



City of Goose Creek

Department of Public Works

Water Specifications

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SECTION 02667 - MATERIAL

I. DUCTILE IRON PIPE AND PVC PIPE / DUCTILE AND CAST IRON FITTINGS FOR WATER MAINS

1.1 DESCRIPTION

This section includes pipe and fitting material specifications, joint material and encasement requirements.

1.2 QUALITY ASSURANCE

1.2.1 Reference Standards of the American National Standards Institute (ANSI)

NSF/14 Plastics Piping System Components and Related Materials.

NSF/60 Drinking water treatment chemicals - Health effects.

NSF/61 Drinking water treatment components - Health effects.

A21.4 Cement-mortar lining for cast-iron and ductile-iron pipe and fittings for water (AWWA C104).

A21.5 Polyethylene encasement for gray and ductile cast-iron piping for water and other liquids (AWWA C105).

A21.10 Gray-iron and ductile-iron fittings, 3 inches through 48 inches for water- land other liquids (AWWA C110).

A21.11 Rubber gasket joints for cast-iron and ductile-iron pressure pipe and fittings (AWWA C111).

A21.15 Flanged cast-iron and ductile-iron pipe with threaded flanges (AWWA C115).

A21.50 Thickness design of ductile-iron pipe (AWWA C150).

A21.51 Ductile-iron pipe centrifugally cast, in metal molds or sand-lined molds, for water or other liquids (AWWA C151).

A21.53 Ductile-iron compact fittings for three inch (3") through twelve inch (12") (AWWA C153).

B1.1 Unified Screw Threads.

B16.1 Cast-iron pipe flanges and flanged fittings, Class 25, 125, 250, and 800.

B18.2.1 Square and Hex Bolts and Screws, Inch Series.

1.2.2 Reference Standards of American Society for Testing Materials (ASTM).

A139 Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).

A307 Standard Specification for Carbon Steel Bolts and Studs, 60 ksi Tensile Strength.

C33 Standard Specification for Concrete Aggregates.

D1598 Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.

D2241 Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).

D2239 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.2.3 Reference Standards of the American Water Works Association (AWWA)

C600 Installation of ductile-iron water mains and their appurtenances.

C651 Disinfecting water mains.

C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100mm through 300 mm) for Water Distribution.

C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ in. (13mm) Through 3 in. (76mm), for Water Service.

1.3 MATERIAL

1.3.1 Ductile Iron Pipe

- (1) Products of the American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company and McWane Cast Iron Pipe Company only shall be used.
- (2) All sizes of pipe shall be laying length of 18'-0" to 20'-0".
- (3) Pipe shall be the following thickness classes unless otherwise specified:
 - (a) 6"-54" pipe shall be class 50.
 - (b) 4" pipe shall be class 51.
 - (c) Flanged pipe shall be class 53.
 - (d) Underwater pipe shall be a minimum of class 60.
- (4) No metric sized pipe shall be permitted.
- (5) All pipe to be shipped with gaskets, glands and bolts. Bolts and nuts shall be low alloy steel.
- (6) Bolted joints for underwater pipe shall be furnished with 316 stainless steel nuts and bolts.
- (7) All pipe lengths must be tested to 500 psi working pressure prior to shipping.
- (8) Threaded flange pipe must be tested after the installation of the threaded flange.

1.3.2 Polyvinyl Chloride (PVC) Pipe

- (1) Provide polyvinyl chloride in accordance with ASTM 2241, ASTM 1598 and AWWA C900 as approved by The City of Goose Creek.
- (2) PVC pipe shall comply with the outside diameter dimensions of cast iron pipe.
- (3) PVC pipe shall have a pressure rating of 150 psi.

- (4) Each length of pipe shall be permanently marked with: manufacturer's name, nominal size, class pressure or SDR number, and material designation and shall bear the National Sanitation Foundation seal (NSF) for conveying potable water.
- (5) Joints shall be of the bell and spigot or similar type utilizing a rubber gasket for straight runs. All joints at bends, tees, reducers, valves, etc. shall be mechanical joint type. Joints shall be as approved by The City of Goose Creek. Rubber gasket shall conform to ASTM F477.

1.3.3 Ductile Iron Fittings

- (1) Products of the American Cast Iron Pipe Company, McWane Cast Iron Pipe Company, Griffin Pipe Company, Tyler Pipe Company, and U.S. Pipe Company only shall be used.
- (2) All fittings shall be ductile iron 250 psi pressure class rating with center-to-socket laying dimensions and wall thickness in accordance with ANSI/AWWA C110/A21.10.
- (3) No metric sized fittings shall be permitted.
- (4) All fittings to be shipped with gaskets, glands, nuts, and bolts. Nuts and bolts shall be low alloy steel.

1.3.4 Locator Tracer Wire

- (1) Tracer wire shall be No. 12 AWG gauge, single or multiple strand plastic coated copper wire.
- (2) Splices shall be made with a mechanical water proof connection such as "3M DBR" or approved equal and shall be watertight and provide electrical continuity.

1.3.5 Metallic Detection Tape

- (1) Provide 2" wide metallic detection tape on all buried piping.
 - Provide 5.0 mil overall thickness with no less than a 50 gauge solid aluminum foil core.
 - Foil to be visible from both sides.
 - No inks or printing extended to the edges of the tape.

- Encase printing to avoid ink rub-off.
 - Tensile strength - 28 lbs/inch.
 - Use heat set mylar inks.
- (2) Locate tape 18" above pipe in trench.
 - (3) Color to be Safety Precaution Blue.
 - (4) Wording on tape to indicate "Potable Water" at no greater than 24" on center.

1.4 JOINT MATERIAL

1.4.1 Push-on Joints, Mechanical Joints and Restrained Joints conform To:

ANSI A21.11 (AWWA C111).

1.4.2 Flanged Joints Conform To:

ANSI A21.15 (AWWA C115).

ANSI B16.1.

1.4.3 Bolts, Nuts, and All-Thread Rod:

- (1) Bolts, nuts, and all-thread rod shall be made of either high-strength cast iron containing a minimum of 0.50 percent copper, or high-strength low-carbon steel per ASTM A307, specifications for carbon steel externally threaded standard fasteners, Grade B, having minimum yield strength of 60,000 psi.
- (2) Stainless steel materials shall contain sufficient chromium to resist corrosion, oxidation, and rust.
- (3) Materials shall be sound, clean, and coated with a rust resistant lubricant.
- (4) Threads shall be in accordance with ANSI B1.1, Unified Inch Screw Threads (UN and UNR Thread Forms), Screw Threads, Gages, and Gaging, conforming to the coarse thread series (UNC) Unified Coarse, with threads Class 2A internal and Class 2B external.

(5) Bolts $\frac{3}{4}$ " and smaller shall be furnished with heavy hex heads conforming to ANSI B18.2.1.

(6) Bolts larger than $\frac{3}{4}$ " may have either standard or heavy hex heads conforming to ANSI B18.2.1

1.4.4 Lubricants which support microbiological growth shall not be used for slip-on joints. Vegetable shortening shall not be used to lubricate joints.

1.4.5 All materials / products that contain potable water must be third party certified as meeting the specifications of ANSI / NSF Standard 61.

1.4.6 Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, setting meters or valves, or other appurtenances which will expose the material to the water.

1.5 POLYETHYLENE ENCASEMENT

Conforms To: ANSI 21.5 8 Mil Polyethylene Tube. (AWWA C105)

1.6 BEDDING MATERIAL

1.6.1 Crushed stone or gravel conforming to ASTM C33, Gradation 67 (3/4 in. to No. 4).

1.6.2 Clean, well-graded Class II and/or Class III soils.

1.7 STEEL CASING FOR HIGHWAY AND RAILROAD CROSSINGS

1.7.1 ASTM A139, Grade B steel pipes primed and coated with hot, coal tar enamel a minimum of 3/32-inches thick. Only new primed and coated pipe shall be used.

1.7.2 The pipe shall have a minimum inside diameter and a minimum wall thickness as specified by Engineer, and in conformance with other applicable standards. The Engineer shall be responsible for determining if the minimum sizes and thicknesses shown on the approved drawings are adequate for placing the casing under the highway and for installing the carrier pipe.

II. *BUTTERFLY VALVES AND GATE VALVES*

1.1 DESCRIPTION

This section includes valve material and quality assurance specifications.

1.2 QUALITY ASSURANCE

1.2.1 Reference Standards of the American National Standards Institute (ANSI)

A21.5 Polyethylene encasement for gray and ductile cast-iron piping for water and other liquids (AWWA C105).

A21.11 Rubber gasket joints for cast-iron and ductile iron pressure pipe and fittings (AWWA C111).

B16.1 Cast iron pipe flanges and flanged fittings, Class 25, 125, 250, and 800.

1.2.2 Reference Standards of American Society for Testing Materials (ASTM).

A48 Standard Specification for Gray Iron Castings

A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A536 Standard Specification for Ductile Iron Castings

1.2.3 Reference Standards of the American Water Works Association (AWWA).

C504 Rubber-Seated Butterfly Valves

C515 Reduced-Wall, Resilient-Seated Gate Valves

C550 Protective Epoxy Interior Coatings for Valves and Hydrants

C600 Installation of Ductile-iron Water Mains and Their Appurtenances

C651 Disinfecting Water Mains

1.3 MATERIAL

1.3.1 Acceptable Manufacturers:

Mueller Company, Henry Pratt Company, American Flow Control, or Goose Creek approved equivalent.

1.3.2 General

Gate valves shall be standard on 4 inch through 12 inch installations. Butterfly or gate valves shall be standard on installations of 14 inch and larger.

1.3.3 Gate valves shall conform to the following:

- (1) Resilient seat type conforming to AWWA C515.
- (2) Epoxy coated inside and outside with rubber encapsulated discs conforming to AWWA C550.
- (3) Ends shall be mechanical or mechanically restrained joint connections conforming to ANSI/AWWA C111/A21.11. ALPHA joints are also acceptable.
- (4) Rated for a 250 psi working pressure.

1.3.4 Tapping valves shall conform to the following:

- (1) Resilient seat type conforming to AWWA C515.
- (2) Epoxy coated inside and outside with rubber encapsulated discs conforming to AWWA C550.
- (3) Ends shall be flanged by mechanical joint conforming to ANSI B16.1, Class 125 and ANSI/AWWAC111/A21.11 respectively.
- (4) Rated for a 150 psi working pressure.

1.3.6 Butterfly valves 14" and larger shall conform to the following:

- (1) Resilient seat type conforming to AWWA C504.
- (2) Epoxy coated inside and out with rubber encapsulated discs conforming to AWWA C550.
- (3) Ends shall be flanged conforming to ANSI BI 6.1, Class 125.
- (4) Rated for a 250 psi working pressure.

1.3.7 Valve Box

- (1) Valve boxes shall be full cast iron with cast iron covers suitable for heavy traffic use and conform to ASTM A48, Class 20 Specifications.

- (2) Valve boxes shall be screw type and have a 5-1/4 inch inside shaft diameter. All parts shall have an asphaltic coating inside and outside with a minimum of 1 mil thickness.

1.3.8 Other Requirements

- (1) All valves shall have Grade B cast iron bodies conforming to ASTM A126 or ductile iron ASTM A536.
- (2) All valves shall have a two (2") inch square operating nut for buried service.
- (3) All valves installed deeper than four feet bury depth shall have a riser installed on the operating nut to bring operation to three (3') to four feet (4') bury depth.
- (3) All valves shall have open left operation
- (4) All valves shall be equipped with a non-rising stem.
- (5) All valves shall be constructed with 316 stainless steel bolts on bonnets, thrust collars, and operating nuts.
- (6) Shall be in conformance with the latest revision of all reference standards of AWWA or ANSI.

III. *FIRE HYDRANTS*

1.1 DESCRIPTION

This section includes material and quality assurance specifications for all fire hydrants.

1.2 QUALITY ASSURANCE

1.2.1 Reference Standards of the American National Standards Institute (ANSI).

A21.11 Rubber gasket joints for cast iron and ductile iron pressure pipe and fittings (AWWA C111)

B16.1 Cast iron pipe flanges and flanged fittings, Class 25, 125,250, and 800.

B26 Standard Specification for Aluminum-Alloy Sand Castings

1.2.2 Reference Standards of the American Water Works Association (AWWA).

C502 Dry-Barrel Hydrants

C515 Reduced-Wall, Resilient-Seated Gate Valves

C550 Protective Interior Coatings for Valves and Hydrants

C600 Installation of Ductile Iron Water Mains and Appurtenances

C651 Disinfecting Water Mains

1.3 MATERIAL

1.3.1 Acceptable Manufacturers

Only the following companies and products shall be used:

American-Darling (Mark 73)

Mueller Company (A-421)

1.3.2 Components

(1) Fire hydrants shall be compression type, opening against pressure and closing with the pressure, and conform to:

- AWWA C502 Dry-Barrel Fire Hydrants

(2) Interior shall be two part thermosetting epoxy coated holiday free to a minimum of 4 mils thick conforming to: AWWA C550 Protective Interior Coatings for Valves and Hydrants.

(3) Exterior coating shall be as follows:

(a) Hydrant barrel, bonnet and nozzle caps will be painted fire hydrant red.

(b) Hydrant parts below ground will be asphalt coated.

(4) An all bronze seat ring shall thread directly into an all bronze drain ring or heavy bronze bushing located between the lower hydrant barrel and shoe securely retained in this position, or it may be threaded into a heavy bronze bushing in the hydrant shoe. Drain rings cast into iron body are not acceptable.

(5) All bronze or brass internal working parts in contact with service water to be low in zinc content.

1.3.3 Joint Material

Connections between the hydrant and the water main shall be mechanically restrained joints conforming to ANSI A21.11 rubber gasket joints for cast-iron and ductile-iron pressure pipe and fittings (AWWA C111). ALPHA joints are also acceptable as well as Goose Creek approved equivalents.

1.3.4 Polyethylene Encasement

Hydrants shall be wrapped in accordance with ANSI A21.5 Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids (AWWA C105). Encasement material to be no less than 8 Mils thick.

1.3.5 Other Requirements

Hydrants shall have 6" mechanically restrained or ALPHA joint connections with at least a 4-1/2" main valve. Hydrant shall have two 2-1/2" hose nozzles and one 4-1/2" pumper nozzle with mechanical removal feature, set screw, lock ring, etc., and shall conform to existing national standard specifications and NFPA No. 194 (ANSI B26). 4-1/2" Pumper nozzle should face road unless otherwise directed.

- (1) Barrel lengths shall generally be for 3-1/2' bury. No riser kits will be accepted.
- (2) Hydrants shall open left.
- (3) Hydrants shall have 250 psi working pressure.
- (4) Hydrants shall be traffic designed.
- (5) Retaining bolts of shoe to lower barrel shall be 316 stainless steel.
- (6) Upper assembly shall be provided with a grease or oil reservoir that automatically lubricates all operating stem threads and bearing surfaces each time of operation. The system shall be completely sealed from the waterway and external contaminants. The reservoir is to have an external filler point that does not require dismantling any portion of the hydrant during regular maintenance.
- (7) Casting shall indicate type, design and date of manufacture.

- (8) All fire hydrants shall be tested to 500 psi test pressure before shipping.

IV. *RETAINER GLANDS*

1.1 DESCRIPTION

This section includes retainer gland material and quality assurance specification.

1.2 QUALITY ASSURANCE

1.1.1 Reference Standards of the American National Standards Institute (ANSI).

A21.11 Rubber gasket joints for cast iron and ductile iron pressure pipe and fittings (AWWA C111)

A21.53 Ductile iron compact fittings for 3 in. through 48 in. (AWWA C153).

A21.51 Ductile iron pipe centrifugally cast in metal molds or sand-lined for water or other liquids (AWWA C151).

1.2.2 Reference Standards of American Standards for Testing Materials (ASTM).

A536 Specifications for ductile iron castings (AWWA C110).

1.3 MATERIAL

1.3.1 Acceptable Manufacturers

- (1) Mega-lug Glands by EBBA Iron, Inc.
- (2) Mechanical Joint Retainer Gland manufactured by Tyler Pipe.
- (3) MJR System manufactured by Tyler Pipe.
- (4) Grip Ring manufactured by Romac Industries, Inc.
- (5) MJ Gripper Gland manufactured by U.S. Pipe.
- (6) ReiberLok Gasket by ReiberLok.

1.3.2 Components

- (1) Ductile iron retainer gland sizes 4" through 24" shall conform to ASTM A536 Specification for ductile iron casting (AWWA C110).
- (2) Coating shall be a bituminous seal coat to conform to ANSIA21.51 Ductile iron pipe centrifugally cast in metal molds or sand-lined molds for water or other liquids (AWWA C151).

1.3.3 Joint Sizes

Dimensions of gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to:

ANSI A21.11 Rubber gasket joints for gray iron and ductile iron pressure pipe and fittings (AWWA C111).

ANSI A21.53 Ductile iron compact fittings for 3 in. through 48 in. (AWWA C153).

1.3.4 Other Requirements

- (1) The gland shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.
- (2) No metric sized nuts or bolts shall be permitted.

V. *BLOW-OFFS*

1.1 DESCRIPTION

This section includes blow-off material and quality assurance specification.

1.2 QUALITY ASSURANCE

1.2.1 Reference Standards of the American National Standards Institute (ANSI).

A21.5 Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids. Thickness: 8 mils (AWWA C105)

A21.53 Ductile Iron Compact Fittings, 3 in. through 12 in., for Water and Other Liquids (AWWA C153).

1.2.2 Reference Standards of the American Water Works Association (AWWA)

C600 Installation of ductile-iron water mains and their appurtenances.

1.3 MATERIAL

1.3.1 Acceptable Manufacturers

(1) Kuperfle Foundry Co. – Mainguard Model #78

1.3.2 Blow-off hydrants shall be non-freezing, self-draining type, with an overall length of six inches (6”) less than bury depth. Set underground in an eighteen by twenty four inch (18”x24”) cast iron meter box. These hydrants will be furnished with a two-inch (2”) FIP inlet, a non-operating rod and shall open to the left. All of the working parts shall be of Bronze to Bronze design and be serviceable from above grade with no digging. The outlet shall also be Bronze and be two and one-half inch (2 ½”) NST. Hydrants shall be lockable to prevent unauthorized use as manufactured by Kupferle Foundry Co., St. Louis, MO or approved equal. See Construction Detail.

VI. *BEDDING MATERIALS*

1.1 DESCRIPTION

This section includes bedding material and quality assurance specification.

1.2 QUALITY ASSURANCE

1.2.1 Reference Standards of the American Society for Testing Materials (ASTM).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping

Class	Type	Soil Group Symbol D 2487	Description
II	Coarse-Grained Soils, clean	GW	Well-graded gravels and gravel-sand mixtures; little or no fines

		GP	Poorly-graded gravels and gravel-sand mixtures; little or no fines.
		SW	Well-graded sands and gravelly sands; little or no fines.
		SP	Poorly-graded sands and gravelly sands; little or no fines.
	Coarse-Grained Soils, borderline clean to w/fines	e.g. GW-GC, SP-SM	Sands and gravels which are borderline between clean and with fines.
Class	Type	Soil Group Symbol D 2487	Description
III	Coarse-Grained Soils, with Fines	GM	Silty gravels, gravel – sand mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures

1.3 BEDDING MATERIAL - CLASS II

Material suitable for bedding in a properly dewatered trench shall consist of any of the following: Well graded coarse granular materials free of roots, branches, stumps, or other material not so suited, with maximum particle size not exceeding 1 inch; sands, silty-sands or clayey sands. Soils having more than 5 percent of its weight passing a No. 200 sieve shall not be used for bedding. Soils shall be compacted to 95% dry density (modified proctor). Class II backfill may be supplanted by use of flowable fill per SCDOT Specifications.

1.4 BEDDING MATERIAL - CLASS III

Class III bedding will be used throughout the project and will generally be excavated trench material free of roots, branches, stumps, or other organic or unsuitable materials.

VII. *BACKFILL MATERIALS*

1.1 DESCRIPTION

This section includes backfill material and quality assurance specification.

1.2 QUALITY ASSURANCE

1.2.1 Reference Standards of the American Society for Testing Materials (ASTM).

C94 Standard Specification for Ready-Mixed Concrete.

D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping

1.2.2 Reference Standards of the South Carolina Department of Transportation (SCDOT).

SC-M-210 Flowable Fill

1.3 MATERIAL - CLASS I (FLOWABLE FILL) BACKFILL

Conform to ASTM C94, Alternate 3. Proportion to obtain a 28-day compressive strength of 150 pounds per square inch maximum.

1.4 MATERIAL - CLASS II BACKFILL

Material suitable for backfill in a properly dewatered trench shall consist of any of the following: Well graded coarse granular materials free of roots, branches, stumps, or other material not so suited, with maximum particle size not exceeding 1 inch; sands, silty-sands or clayey sands. Soils having more than 25 percent of its weight passing a No. 200 sieve shall not be used for backfill. Soils shall be compacted to 95% dry density (modified proctor). Class II backfill may be supplanted by use of flowable fill per SCDOT Specifications.

1.5 MATERIAL - CLASS III BACKFILL

Class III backfill will be used throughout the project and will generally be excavated trench material free of roots, branches, stumps, or other organic or unsuitable materials.

1.6 MATERIAL - CONCRETE FOR PIPE BLOCKING

Conform to ASTM C94, Alternate 3. Proportion to obtain a 28-day compressive strength of 3,000 pounds per square inch.

VIII. *WATER SERVICES*

1.1 DESCRIPTION

This section covers the work necessary to install water services from the main to the water meter.

1.2 QUALITY ASSURANCE

1.2.1 Reference Standards of the American National Standards Institute (ANSI).

NSF/14 Plastics Piping System Components and Related Materials.

NSF/60 Drinking water treatment chemicals - Health effects.

NSF/61 Drinking water treatment components - Health effects.

1.2.2 Reference Standards of American Society for Testing Materials (ASTM).

B62 Standard Specification for Composition Bronze or Ounce Metal Castings.

D2239 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

1.2.3 Reference Standards of American Water Works Association (AWWA).

C510 Double Check Valve Backflow Prevention Assembly.

C511 Reduced-Pressure Principle Backflow Prevention Assembly.

C700 Cold-Water Meters – Displacement Type, Bronze Main Case.

C701 Cold-Water Meters – Turbine Type, for Customer Service.

C702 Cold-Water Meters – Compound Type.

- C703 Cold-Water Meters – Fire Service Type.
- C800 Underground Service Line Valves and Fittings
- C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ in. (13mm) Through 3 in. (76mm), for Water Service

1.3 MATERIAL

1.3.1 Polyethylene (PE) Pipe:

- (1) Provide polyethylene pipe in accordance with ASTM D2239, NSF 14, and AWWA C901.
- (2) Minimum water service shall be 1” nominal.
- (3) Polyethylene pipe shall have a working pressure rating of 200 psig.
- (4) Each length of pipe shall be permanently marked with: manufacturer's name, nominal size, class pressure or SIDR number, and material designation and shall bear the national Sanitation Foundation Seal (NSF) for conveying potable water.
- (5) Joints will contain an appropriate size stainless steel stiffener at each end. Accepted manufacturers are:
 - Ford - Insert Stiffeners
 - A.Y. McDonald - IPS PE Insert

Other Requirements:

- (1) All water services that cross a perpendicular travel way shall be encased in a casing pipe.

1.3.2 Corporation Valves

- (1) Provide corporation valves in accordance with ASTM B62, ASTM D3350, NSF 14, and AWWA C800.
- (2) Corporation Valves for 1” through 2” size taps will have AWWA/CC Taper Thread inlets if available, else MIP. The outlet connection on 1” through 2” valves will be IPS/PE, compression type (pack joint). Accepted manufacturers are:
 - Ford
 - Mueller
 - A.Y. McDonald

- (3) Corporation Valve shall have a working pressure rating of 100 psig.

1.3.3 Curb Valves

- (1) Provide corporation valves in accordance with ASTM B62, ASTM D3350, NSF 14, and AWWA C800.
- (2) Curb Stop Valves will be lockable via padlock wings and have pack joint for polyethylene pipe on both ends. Accepted manufacturers are:
 - Ford
 - Mueller
 - A.Y. McDonald

- (3) Curb Valves shall have a working pressure rating of 80 psig.

1.3.4 Water Meters

- (1) Provide corporation valves in accordance with NSF 14, AWWA C700, C701, C702, C703 and AWWA C800.
- (2) Gate Valves will be provided on each side of commercial / fire service installations as necessary to isolate meters for maintenance/ replacement. See Section II.
- (3) Water meters shall be radio read type with electronic registers measuring to the nearest tenth (0.10) of a gallon.

1.3.5 Backflow Prevention Devices

- (1) Residential Dual Check Valve
 - a. Provide residential dual check valves in accordance with ASTM B62, ASTM D3350, NSF 14, and AWWA C800.
 - b. A Residential dual check valves will be installed immediately downstream of the water meter. Accepted manufacturers are:
 - Ford
 - Mueller
 - A.Y. McDonald

(2) Reduced Pressure Principle Assembly

- a. Provide backflow prevention devices in accordance with AWWA C511, NSF 61, Annex G and the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California (USC-FCCC & HR).
- b. Reduced Pressure Principle Assembly check valves will be installed immediately downstream of the water meter. Accepted manufacturers are:
 - Watts
 - Wilkins
 - Febco
 - Ames
 - Conbraco
 - As listed in the City of Goose Creek Cross-Connection and Backflow Prevention Program Manual
- c. Isolation Gate valves will be installed on either end of the check valve assembly to facilitate maintenance / repairs / replacement.

(3) Double Check Valve Assembly

- a. Provide backflow prevention devices in accordance with AWWA C510, NSF 61, Annex G and the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California (USC-FCCC & HR).
- b. Double Check Valve Assembly check valves will be installed immediately downstream of the water meter. Accepted manufacturers are:
 - Watts
 - Wilkins
 - Febco
 - Ames
 - Conbraco
 - As listed in the City of Goose Creek Cross-Connection and Backflow Prevention Program Manual
- c. Isolation Gate valves will be installed on either end of the check valve assembly to facilitate maintenance / repairs / replacement.

1.3.6 Meter Box Assembly

- (1) Provide water meter box assemblies with a load rating for light traffic.
- (2) Meter box assemblies should be fiberglass reinforced polymer concrete & fiberglass reinforced polymer with flared walls (See Standard Detail).
- (3) Meter box lids should be bored to accept radio read antennae.
- (4) Meter Box should be sized to allow access to all components from curb stop to residential dual check valve.

SECTION 02667 - CONSTRUCTION PROCEDURES

I. *TRENCH EXCAVATION AND BACKFILL*

1.1 DESCRIPTION

This section covers the work necessary for the trench excavation and backfill, except for pipe base and pipe zone backfill.

1.2 USES OF BACKFILL

Trench backfill above the pipe zone is classified as follows:

1.2.1 Class I (Flowable Fill) Backfill

Use Class I (Flowable Fill) backfill where there is less than 24" of cover over the pipe for proper protection. Class I is also required when a water main and a sewer cross with less than 18 inches clearance. In this case, encase the sewer line according to the requirements of SCDHEC and The City of Goose Creek.

1.2.2 Class II Backfill

Class II backfill can be limited to paved streets, driveways and parking lots where final surface replacement will be made shortly after backfilling and subsequent settlement must be held to a minimum. Class II backfill shall also be used under all culverts, water, gas, irrigation, and sewer lines, buried telephone, power and television cable, and any other buried pipelines or cables that cross or parallel the excavated trench.

1.2.3 Class III Backfill

It is intended that all surfaces for which Class III backfill is specified shall be returned to equal or better condition than that existing prior to construction. Surfaces shall not settle due to normal weathering and settling that can be expected for each area, and should be completed to a minimum of 85% dry density (modified proctor), per ASTM D1557.

1.3 COMPACTION

Utilize compaction equipment of suitable type and adequate to obtain a compaction in accordance with ASTM D1557. Operate in strict accordance with the manufacturer's instructions and recommendations and maintain in such condition that it will deliver the manufacturer's rated compactive effort.

Impact type compactors are suitable. Rubber tired rollers and track type equipment is not suitable and is not allowed for Class II or III backfill. No mechanical equipment is allowed in pipe zone.

1.4 SETTLEMENT POLICY

Any subsequent settlement of the finished surfacing during the 2 year warranty period shall be considered to be a result of improper or insufficient compaction and shall be promptly repaired at no cost to The City of Goose Creek.

1.5 PREPARATION OF RIGHT-OF-WAY

1.5.1 Obstructions

Remove obstructions within the trench area or adjacent thereto such as but not limited to tree roots, stumps, abandoned piling, buildings and concrete structures, logs, and debris of all types.

Properly dispose of obstructions removed from the excavation in accordance with local municipality directives.

1.5.2 Pavement, Curb, and Sidewalk Removal

Cut all bituminous and concrete pavements, regardless of thickness, and all curbs and sidewalks, prior to excavation of the trenches as specified in the South Carolina Department of Transportation. Width of the pavement cut shall be at least equal to the required width of the trench at ground surface. Pavement cut lines shall be even and parallel. Any ragged or uneven cuts shall be cut smooth before patching. Pavement and concrete materials removed shall be hauled from the site and not used for trench backfill.

1.6 EXCAVATION

1.6.1 Trench Width

Minimum width of un-sheeted trenches in which pipe is to be laid shall be 18 inches greater than the inside diameter of the pipe, but not less than that required for proper compaction around the pipe. Sheet piling requirements shall be independent of trench widths.

The maximum trench width at the top of the pipe zone is limited to 1.33 times the pipe outside diameter plus 18 inches.

In general, the maximum width at the top to the trench will not be limited, except where excess width of excavation would cause damage to adjacent

structures or property. However, confine trench widths to dedicated rights-of-way or construction easements, unless special prior written agreements have been made with the affected property owner.

1.6.2 Grade

Excavate the trench to the lines and grades shown on the plans with proper allowance for pipe thickness and for pipe base or special bedding when required. If the trench is over excavated below the required grade, correct any part of the trench excavated below the grade with crushed stone or Class II backfill as specified herein. Unauthorized over excavation shall be backfilled at no additional cost to the owner.

Place the pipe bedding material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade.

1.6.3 Shoring, Sheeting, and Bracing of Trenches

Sheet and brace the trench consistent with OSHA Regulations when necessary to prevent caving in during excavation or to protect adjacent structures, property, workmen, and the public, increase trench widths accordingly by the thickness of the sheeting. Maintain sheeting in place until the pipe has been placed and backfilled at the pipe zone. Shoring and sheeting shall be removed in accordance with OSHA regulations and, as the backfilling is done, in a manner that will not damage the pipe or permit voids in the backfill. All sheeting, shoring, and bracing of trenches shall conform to the safety requirements of the Federal, State, or local public agency having jurisdiction. The most stringent of these requirements shall apply.

1.6.4 Dewatering

Provide and operate equipment adequate to keep all excavations and trenches free of water. Remove all water during period when concrete is being deposited, when pipe is being laid, during tunneling or jack and bore operations, during the placing of backfill, and at such other times as required for efficient and safe execution of the work. Dispose of water in a manner that will not damage adjacent property. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavator. Design dewatering system to prevent removal of fines from existing ground.

1.6.5 Foundation-Stabilization

When the existing material in the bottom of the trench is unsuitable for supporting the pipe, provide foundation stabilization as described here.

Excavate below the pipe zone and backfill to specified grade with crushed stone or Class II backfill. Place the crushed stone or Class II backfill over the full width of the trench and compact to the required grade.

1.7 BACKFILL PROCEDURES

1.7.1 Pipe Base and Pipe Zone Backfill

Pipe base and pipe zone backfill shall be as defined in MATERIALS, Bedding Material. The pipe base and entire pipe zone shall be compacted to 95% of standard proctor density in accordance with ASTM D698.

1.7.2 Trench Backfill Above Pipe Zone-General

When backfill is mechanically placed, push the backfill material onto the slope of the backfill previously placed and allow it to slide down into the trench. Do not push backfill into the trench in such a way as to permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Under no circumstances allow sharp and/or heavy pieces of material to drop directly onto the pipe or the tamped material around the pipe. Do not use backfill material of consolidated masses larger than 1/2 cubic foot

1.7.3 Class I (Concrete) Block

Place concrete backfill in such a manner that no dirt or foreign material becomes mixed with the concrete. Minimum thickness of concrete protection shall be 6 inches on the top and sides of the pipe. Concrete shall have sufficient time to reach initial set before any additional backfill material is placed in the trench. Place stabilized aggregate base in all trenches requiring concrete backfill.

1.7.4 Class II Backfill Under Structures, Utilities, and/or Pavement

Backfill the trench above the pipe zone with approved backfill material in lifts not exceeding 6-inch loose depth and compact each lift to a minimum of 95 percent of maximum density as determined by ASTM D 1557, with mechanical vibrating or impact tampers.

Maintain the surface of the backfilled trench level with the existing grade with an 8 inch layer of stabilized aggregate base until pavement is replaced.

1.7.5 Class III Backfill

Backfill the trench above the pipe zone with excavated trench materials. Place the backfill in suitable lifts per governing agency; Determine the type

of compaction equipment, and method to use to provide all of the following: compaction to a density equal to existing-trench side materials but not less than 85% percent of maximum density as determined by ASTM D 1557; compaction so that subsequent settlement shall be prevented; compaction of graded surface along dirt roads, road shoulders so that the upper 6 inches of backfill reaches a minimum of 95 percent of maximum density as determined by ASTM D 1557.

Remove all boulders and stones 2 inches in diameter and larger from material used for backfill.

1.7.6 Moisture Control - Backfill

During all compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the earth fill. Maintain moisture content uniform throughout the lift. Supplement, if required, by sprinkling the earth fill. During all compaction, the water content of the material shall be at optimum moisture content, plus or minus 2 percentage points.

Do not attempt to compact fill material that contains excessive moisture. Aerate material by blading, dicing, harrowing, or other methods, to hasten the drying process.

1.7.7 Maintenance of Trench Backfill

Maintain the surface of the backfilled trench level with the existing grade until the entire project is accepted. Any subsequent settlement of the finished surface during the warranty period shall be considered to be a result of improper or insufficient compaction and shall be promptly repaired at no cost to The City of Goose Creek.

Maintain the backfilled trench surface until the following operations have been completed and approved by The City of Goose Creek:

- (1) Valves and valve boxes installed.
- (2) Hydrostatic testing.
- (3) Cleanup and restoration of all physical features, utilities restored to their original condition or better, and, in general, all work required with the exception of repaving.

Maintenance shall include, but not be limited to, the addition of crushed rock backfill material to keep the surface of backfilled trenches reasonably smooth, free from ruts and pot-holes, and suitable for normal traffic flow.

1.7.8 Compaction Test

The City of Goose Creek, or other agencies having jurisdiction over the work, reserves the right to require the contractor to provide, at his expense, all testing necessary to determine the in-place density and moisture content of the sub-grade and compacted fill according to ASTM D1556. Test results and a certified statement by the soil testing company that the actual soil compaction found meets these specifications shall be submitted to The City of Goose Creek as soon as it is available to the Contractor.

II. *ASPHALT PAVEMENT*

1.1 APPLICABLE STANDARDS

All construction, repair, and resurfacing of asphalt pavement shall be conducted in accordance with the South Carolina State Highway Department Standard Specification for Highway Construction latest revision.

1.2 GUARANTEE

The Developer and Contractor shall guarantee all pavement work and repair completed incidental to the installation of the water distribution system for a period of two (2) years following acceptance by The City of Goose Creek, and shall repair or replace, at no cost to The City of Goose Creek, any pavement or pavement repair which crumbles, cracks, settles, or is otherwise unsound or unacceptable during this two year period.

III. *INSTALLATION OF PIPE, VALVES, HYDRANTS, APPURTENANCES*

1.1 APPLICABLE STANDARDS

Installation of all water mains and appurtenances shall be in accordance with section C of the AWWA Standards and / or the manufacturer's recommended installation procedures.

1.2 ALIGNMENT AND GRADE

Fittings, valves and other appurtenances shall be located where shown on the approved plans, with the pipe being cut if necessary to assure accurate placement. Install the pipe, valves, hydrants, and appurtenances to the alignment and profile shown on the approved drawings. Maintain a minimum depth of cover of three (3) feet unless actual depths are shown on the approved drawings.

1.2.1 Water/sewer line separation shall be in accordance with Section R.61-58.4D (12) of the "State Primary Drinking Water Regulations."

(a) Separation requirements shall be 10 ft. horizontal separation when new water line is laid parallel with any new or existing sewer line. In situations where a 10 ft. separation is not possible, deviations may be allowed if the water line is laid in a separate trench and bottom of water line is located 18 inches above the top of the sewer line. Any deviations are subject to approval from the design engineer.

(b) Situations that require a perpendicular crossing shall have a minimum 18 inch separation between water and sewer lines with water crossing preferably over sewer line. Crossing water under sewer line will require approval from design engineer. Water line shall be situated such that joints are located as far as possible from the crossing point.

(c) Water line shall not come into contact with or pass through any sewer manhole.

1.3 RIGHTS-OF-WAY, EASEMENTS, AND PERMITS

It is the responsibility of the developer/engineer to obtain all necessary legal documentation and permits and advise The City of Goose Creek of the status of each prior to the commencement of work. All installation work is to be conducted within the parameters stipulated in the right-of-way, easements, and permits, etc. Any damages caused by encroachment beyond the legal limits as stipulated shall be the responsibility of the owner and/or contractor.

1.4 PROTECTION OF PIPE, VALVES, HYDRANTS, AND APPURTENANCES

1.4.1 Protection of Pipe, Gaskets, and Polyethylene Film

Store rubber gaskets and polyethylene film under cover and out of direct sunlight. Do not store nuts, bolts, glands, and other accessories directly on the ground. Keep insides of pipe and fittings free of dirt and debris.

1.4.2 Protection of Valves

Keep materials off the ground and keep interiors free of dirt and debris. Do not expose valve interior to direct sun light.

1.4.3 Protection of Fire Hydrants

Inspect materials upon receipt for damaged or missing items. Rubber gaskets shall be stored under cover, out of direct sunlight. Do not store nuts, bolts, glands, and other appurtenances directly on the ground: Keep interiors free of dirt and debris.

1.5 INSTALLATION OF PIPE, VALVE, HYDRANT, BLOW-OFF AND APPURTENANCE

1.5.1 Pipe Distribution

Deliver the pipe to the job site, from the designated storage area, in a safe manner.

1.5.2 Installation of Pipe and Valves

Inspect pipe for damage. Remove damaged and unacceptable pipe. Keep interior and joint surfaces clean and free of foreign materials. Install a mechanical joint or push-on type ductile iron plug whenever work stops for a period of a day or greater.

Provide and use proper implements, tools, and facilities for the safe and proper installation of the work. Lower all pipe, fittings, and appurtenances into the trench, piece by piece, by means of a crane, slings, or other suitable tools or equipment, in such a manner as to prevent damage to the pipeline materials and protective coatings and linings. Do not drop or dump pipeline materials into the trench.

Remove all lumps, blisters, and excess bituminous coating from the bell-and-spigot ends of each pipe. Clean the spigot and the inside of the bell and wipe clean and dry. Ensure surfaces are free from oil and grease before the pipe is laid.

Wipe the ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of all dirt, grease, and foreign matter.

1.5.3 Installation of Hydrants

Hydrants 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 operation are left in the hydrant. Hydrants shall be installed plumb. Hydrant-safety flange or breakaway flange shall be installed above grade but not to exceed 2" above finished grade. The Contractor will provide proper anchorage to fire hydrant installations by means of restraint and/or all thread rods (See Standard Detail).

1.5.4 Installation of Blow-offs

All working parts shall be serviceable from above grade with no digging. Installation will require a 4" MJ Cap,-tapped 2". A corporation stop, meeting or exceeding The City of Goose Creek specifications, shall be installed at the cap as an emergency shut-off. A swing-joint comprised of two 90' bronze ells, for load-bearing and grade adjustment, shall be included (See Standard Detail).

1.5.5 Installation of Retainer Glands

- (1) Adjoining surfaces shall be clean and lubricated meeting with requirements of ANSI/AWWA C111/A21.11
- (2) Install using assembly recommendations established in: ANSI/AWWA C111/A21.11-80
- (3) Retainer Glands - Tighten the T-head bolts to the normal range as recommended by the manufacturer.
- (4) Retainer Glands - All set screws will be installed with proper torque as required by manufacturer:

1.6 CUTTING PIPE

Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Cuts must be even and perpendicular with length of pipe. Dress cut ends of pipe in accordance with manufacturer's directives for the type of joint to be made.

1.7 JOINING PIPE, VALVES, HYDRANTS AND APPURTENANCES

1.7.1 Mechanical, Push-On, and Restrained joint

Join pipe with mechanical or push-on type joints in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be used and shall be manufacturer's standard. All mechanical joints used on hydrants, hydrant leads, taps and valves should have retainer glands.

1.7.2 Flanged

Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure

proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts re-tightened.

1.7.3 Pipe Bedding

Excavate trench bottom to provide a level cross section with vertical walls extending to the top of the pipe zone. Excavate evenly to provide smooth profile grade without holes and ridges. Keep trench dewatered. Refer to "Materials", "Bedding Materials."

Lay pipe on bedding such that it is continuously supported along the barrel, and is ***not bearing*** on the bell. After joint construction, place bedding material under bell. Unless otherwise directed, lay pipe with bell end facing in the direction of the laying (See Standard Details).

1.7.4 Valves

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 operation are left in the valve. Valves shall be installed in a position such that the plane of operation or rotation for the operating nut is parallel to the ground surface.

A Valve Box shall be installed on each underground valve. They shall be carefully set, centered exactly over the operating nut and truly plumbed. The base shall be set as outlined in the most current GCDPW Standard Details, so arranged that the weight of the valve box and super-imposed loads will bear on the valve box adaptor / base and not on the valve or pipe. Extension stems shall be installed where depth of bury places operating nut in excess of four (4) feet beneath finished grade.

1.8 DEFLECTION

The maximum permissible deflection at joints shall be 75% of the maximum allowed by AWWA Standard C600, Tables 5 and 6.

1.9 POLYETHYLENE ENCASEMENT

All Valves, pipe, hydrants, fittings, bolts and appurtenances are to be wrapped in an 8 mil polyethylene film in accordance with ANSI Standard A21.5 (AWWA C105). Close all open ends and damaged areas, securely tape two linear feet beyond last fitting to ensure complete protection. Damaged polyethylene film cannot be repaired, replace with new film.

1.10 ANCHORAGE

1.10.1 General

On all pipelines securely anchor by acceptable thrust blocking, restrained joints or a combination of both. Retainer glands shall be used on all mechanical joint fittings. All tees, plugs, caps and bends which are equal to or greater than 11-1/4 degrees, and at other locations where unbalanced forces exist, must also have acceptable thrust restraint as detailed in the manufacturer's recommendations.

1.10.2 Blocking

The concrete mix used for thrust blocking shall have 28-day compressive strength of not less than 3,000 pounds per square inch. Place blocking between the undisturbed ground and the fitting to be anchored. Place the blocking so that the pipe and fitting joints will be accessible to repairs, unless otherwise shown.

1.10.3 Restrained Joints

Restrained joints shall be used in lieu of reaction blocking or in combination with blocking where appropriate and as designated by the engineer or The City of Goose Creek.

1.11 WET-TAP CONNECTIONS

Connections to existing water mains shall be done by cutting in a tee or use of wet taps using tapping sleeves or tapping saddles and tapping valves. Installation of a tee is the preferred method. Wet taps larger than 1" will be made by the contractor under the supervision / inspection of The City of Goose Creek (See Standard Detail).

1.12 HIGHWAY AND RAILROAD CROSSINGS

1.12.1 General

Installation shall conform to the permits of all agencies having jurisdiction. Method of installation shall be specified by the Engineer.

1.12.2 Casing Pipe

Continuously weld lengths of casing pipe to the preceding section in accordance with AWWA recommended procedures. Clean all debris from

casing interior after casing installation is complete. Pressure grout any void areas apparent outside the casing. After installation of the carrier pipe, close ends of the casing with 4-inch thick brick walls, plastered with Portland cement mortar and waterproofed with a bituminous coating

1.13 WATER SERVICE SLEEVES, (New Construction Only)

In subdivisions where domestic (1") water services must be laid beneath road or other paved surfaces to service residences on the opposite side of the street from the water main, the contractor shall install a 3 inch Schedule 40 P.V.C. water service carrier pipe. The carrier pipe shall be installed a minimum of 36 inches, and a maximum depth of 5' below the surface of the road and made easily accessible to The City of Goose Creek crews. The carrier pipes shall be flagged with direct burial electronically detectable tape. The carrier pipe will service two residences and should therefore be placed so as to intercept the two lots at the alternate property line from the sewer lateral (See Standard Detail). In those cases where services greater than 1" are required, such as for commercial, fire or irrigation purposes, approval of the size and type of carrier pipe is to be obtained from The City of Goose Creek prior to construction.

1.14 TESTING AND STERILIZING

1.14.1 Testing

Each section of the pipeline shall be subjected to and successfully meet a pressure test of one hundred and fifty percent (150%) of its working pressure, but not less than one hundred and fifty pounds per square inch (150 psi). The line shall be slowly filled with water and all air expelled through the air valves or other means. A suitable test pump, furnished by the Contractor, shall be connected to the line by means of a tap in the line, or other suitable methods, and the proper test pressure slowly applied to the line. The test pressure shall be maintained for at least two hours. Leaks, if found shall be immediately repaired. The City of Goose Creek representative must be on site to witness the test. No leaks will be allowed.

Pressure and leakage tests must be conducted in accordance with AWWA Standard C600 & C605, latest edition. The pressure must be at least 1.5 times the maximum working pressure or 150 psig, whichever is greater, at the point of testing for at least two (2) hours. The following formulas shall be used to determine the allowable leakage:

$$L = [SD(P)^{1/2}] \div 148,000;$$

where:

- L = allowable leakage (gal/hr.)
- S = length of pipeline tested (ft)
- D = diameter of pipe (inches)

P = average test pressure (psig)

1.14.2 Sterilizing

Disinfection of all new water mains shall be conducted in accordance with AWWA C651. Before being placed in service, all new mains and repaired portions of existing mains must be thoroughly flushed then chlorinated with not less than 25 ppm. Water from the existing distribution system or other supply shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. The solution must be retained in the pipeline for not less than 24 hours. At the end of the minimum 24 hour period, the treated water in all portions of the main must have a residual of not less than 10 ppm free chlorine. The system must then be flushed with potable water and the sampling program started. The number of sampling sites will depend on the amount of new construction but must include all dead end lines and be representative of the water in the newly constructed line. At each site, a minimum of 2 satisfactory bacteriological samples taken at least 24 hours apart shall be obtained. Also at each site, chlorine residual at time of sampling must be measured and reported. If the membrane filter method of coliform analysis is used, non coliform growth must also be reported. All samples shall be drawn and analyzed by a State approved laboratory with results being submitted with the design engineer's letter of certification.