwise indicated.
- 3. Any pipe, solder, or flux used shall be lead free (lead free is defined as less than 0.2% lead in solder or flux and less than 8.0% lead in pipes and fittings).
- 4. Gaskets are to be factory-installed and integral with the pipe.

5. All materials and products that contact potable water shall be third party certified as meeting the specifications on ANSI/NSF Standard 61.
6. All chemical or products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.
7. For valves, cast all markings integral on the valve body with the size of valve, year of manufacture and the class working pressure.
 - a. Certifications to rate a 150B valve body to a Class 250 valve will not be acceptable.
8. For valves, spray coat all interior wetted ferrous surfaces with two-component epoxy applied to a nominal thickness of 3 to 4 mils.
 - a. Coating material to be AWWA and U.S. Food and Drug Administration approved for use with potable water.
9. Exterior Coatings: For ductile iron pipe
 - a. For buried service provide bituminous coating.

B. Pipe Types:

1. Ductile iron pipe (DIP):
 - a. Comply with ANSI/AWWA C150/A21.50 or AWWA C151/A21.51, latest revision.
 - b. The class or nominal thickness, new weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.
 - c. Wall thickness in accordance with Table 50.5 of ANSI/AWWA C150/A21.50, depth of cover indicated and Type 3 bedding conditions, minimum Pressure Class 350.
 - d. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
2. Plastic Pipe (4" – 12" C900):
 - a. Marked with NSF approval at 18" intervals.

- b. Gaskets to comply with ASTM F477. Natural rubber gaskets are not acceptable.
 - c. Pipe to be made of compound meeting cell class 12454 compound per ASTM D1784.
 - d. Joints to comply with ASTM D3139.
 - e. Pressure class to be submitted and approved by the Owner.
3. High Density Polyethylene (HDPE) pipe:

- a. Comply with AWWA C-906.
- b. The pipe supplied under this Specification shall be SDR high performance, high molecular weight, high density polyethylene pipe, and shall conform to ASTM D 1248 (Type III C, Category 5, P34). Minimum cell classifications values shall be 345434C as referenced in ASTM D 3350 – latest edition. All pipe resin shall be manufactured by the same company that manufactures the pipe itself, in accordance with these specifications to ensure complete resin compatibility and total product accountability.

The fittings supplied in this specification shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe. To ensure compatibility of polyethylene resins, all fitting supplied under this specification shall be of the same manufacture as the pipe being supplied.

- c. Physical Properties:
 - 1) The pipe shall conform to the physical properties as described herein.
 - 2) Typical pipe physical properties:

<u>Property</u>	<u>Test Method</u>	<u>Unit</u>	<u>Value</u>
Density	ASTM Method	gms/cc	0.955
Melt Index	ASTM D-1238 (190/2.16)	gms/10 min	
Environmental Stress Cracking Resistance:			
Condition A, B, & C, F-0	ASTM D 1693	hrs	>5000**
Compressed Ring, F-60	ASTM F 1248	hrs	>1500

Tensile Strength			
Yield	ASTM D 638	psi	3200
Type IV Speciment	(2"/min)		
Elongation at Break	ASTM D 638	%	>750
Victate Softening Temp	ASTM D 1525	°F	257
Brittleness Temp	ASTM D 746	°F	<-180
Flexural Modulus	ASTM D 790	psi	135,000
Modulus of Elasticity	ASTM D 638	psi	130,000
Hardness	ASTM D 2240	Shore D	65
Linear Thermal Expansion Coef.	ASTM D 696	in./in./°F	1.2x10-4
Thermal Conductivity	Dynatech-Colora BTU	In./Thermoconductor	
		ft./2 hrs./°F	2.7

**Long Term
Strength:**

73° F	ASTM D 2837	psi	1600
UV Stabilizer	ASTM D 1603	%C	2.5
Material Cell Classification	ASTM D 1248		345434C
Material Description	PPI Recommendation		PE 3408

- d. **Quality Control:** The resin used for manufacture of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties. The polyethylene resin used shall have all ingredients pre-compound prior to extrusion of pipe, in plant blending is not acceptable. Owner may request, as part of the quality control records submit, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from manufacturer's testing or random sampling by the Engineer that do not meet appropriate ASTM standards or manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9. Certified lab data may be requested to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.
- e. **Rejection:** The Owner reserves the right to reject any polyethylene pipe and fittings failing to meet any of the requirements of this specification.

- f. Pipe Dimensions: Pipe supplied under this specification shall have a nominal DIP (ductile iron pipe) size O.D. unless otherwise specified. The SDR (Standard Dimension Ratio) of the pipe supplied shall be submitted and approved by the Owner.

C. Joints:

1. Ductile iron pipe:

- a. Use mechanical or push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI/AWWA C151/A21.51.
- b. Use gaskets and lubricant complying with ANSI/AWWA C111/A21.11. Natural rubber gaskets are not acceptable.
- c. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints. They shall be NSF approved.

d. Exposed pipe:

- 1) Class 53 Minimum.
- 2) Use flanged joints complying with ANSI/AWWA C115/A21.11, latest revision; and
 - i. Flanges to be solid type.
 - ii. Use full face, red rubber, factory cut, 1/16" thick for pipe up to 10" diameter and 1/8" thick for larger sizes.
 - iii. Bolts and nuts shall be standard carbon steel machine bolts, hex head complying with ANSI A21.11/AWWA C111.

2. Plastic pipe:

- a. Use integral bell or coupling type with elastomeric gaskets.
- b. Integral bells to comply with ASTM D2672.
- c. Couplings to comply with ANSI/AWWA C900.
- d. Gaskets to comply with ASTM F477.

- 1) Natural rubber gaskets are not acceptable.
 - e. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints. They shall be NSF approved.
3. Polyethylene pipe:
- a. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed by the manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and fusion pressures. Prior approval of equipment and personnel shall be obtained before fusion begins. The completed pipe joints shall be guaranteed for five years in writing to the Owner and its Contractor.
 - b. End Connections: Special restrained joint mechanical joint adapters may be required for each end of the PE pipeline. The price quoted shall include any special end configuration and polyethylene ring to hold a standard mechanical joint.
 - c. Provide restrained joint mechanical joint adapters for each end of the PE pipeline.
 - 1) Include any special end configuration and polyethylene ring to hold a standard mechanical joint.
 - d. Expansion joint: Provide one on each end of the polyethylene pipeline.
 - 1) Ductile iron conforming to ANSI/AWWA C153/A21.53.
 - 2) Minimum 15 mil fusion bonded epoxy lining meeting ANSI/AWWA C213 and C550.
 - 3) Restrained mechanical joint.
 - 4) Minimum pressure rating of 350 psi.
 - 5) Provide minimum of 8" of expansion capability for expansion joint.
 - 6) Provide Ex-Tend 200 by EBBA Iron Sales, Inc.

D. Fittings and specials:

1. Ductile Iron Pipe:

- a. Use 350 psi pressure rated ductile iron fittings or specials unless otherwise indicated, complying with ANSI/AWWA C110/A21.10.
- b. Compact fittings for piping 4"-16" may be provided in accordance with ANSI/AWWA C153/A21.53.88.b.
- c. Fittings for use with push-on joint pipe, comply with ANSI/AWWA C111/A21.11.
- d. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
- e. The maximum phosphorous level in the casting will be 0.08%.
- f. The fitting surface finish will conform to MSS SP-112 Quality Standard for Evaluation of Cast Surface Finishes.
- g. The manufacturer shall be ISO 9000 certified.
- h. Markings: Each fitting shall have the following markings cast integrally to the fitting:
 - 1) Manufacturer's Name or Logo
 - 2) "MJ"
 - 3) Country or origin
 - 4) Manufacturer's Foundry Mark
 - 5) AWWA C-153 or C110
 - 6) Pressure Rating
 - 7) Nominal Diameter (each leg)
 - 8) "DI" or "Ductile"
 - 9) No. of Degrees (bends)

2. Plastic pipe 4" – 12":

- a. Use PVC fittings, 160 psi at 73°F pressure rating, joint design to conform to pipe joints.

E. Couplings:

- 1. Provide couplings where needed to make piping connections and as specified and located on the plans. Couplings shall be provided by Romac Industries, Inc. or approved equal by the Owner for pipe sizes 4" and larger and Hymax or an approved equal by the Owner for pipe sizes less than 4".
- 2. Provide cutting-in mechanical joint ductile iron sleeve where installing fittings into an existing line. Sleeves shall have a minimum lay length of 12".

3. Provide restrained joint couplings where restrained joints are indicated on the plans. Restraint joint couplings shall be Alpha by Romac Industries, Inc. or an approved equal by the Owner for pipe sizes 4" and larger and Hymax Grip or an approved equal by the Owner for pipe sizes less than 4"

F. Restrained joint pipe and fittings:

1. Provide restraint on all piping at each fitting, including valve and fire hydrant connections, and on the pipe joints to a minimum distance of two (2) joints to either side of the fitting.

2. Ductile Iron Pipe:

a. Push on pipe joints (gasket or restraint harness):

- 1) Fast Grip Gasket by American Cast Iron Pipe Company.
- 2) Field LOK 350 by U.S. Pipe.
- 3) MEGALUG Series 1700 Harness by EBAA Iron.

b. Pipe fittings, valves and hydrants:

- 1) Provide the following rated pressure with minimum 2 to 1 safety factor; 3"-16" 350 psi, 18"-48" 250 psi.
- 2) "MEGALUG" Series 1100 as manufactured by EBAA Iron, Inc. or approved equal.

3. PVC Pipe:

a. Push on pipe joints:

- 1) Series 1900 Harness by EBAA Iron, Inc. or approved equal.

b. Pipe fittings, valves and hydrants:

- 1) "MEGALUG" Series 2000PV as manufactured by EBAA Iron, Inc. or approved equal.
- 2) Series 2500 Restraint Harness by EBAA Iron, Inc. or approved equal.

G. Plugs or caps:

1. Provide at all pipe ends and unused branches of fittings.
2. All plugs and caps shall be tapped 2" and provided with 2" plug.
3. Plugs and caps to the restrained joint.

2.3 COPPER TRACER WIRE

- A. All pipe shall be provided with a continuous 12-gauge blue insulated copper tracer wire in accordance with the following requirements:
1. Tracer wire to be approved for direct burial by the manufacturer. THHN wire shall not be used.
 2. Locate tracer wire a minimum of 6-inch above top of water main.
 3. Terminate tracer wire at each valve and meter and make provisions to allow or connection of testing apparatus without interfering with the proper operation of valves and meters.
 4. Connect to the water line with duct tape at every bell connection or every 20' to ensure that the wire is directly over the top of the pipe.
 5. Place in the trench with all service lines.
 6. Splice at each service lateral and tee connection with an approved copper compression lug.

2.4 GATE VALVES

- A. General:
1. Open by turning counterclockwise. Two-inch metal operating nut with arrow indicating direction of opening.
 2. End connections as required for the piping in which they are installed.
 3. Use valves designed for a working pressure of not less than 200 psi.
 4. Provide stem extensions on all valves where the top of the operator nut is located greater than 36 inches below the top of the valve box.
 5. Fully coat all internal ferrous meter surfaces and valve exterior with two-part thermosetting epoxy.
 6. Design for external stem failure when excessive closing torque is applied with no failure of the pressure retaining parts.
 7. Provide double disc gate valves with bevel gears, grease case, and other necessary appurtenances of horizontal installation.

8. Valves to be manufactured in the United States. Manufacturer shall be Mueller.

9. Provide all wetted rubber compounds of synthetic rubber.

B. Gate Valves 1-1/2-Inch and Smaller:

1. Use all bronze ball valves, ¼ turn with stop, 2-inch square nut operator.

2. Provide Ford Model B11-QT67 or equal.

C. Gate Valves 2-inch through 12-inch:

1. Use resilient seated wedge valves complying with ANSI/AWWA C509.

2. Provide integrally cast bronze stem nut on resilient seated wedge valves.

3. Suitable for working pressure of not less than 250 psi.

4. Design for external stem failure outside of the valve body or bonnet when excessive closing torque is applied with no failure of the pressure retaining parts per AWWA Section 3.2.

5. Factory test with no leakage from either side of the disc.

6. Test shell to 500 psig.

7. Provide certification to NSF 61.

8. Resilient wedge valves:

a. Completely encapsulate resilient iron wedge by an elastomer, without thin spots or voids.

b. Provide polymer wedge guide bearing caps bearing surface between the encapsulated wedge and the interior epoxy coating, lowering operation torque and extending service life of the valve.

9. The manufacturing plant to have ISO9001 certification.

D. Valve Operator:

1. Provide one T-handle operator for each ten buried valves with nut operator.

2. Provide one stainless steel T-handle operator for each four buried valves with "T" head.

2.6 HYDRANTS

A. Fire Hydrants

1. Comply with ANSI/AWWA C502.
2. Provide Mueller Super Centurion 250 only.
 - a. Waterway valve opening, 5-1/4-inch.
 - b. Six-inch bell connection, two 2-1/2-inch hose connections, one 4-1/2-inch steamer connection with cap chain on all connections.
3. National Standard screw threads on outlet nozzles. Open by turning counterclockwise, cast in top indicating direction of opening.
4. Two-part breakable safety flange shall be an integral part of barrel casting.
5. Depth of bury, 3-6" inches.
6. Finish coat with industrial enamel, OSHA safety yellow.
7. Provide one hydrant wrench for each ten hydrants.

B. Reflector:

1. Provide industry standard blue hydrant reflector for paved roadway.

C. Offset Fitting:

1. Provide an offset fitting at slope areas where required for the hydrant connections to be located 1'4 inches above finished grade.
2. Locate between the shut-off valve and each hydrant with a 12-inch offset.
3. Provide ductile iron per AWWA C153, compact design, coated per AWWA C104.
4. Provide Grade Lok as manufactured by Assured Flow Sales, Inc., or approved equal.

2.7 VALVE BOX

- A. Provide cast-iron Tyler Series 6850.
- B. Provide at each buried valve.

- C. Cast iron extension type, suitable for minimum cover of 3'6 inches over the pipe.
- D. Minimum inside diameter at the top of 5-inch, minimum wall thickness 3/16-inch.
- E. Have the word WATER cast into the cover.
- F. Where depth requires more than a two-piece box use adjustable cast iron extensions.
- G. Coat box and cover with two (2) shop coats of bitumastic paint.

2.8 VALVE BOX PROTECTION RING

- A. Provide at each valve box a pre-cast concrete protection ring.
- B. Provide two rings of No. 3 reinforcing steel, one 14-inch in diameter, and one 23-inch in diameter.
- C. Inside dimensions to be 9-1/4 inches.
- D. Outside diameter to be 27 inches.
- E. Provide 5-inch thickness at interior with a continuous slope to 2-inch thickness at the outside.
- F. Minimum weight of 100 pounds.

2.9 SERVICE SADDLE

- A. Provide the following materials:
 - 1. Body – Ductile Iron ASTM-A536.
 - 2. Bales and Strips – Type 304 stainless steel.
 - 3. Studs – Type 304L stainless steel.
 - 4. Hardware – Type 304 stainless steel.

2.10 TAPPING SLEEVE AND VALVE

- A. Tapping Sleeve:
 - 1. Provide Type 304L stainless steel per ASTM A240.
 - 2. Provide rolled thread stainless steel bolts per ASTM A153, Type 304.

3. Provide Type 304 stainless steel hex head nuts, coated to prevent galling.
4. Virgin SBR gaskets, compounded for water and wastewater service.
5. Provide ¾" NPT stainless steel test plug.
6. Maximum working pressure of 200 psi.
7. Provide ROMAC Industries Model SST or approved equal.

B. Tapping Valve:

1. Construct of material compatible with tapping sleeve.
2. Valve to conform to Paragraph 2.3 above.
3. Joints – Flange to tapping sleeve, push-on (mechanical joint) (restrained joint) for pipe end.

C. Tie Rods:

1. Provide steel rods complying with ASTM Designation A242, galvanized in accordance with ASTM Designation A123.
2. Acceptable Products: Super Star Tie-rod Figure No. SS12 and Tie-bolt Figure No. SST7 as manufactured by Star National Products or approved equal.

2.11 AIR RELEASE VALVES (Not Applicable)

2.12 INSERTION VALVE

A. General

1. Equipment shall be capable of installation, without shutdown of distribution main for pipe ranges from 4" to 14". The valve shall completely stop the flow through the pipe.
2. Valve shall be capable of pressure tight assembly to exterior of the pipe in which flow is to be stopped at a working pressure not to exceed 250 psi.
3. Valve shall be constructed of two piece, ductile iron casting, to be bolted together.
4. Valve shall meet or exceed AWWA specification C509 for resilient seal valve suitable for potable water service.

5. The ductile iron gate shall have a resilient rubber seal 360 degrees around the gate and is expandable to the inside diameter of the pipe.
6. The valve stem shall be stainless steel or equal with a tensile strength of 60,000 psi.
7. Valve operator shall be the industry standard 2" square operating nut.
8. The valve body shall have an epoxy coating of no less than 8 mills.
9. The valve shall use stainless steel fasteners joining the valve bonnet to the valve top casting, unless noted in assembly drawing.
10. Chips created by the cutting process shall be flushed outside the pipe through the chip flushing hose attached to the valve body.

2.13 MISCELLANEOUS PARTS AND ACCESSORIES

- A. Use standard commercial grade suitable for the type of installation or system involved, and conforming to the applicable standards and specifications of the AWWA.

PART 3 – EXECUTION

3.1 HANDLING

- A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:
 1. Carry pipe into position – do not drag.
 2. Use pinch bars or tongs for aligning or turning the pipe only on the flare end of the pipe.
 3. Use care not to injure pipe linings.
 4. Do not damage pipe with chokers or lifting equipment.
- B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved by the Engineer.
- C. Before installation, inspect each piece of pipe and each fitting for defects.

1. Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the Owner.
- D. Rubber Gaskets: Store in a cool dark place until just prior to time of installation.

3.2 PIPE CUTTING

- A. Cut pipe neatly and without damage to the pipe.
- B. Unless otherwise recommended by the pipe manufacturer, and authorized by the Engineer, cut pipe with mechanical cutter only.
1. Use wheel cutters when practicable.
 2. Cut plastic pipe square and remove all burrs, and grind bevel on end.

3.3 LOCATING

- A. Where possible, locate water line at least ten feet away, horizontally, from sewer pipes.
- B. Should ten-foot separation not be practical, then the water main may be located closer with South Carolina Department of Health and Environmental Control (SCDHEC) approval provided:
1. It is laid in a separate trench.
 2. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.
 3. In either of the above cases, crown elevation of the sewer shall be at least 18" below invert elevation of water line.
- C. Where water lines cross over sewers, maintain 18" minimum clearance between crown of sewer and invert of water line.
- D. Where water lines cross under sewers, each line shall be cast iron or ductile iron.
1. A full length of water line shall be located over the sewer so that joints will be as far from each other as possible.

2. Where a new water main crosses a new sewer line, a full length of pipe shall be used 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 each other
- E. Potable water lines shall not be laid less than 25 feet horizontally from any portion of a wastewater tile field or spray field.
- F. Water lines shall be located outside all contaminated areas, unless using pipe materials that will protect the water supply.
- G. No flushing device or drain directly connected to any type of sewer is allowed.
- H. No cross connections between water lines and any pipes, valves, tanks or pumps that are not part of the potable water system are allowed.
- I. Water lines may come in contact with storm sewers or catch basins if there are no other practical alternatives provided that ductile iron is used and no joints of the water line are within the storm sewer or catch basin, and provided that the joints are located as far as possible from the storm sewer or catch basin.
- J. Structures containing valves, blow-offs, meters, air release valves, etc., shall not be connected directly to any storm drainage or sewer system.

3.4 EXCAVATION AND BACKFILLING

- A. Comply with pertinent provisions of Section 02221 and Section 02615 of these Specifications.
- B. For P.E. Pipe, comply with manufacturer's recommendations.

3.5 BEDDING

- A. A continuous and uniform bedding shall be provided in the trench for all buried pipe.
- B. Back-fill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe.
- C. Stones, other than crushed bedding, shall not come in contact with the pipe and shall not be within 6 inches of the pipe.

3.6 ALIGNMENT OF PIPE

- A. Pipe lines intended to be straight shall be so laid.
- B. Where vertical or horizontal alignment requires deflection from straight line or grade, such deflection shall not exceed maximum deflection recommended by the pipe manufacturer.
- C. If alignment required deflection exceeding recommended limits, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the allowable limits.

3.7 PLACING AND LAYING

A. General:

1. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the Engineer.
2. Do not dump or drop any of the materials of this Section into the trench.
3. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
4. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
5. Take up and relay pipe that has the grade or joint disturbed after laying.
6. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.
7. Securely close open ends of pipe, fittings, and valves when work is not in progress.
8. Where any part of coating or lining is damaged, repair to the approval of the Engineer and at no additional cost to the Owner.
9. Structures containing valves, blow-offs, meters, air release valves, etc., shall not be connected to any storm drain or sewer system.

B. Ductile Iron Pipe:

1. Mechanical, push on and flanged joints, install in accordance with ANSI/AWWA C600.

2. Gaskets: Handle, lubricate where necessary and install in strict accordance with manufacturer's recommendations.
- C. Plastic Pipe:
1. Clean gasket, bell or coupling interior, especially groove area.
 2. Lubricate and insert gasket as recommended by manufacturer.
 3. Align spigot to bell, insert spigot into bell until it contacts gasket uniformly.
 4. Bell pipe using manufacturer's approved leverage bar.
 - a. Do not use machinery to push pipe "home".
 5. Push pipe "home" until reference mark is at proper location and clearly visible.
 6. Follow all pipe manufacturers' installation instructions.
- D. Flanged joints:
1. Provide true face flanges, field clean and fit with one full face gasket and make bolts up finger tight.
 2. Use torque wrench to alternately tighten bolts 180° apart until full gasket flow and seal are secured.
 3. Bias cut or unusual refacing of any flange will not be acceptable.
- E. Restrained joints:
1. Install in accordance with manufacturer's instructions.
 2. Tighten set screws to the manufacturer's rated torque using a torque wrench.
 3. If twist-off nuts are provided, tighten screws until nut breaks loose.
- F. HDPE pipe:
1. Install in accordance with manufacturer's recommendation and ASTM D 2321.

2. Provide factory-trained personnel to conduct effusion joint work.

G. Polyethylene Encasement: Comply with AWWA A105.

3.8 SETTING VALVES AND VALVE BOXES

A. General:

1. Center valve boxes on the valves, setting plumb.
2. Tamp earth fill around each valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet.
3. Install shaft extensions plumb without any binding.
4. Fully open and close each valve to assure that all parts are in working condition.
5. Place valve box protection ring around top of valve box as indicated on the plans.
 - a. Install ring level with top 1" above finished grade.
 - b. Top of ring to be level with or no more than 1" above the top of the valve box.

3.9 INSTALLATION OF HYDRANTS

A. General:

1. Inspect carefully, insuring that all foreign material is removed from the barrel.
2. Set plumb and at such elevation that connecting pipe and distribution main have same depth of cover.
3. Install stone drainage bed and thrust blocking as indicated.
4. No connection or location of hydrant drains within 10' of sewer systems is allowed.
5. Hydrant leads to be a minimum of 6" in diameter and to include an auxiliary gate valve.
6. Fully open and close each hydrant to assure that all parts are in working condition.

7. Install blue hydrant reflector on centerline of paved roadway marking the perpendicular location of hydrant with reference to the road centerline.

3.10 THRUST BLOCKS

A. General:

1. Provide thrust blocks, or metal tie rods and clamps or lugs, on plugs, caps, tees, hydrants and bends deflecting $11\text{-}1/4^\circ$ or more either vertically or horizontally, and on water lines 4" in diameter or larger. Thrust blocking is not required where restrained joints are indicated unless requested by the Owner.
2. Provide concrete thrust blocking with a compressive strength of 3000 psi in 28 days.
3. Size of the blocking will be determined by the Engineer, based on soil bearing capacity.
4. Provide 8 mil polyethylene film between the thrust block and fitting.

B. Installation:

1. Locate thrust blocking between solid ground and the fitting to be anchored.
2. Unless otherwise shown or directed by the Engineer, place the base and thrust bearing sides of thrust blocking directly against undisturbed earth.
3. Sides of thrust blocking not subject to thrust may be placed against forms.
4. Place thrust blocking so the fitting joints will be accessible for repair.
5. Protect steel rods and clamps by hot dipped galvanizing.

3.11 HYDROSTATIC TESTING

A. General:

1. Pressure and leakage testing must be conducted in accordance with AWWA Standards C600.
2. Clean and flush line of air, dirt and foreign material.
3. Do not perform hydrostatic tests until at least five days after installation of concrete thrust blocking.
4. Test pump, pipe connection, pressure gauges, measuring devices and all other necessary appurtenances to conduct tests are to be provided by the contractor.
5. Install brass corporation cocks at all high points that do not have permanent air vents. Corporation cocks are to be left in place and all costs for providing such cocks are to be borne by the Contractor.
6. Conduct tests on each line or valved section of line.
7. Test pressures to be 150 psi, or 1.5 times the maximum working pressure, whichever is greater, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge.
8. Do not test pipe at pressures exceeding manufacturer's recommendations.
9. The Contractor must provide documentation of the pressure and leakage tests. Documentation must include length of lines, diameter of pipe(s), amount of water required to fill line after test was performed, and amount of allowable leakage.
10. The witness to the hydrostatic testing is to be someone other than the Contractor or the utility installing the lines.

B. Pressure tests:

1. After the pipe is laid, the joints completed, and the trench backfilled, subject the newly laid piping and valved sections of the piping to the test pressure specified in Part A above.
2. Open and close each valve within the section being tested several times during the test period.
3. Replace and remake joints showing leakage.

- a. Remove cracked pipe, defective pipe, and cracked or defective joints, fittings and valves. Replace with sound material and repeat the test until results are satisfactory.
- b. Make repair and replacement without additional cost to the Owner.

C. Leakage test:

1. Conduct leakage test after the pressure test has been completed satisfactorily.
2. Duration of each leakage test: At least two hours.
3. During the test, subject water lines to the test pressure specified in Part A above.
4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
 - a. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula(s):

1) Ductile Iron piping:

$L = S \times D \times \sqrt{P} / 133,200$; where
L = allowable leakage in gallons per hour;
S = length of pipe tested in feet;
D = nominal diameter of pipe in inches; and
P = average test pressure psi gauge.

2) PVC piping:

$L = N \times D \times \sqrt{P} / 7,400$; where
L = allowable leakage in gallons per hour;
N = number of joints in pipeline being tested;
D = nominal diameter of pipe in inches; and
P = average test pressure psi gauge.

- b. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size will be allowed.

- 1) Should any test of pipe disclose leakage greater than that specified above, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.
- 2) Repair all visible leaks regardless of test results.

3.12 STERILIZATION

A. General:

1. Upon completion of testing, sterilize all water lines to meet requirements of the South Carolina Department of Health and Environmental Control.
2. Newly laid valves or other appurtenances shall be operated several times while line is filled with chlorinating agent.
3. Should initial treatment fail to meet results specified, repeat procedures until satisfactory results are obtained, at no additional cost to the Owner.
4. All pipe taps, feeders, chemicals, etc., for sterilization shall be provided by the Contractor.

B. Procedure:

1. Flush line to extent possible with available pressure and outlets, prior to sterilization.
2. Hydrant openings required to produce flushing velocity at 40 psi are:

Pipe Size (Inches)	Hydrant Openings
4 through 12	One 2-1/2"
14 through 18	Two 2-1/2"
20	One 4-1/2"

3. Comply with the latest revision of AWWA C651 and the following:
 - a. Apply chlorine as liquid chlorine or chlorine compound such as calcium hypochlorite with known chlorine content.
 - b. Apply through corporation cock in top of main located no greater than ten (10) sections from the beginning of section being sterilized.

- c. Control water flow to a slow flow into the line.
- d. Use proper feeder and flow regulator to introduce chlorinating agent.
- e. Application rate shall be not less than 25 ppm and no greater than 50 ppm.
- f. Retain chlorinated water in main not less than 24 hours.
- g. At the end of the retention period, at least 10 ppm of chlorine shall remain in the water at the extreme end of section.
- h. Dechlorinate and flush line thoroughly.

C. Acceptance:

1. Provide two separate samples for each sample location, taken at 24-hour intervals, free from coliform bacteria.
 - a. GBPW (Owner) to take 1st and 2nd Bac-T samples.
 - b. Bac-T results shall be delivered to South Carolina Department of Health and Environmental Control (SCDHEC) along with chain-of-custody reports to request a Permit to Operate.
 - c. The first and second sample results shall include the free chlorine residual at the time the samples were collected.
2. At a minimum, sample locations shall be as required by SCDHEC and the following:
 - a. The tie-in location of new and existing water lines.
 - b. The end of all dead end lines.
 - c. At the intervals of no more than 1,200' for all new lines longer than 1,200' in length.
3. All sample locations are to be given an identifying label and a corresponding identification label is to be included on the record drawings indicating each sample location.

3.13 DECHLORINATION OF CHLORINTED STERILIZATION WATER

- A. Dechlorinate the chlorinated water used for sterilizing water lines.
- B. Apply dechlorinating agent as liquid sulfur dioxide or sulfite salts.
- C. Prepare a mixing chamber using a 55-gallon tank. Feed the discharge and dechlorinating agent at the bottom of the tank with overflow at the top.
- D. Discharge total chlorine residual to be less than 0.5 milligrams per liter.

END OF SECTION

SECTION 02661

WATER SERVICE CONNECTIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work included: Provide water service connections, including service pipe, and other appurtenances as shown on the drawings, specified herein, and needed for a complete and proper installation.
 - 1. Service connections include connection to the distribution main, service line between main and the Board of Public Works water meter.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. All materials in this Section are to be manufactured in the United States.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01640.

PART 2 – PRODUCTS

2.1 SERVICE SADDLES:

- A. Provide service saddles suitable for use on Ductile Iron Pipe (CI.350), or SDR11 HDPE water distribution mains.
- B. Provide service saddles by ROMAC or equivalent equal.

2.2 CORPORATION STOPS:

- A. Provide ball type corporation valves suitable for system operating pressures of 175 psi and maximum valve working pressure of 300 psig.
- B. Valves shall be manufactured and tested to comply with ANSI/AWWA C800 standard.
- C. Valve to be supplied with double o-ring seals supported in precision machined grooves to provide secure, leak-tight sealing.
- D. Heavy brass components shall be constructed of 85-5-5-5 ASTM B62 brass.
- E. Ball shall be PTFE coated to ensure smooth, easy turning operation. Rotation of ball shall be 360 degrees.
- F. Outlet connection shall be compression type connection.
- G. Corporation stop and valve shall be Ford #F600-3-NL.

2.3 SERVICE PIPE:

- A. ¾-inch copper tubing with a minimum working pressure of 250 psi.

2.4 WATER SERVICE METER:

- A. New water service meters will be provided by the contractor and installed by the Owner, as shown on the Plans and Details.

2.5 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 – EXECUTION

3.1 GENERAL

- A. Depth of the service connection shall be no less than the top of main connection.
- B. Install insulating couplings between ferrous and non-ferrous pipe, fittings, etc. of such shape to effectively prevent metal-to-metal contact between the dissimilar metals.

3.2 EXCAVATION AND BACKFILLING

- A. Comply with pertinent provisions of Section 02220, except as otherwise specified herein.
- B. Under paved areas install service lines dry boring, unless otherwise directed by the Engineer.

3.3 INSTALLATION – SERVICE LINES

- A. Install $\frac{3}{4}$ " copper service lines from the distribution main to the new meter, or at each location indicated or directed by the Engineer.
- B. Install flexible service lines in one continuous piece from the service meter to (LMI) residence's plumbing as directed by the Owner.

3.4 FLUSHING

- A. Flush each service line thoroughly after installation to clear of sand, dirt, or other construction debris.

END OF SECTION