

4.4 PIPELINE CONSTRUCTION. This subsection covers the requirements for materials, trenching, placing, backfilling, cleaning, testing and other miscellaneous requirements for underground pipeline construction and associated work. This section incorporates the requirements of the AWWA Standards and the Manufacturer's Recommended Installation Procedures, whichever is more stringent.

4.4.1 MATERIALS. This subsection specifies the acceptable materials for pipeline construction for use in sanitary sewers, underground culverts, storm drains, water pipes, and appurtenant construction. All materials shall be new and conform to the requirements for class, brand, size and material as specified herein. All materials shall be stored and handled in accordance with manufacturers recommendations.

4.4.1.1 SEWER PIPE AND FITTINGS. Only those pipe materials listed below may be used in the construction of sanitary sewer line unless otherwise approved in writing by the City Engineer.

A. POLYVINYL CHLORIDE (PVC) PLASTIC SEWER PIPE. This specification covers rigid polyvinyl chloride (PVC) pipe and fittings. PVC pipe and fittings from four (4) inches to fifteen(15) inches in diameter shall meet or exceed all of the requirements of ASTM D-3034 with a minimum wall thickness to diameter ratio of SDR-35. PVC pipe and fittings from eighteen (18) inches to twenty seven (27) inches in diameter shall meet or exceed the requirements of ASTM F-679.

Each pipe shall be stamped by the manufacturer indicating compliance with the requirements of the appropriate specification. Any pipe not so stamped shall be rejected.

All pipe and fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. All PVC pipe and fittings shall be made from clean, virgin, Type 1, Grade 1, Polyvinyl Chloride conforming to ASTM D-1784.

All pipe joints shall be bell and spigot type with flexible elastomeric seals in accordance with ASTM F-477. Pipe and fittings shall be assembled with a non-toxic lubricant. Pipes of four (4) inch and six (6) inch diameter may be the solvent weld type, in accordance with ASTM F-656 for primer and ASTM D-2564 for glue. Pipe shall have the following minimum SDR-35 dimensions.

Nominal Pipe Size (Inches)	Outside Diameter (Inches)	Minimum Wall Thickness (Inches)
4	4.215	0.125
6	6.275	0.180
8	8.400	0.240
10	10.500	0.300
12	12.500	0.360

Spigot ends shall have a fifteen (15) degree tapered end with a memory mark around the diameter of the pipe to indicate proper insertion depth. Fittings shall be of the same material as the pipe, and shall not have a wall thickness less than that of the pipe furnished.

B. A.B.S. COMPOSITE AND SOLID WALL SEWER PIPE. This specification covers Acrylonitrile-Butadiene-Styurine (ABS) gravity sewer pipe.

All ABS composite sewer pipe shall conform to the latest revision of ASTM Specification D-2680. The ABS material used shall be a virgin rigid plastic conforming to ASTM Specification D-1788 for rigid ABS plastics. The other component shall be Portland Cement, Perlite concrete or other inert filler material exhibiting the same degree of performance.

All solid wall ABS pipe shall conform to ASTM Specifications D-2751. Solid wall pipe used for laterals shall have a minimum wall thickness to diameter ratio of SDR-35. Fittings not described by these standards shall be shop fabricated or molded from materials listed in paragraphs 4 and 5 of ASTM D-2680 and shall be of equivalent quality to those described.

All field joints shall be chemically welded. Primer, then cement, shall be applied liberally to the outside of the spigot end and the inside of the coupling immediately prior to stabbing the pipe together. The pipe spigot end shall be supplied with home marks to assure proper jointing.

C. NON-REINFORCED CONCRETE PIPE. Non-reinforced concrete sewer pipe may be used up to and including twenty-four (24) inch size, unless otherwise designated by the City Engineer or these

specifications. Appropriate design justification shall be submitted by the Engineer to the City for review and approval prior to use. Pipe shall be extra strength and manufactured to comply with the requirements set forth in ASTM Designation C-14, Class 3 unless otherwise approved by the City Engineer. Type V cement shall be used unless otherwise approved. Joints shall be of the bell and spigot-type with rubber gasket design, and with joints and gaskets conforming to the requirements of ASTM Designation C-443. Pipe joints shall be so designed to provide for self-centering, and when assembled the gasket shall compress to form a water-tight seal. The gasket shall be confined in a groove on the spigot so that pipe movement or hydrostatic pressure will not displace the gasket.

D. REINFORCED CONCRETE PIPE. Reinforced concrete pipe may be used for all appropriate applications. For pipe greater than twenty-four inches in diameter, and where any non-reinforced concrete pipe installation does not provide a cover of at least three feet over the top of the pipe, reinforced concrete pipe shall be used. Reinforced concrete pipe shall comply with the requirements of ASTM C-76 (Class II - V) unless otherwise approved by the City Engineer. Type V cement shall be used unless otherwise approved. Joints shall be of the bell and spigot design with rubber gasket type joints, with an alternate option of tongue and groove joints for storm drain lines when approved by the City Engineer.

4.4.1.2 STORM DRAIN PIPE. Pipe listed under Sections 4.4.1.1 A, C, and D, "Sewer Pipes" of these standards, as well as the following pipes, may be used in the construction of storm drain lines and culverts.

A. CORRUGATED POLYETHYLENE PIPE. Corrugated polyethylene pipe shall be high density polyethylene corrugated exterior with a smooth interior wall. Eight to ten (8-10) inch diameter shall meet the requirements of AASHTO M-252 and have a smooth interior liner. Twelve to thirty six (12-36) inch diameters shall conform to AASHTO M-294 Type S. Forty-two to forty-eight (42-48) inch diameter shall conform to AASHTO MP-6 type. Materials shall conform to ASTM D-3350. All pipe joints and fittings shall be water tight and conform to AASHTO M-353 or M-294, and shall be approved by the City's Representative.

B. CORRUGATED ALUMINUM PIPE: Corrugated aluminum alloy pipe shall conform to AASHTO designation M-196. Any aluminum alloy to be in contact with concrete shall first be spray or brush coated to a minimum thickness of 0.05 inch with an asphalt-fiber compound

conforming to the requirements of Section 702 of the State of Utah Standard Specifications for Road and Bridge Construction. The aluminum alloy shall be thoroughly cleaned, including the removal of oil and grease, and shall be dry prior to treatment. Pipe installation and appurtenances shall conform to UDOT Standard Specifications, 1992.

C. **CORRUGATED STEEL PIPE.** Use of corrugated steel pipe shall require pre-approval from the City Engineer and shall be on a case-by-case basis.

Corrugated steel pipe shall be in conformance with AASHTO M-36 and other applicable AASHTO standards as required. Smooth flow spiral rib pipe shall generally be used in storm drain applications while other applications may require annular or helical corrugations. Pipes shall be fabricated with a continuous lock seam or ultra high-frequency resistance welded seams.

(1) **COATINGS.** All pipe shall have an aluminized coating, both sides, in accordance with AASHTO M-274 specifications unless otherwise approved. The pipe shall be fabricated from steel coils that have been hot-dipped coated in a bath of commercially pure aluminum. This coating shall be uniform throughout on both sides of the sheet and be metallurgically bonded between the metals.

When a polymer coating is approved for use, such coating shall be a minimum of 10 mils in thickness and shall be a two-sided coating and shall conform to AASHTO M-245

When a galvanized coating is approved for use, such coating shall be hot dipped in accordance with AASHTO M-245. The coating shall be on both sides.

Other coatings and linings may be approved.

(2) **JOINTS.** All joints shall have the same base metal and coating as the pipe being joined. Joints shall provide circumferential and longitudinal strength to preserve the pipe alignment, to prevent separation of the pipe, to prevent infiltration of fill material and to provide water tight joints. O-ring gaskets or other acceptable material shall be used.

(3) **FITTINGS AND ACCESSORIES.** All fittings, bolts and accessories shall meet applicable specifications of the pipe being

used. Use accessories and gaskets recommended by the manufacturer.

(4) **INSTALLATION.** Installation shall be in accordance with the manufacturers recommendations and these specifications.

NOTE: Use of this pipe may require significant testing and evaluation to determine compatibility with the ground and the intended installation. Soil Ph, resistibility and other necessary determinations should be made to ensure compatibility.

4.4.1.3 SEWER MANHOLES. This subsection covers the requirements for the materials used in sanitary sewer and storm water manholes. Manholes shall be water tight and be furnished complete with cast iron rings and covers as follows:

A. CONCRETE BASES. Manhole bases shall be either pre-cast or cast in place. Precast manhole bases shall conform to ASTM C-478. Concrete for cast in place bases shall be in accordance with Section 4.8.1 of these specifications. Type V cement shall be used for precast and cast in place bases.

Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross-section. Changes of direction of flow within the manholes shall be made with a smooth curve with the longest radius possible. The depth of the channel in the manhole base shall be the full diameter of the sewer pipe being used at that manhole. The floor of the manhole outside the flow channels shall be smooth and slope toward the channel in accordance with standard drawings and not less than one-half (1/2) inch per foot nor more than one (1) inch per foot.

B. WALL AND CONE SECTIONS. All manholes shall be constructed of either forty eight (48) inch or sixty (60) inch inside diameter pre-cast, sectional, reinforced concrete manholes. Both cylindrical and taper sections shall conform to the requirements of ASTM Designation C-478 for precast Reinforced Concrete Manhole Sections. All Manholes shall have ladders in accordance with the standard drawings.

Throat length of manholes shall be adjustable by use of appropriate diameter grade ring sections. The maximum height shall be eighteen (18) inches.

The taper section shall be a maximum of three (3) feet in height, shall be of eccentric conical design, and shall taper uniformly from forty eight (48) or sixty (60) inches to thirty (30) inches inside diameter. The cone shall be set on the manhole sections so all ladder rungs are aligned.

When manhole depths are less than four (4) feet manhole cones shall not be used. The manhole shall consist of a cylindrical manhole section with a precast flat manhole top in accordance with ASTM C-478.

Sixty (60) inch inside diameter sewer manholes shall be required for all sewers greater than twelve (12) inches in diameter or deeper than twelve feet, or where three (3) or more eight (8) inch or greater lines converge in the manhole.

The shaft section of the manhole shall be furnished in section lengths of one (1), two (2), three (3), and four (4) feet as required. The least number of sections should be used.

Manholes larger than sixty (60) inch inside diameter may be required when designated by the City Engineer.

All joint surfaces of pre-cast sections and the face of the manhole base shall be thoroughly cleaned prior to setting the sections. Joints shall be sealed with a minimum one (1) inch thick flexible joint sealant which shall conform to the requirements of ASTM C-923.

C. WATER-TIGHTNESS. All manholes shall be water tight. Any cracks or imperfections shall be satisfactorily repaired. Materials and methods used shall be subject to approval of the City's Representative.

D. IRON CASTINGS. All iron castings shall conform to the requirements of ASTM A-48 (Class 30) for grey iron castings. Frames and covers shall have a minimum combined weight of four hundred (400) pounds. All castings shall be designed to carry a minimum HS-20 traffic loading.

The cover and ring seat shall be machined so that the entire area of the seat will be in contact with the cover, in any position of the cover on the seat. Frames and covers shall be so constructed and machined that the parts are interchangeable. The tops of the cover and frames shall be flush, and the clearance between the frame and

cover shall be one-eighth (1/8) of an inch all around. The top surface of each cover shall be cast with a studded pattern including the word "Sewer" for sanitary application and "Storm" for storm drain applications. Letters and studs shall be raised three-eighth (3/8) inch. Each cover shall be provided with not less than twelve (12) ventilating holes of three quarter (3/4) inch diameter each.

All manhole frames shall be carefully set to the finished grade or as directed by the City's Representative. When set in roadways, walkways or other travelways, the finished manhole cover, grade, and slope shall be adjusted to match that of the traveled surface. Manhole frames shall be set in place on the manhole throat and shall be sealed with an approved flexible joint sealant which shall conform to the requirements of ASTM C-923. Frames or covers loosened from the manhole throat shall be reset and any frames, covers or throat sections damaged or broken shall be replaced prior to acceptance by the City's Representative.

E. MANHOLE STEPS. Manhole steps shall be constructed in accordance with ASTM C-478 and the standard drawings.

Manhole steps shall be installed at intervals no closer than twelve (12) inches and at evenly spaced intervals not to exceed eighteen (18) inches between steps. Steps shall be firmly installed into the concrete wall and taper sections of all manholes to a minimum depth of three and three-eighth (3 3/8) inches, as shown in the drawings. Each step shall be solidly anchored to the wall so it will not pull out or break under repeated use. Steps shall be aligned vertically to form a continuous ladder from top to bottom.

4.4.1.4 WATER PIPE AND FITTINGS. The materials used for pipe and fittings shall all be new and conform to the requirements for class, brand, size and material as specified.

A copy of the manufacturer's installation recommendation for each type of pipe shall be provided for each construction job and shall be available on the jobsite at all times. These recommendations shall be followed during construction unless instructed otherwise by the City's Representative. All pipe materials are as outlined below.

A. GENERAL PIPE REQUIREMENTS. Pipe materials shall conform to the following requirements.

SIZE	TYPE
3/4" to 1"	Copper Type K
1 1/2" - 2"	Black or Blue Poly (HDPE) Copper Tube Size
Over 2"	Ductile Iron Class 51 with poly jacket sock or PVC C-900, Class 150 (sand bedded) see note #1 below. Ultra-Blue PVC (mo) Pressure Pipe C-909PC150

Note:

1. High density polyethylene pipe may be used upon approval of the Water Department.
2. For pipes greater than 12 inches, material type will be determined by the Water Department. When the pipe is to be installed in a rocky area, the pipe material will be ductile iron.

All pipe shall conform to the current AWWA standards for each class of pipe listed above.

B. CONNECTING WATER METERS. Only authorized employees of the Water Department shall be allowed to connect or disconnect water meters. All boxes set in concrete shall be flanged to prevent settlement.

C. DUCTILE IRON PIPE. All ductile iron pipe shall be Class 51 conforming to the latest edition of AWWA Specifications C-151 (ANSI A21.51).

C.1 JOINTS. Ductile Iron Pipe shall be either Mechanical Joints, Rubber Gasket Slip-on Joints, Flanged Joints, or a combination of the above as specified on the plans. Pipe shall also conform to all current AWWA standards.

C.2 POLYETHYLENE WRAPPING. A polyethylene wrap shall be required on all ductile iron pipe. The polyethylene wrap tubing shall be cut to provide for a minimum of one foot of lap over both the adjoining pipes. The ends of the tubing shall be wrapped using three circumferential turns of plastic adhesive tape. The loose wrap on the barrel shall be pulled snugly around the barrel of the pipe and the excess folded

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For pressures greater than 125 psi, a mechanical joint sleeve type will be required. The following are approved for use.

Mueller H-615
5-149-DI
Clow F-5205
Power Seal Model 3490
Romac SST-III with ductile flange rated at 200 psi
Ford FTSS

For larger diameter pipe:

FTS-425 Class D
For HDPE - Romac SST-H

H. TAPPING MATERIAL SPECIFICATION. For small tapplings (three quarter (3/4) inch through two (2) inch) tapped into cast iron, steel, PVC, or ductile iron pipe, the following materials shall be required:

H.1 SADDLE CASTINGS. Large saddle tapplings shall be stainless steel or bronze single/double strap.

H.2 STAINLESS STEEL STRAP. The stainless steel strap shall consist of a two (2) inch wide strap and shall come complete with sufficient stainless steel or bronze bolts, nuts and washers (with five-eighths [5/8] inch N.C. Teflon coated roll threads) to properly clamp the strap to the pipe. M.I.G. welds shall be pasivated for resistance to corrosion.

H.3 GASKETS. Gaskets shall be made from virgin SBR compounded for water services

I. REPAIR CLAMPS. All repair clamps shall be stainless steel and be equal to the following approved brands:

Romac SS1-552
Power Seal 3121AS, 3122 AS

For HDPE

Romac Style SS1-H, SS2-H

J. VALVES AND BOXES. Unless otherwise specified by the Water Department, all valves, ten (10) inches and smaller, shall be of a resilient-seat-gate-valve type, and all valves over ten (10) inches shall be butterfly valves; except for a ten (10) inch "hot tap".

J.1 GATE AND BUTTERFLY VALVES. Valves shall conform to the latest revision of AWWA valve standards. All valves shall be Mueller, Kennedy, Clow, or Pratt. Exceptions to this will require the City Water Department Engineer's approval.

All valves, ten (10) inches and less, installed next to a fitting must be flange x mechanical joint (MJ) and installed with the flange end connecting to the tee, cross, or fitting and megaluged to the line unless otherwise approved by the Water Department. Valves greater than twelve inches shall have flange x flange with an MJ adaptor in order to flange to tee, cross, or fitting and shall be megaluged to line.

All six and eight inch valves shall have a 16"x 16"x 4" slab of concrete placed under them for support. Valves ten inches and greater shall have a 20"x 20"x 4" concrete slab placed under them for support. All support slabs shall be tied to the valves.

All setter shut off valves shall be provided with bronze handles.

J.2 VALVE BOXES. All valves shall be provided with a cast iron valve box of the extension sleeve type or a screw type adjustable, and the height shall be adjusted to bring the top of the valve box flush with the finished surface. Extension sleeve shall be drilled or slotted and the marking wire shall be threaded through. The valve box shall not be less than five inches in diameter and shall have a minimum wall thickness of .375 inch. The box shall be provided with a suitable base and cover. The word "WATER" shall be cast on the cover.

Valve boxes shall be installed plumb and properly positioned to allow access of the operating wrench. To ensure that the box is not displaced during backfill operations, the backfill shall be hand mechanically tamped for a distance of five feet each way along the trench. All valve boxes shall include a concrete collar in accordance with the standard drawings with flow indication arrows.

K. WATER SERVICE LATERALS. The material used for water service connections shall comply with the following requirements.

K.1 SERVICE PIPE. Service pipe shall be copper or polyethylene.

Note: When polyethylene pipe is used, only Instatite fittings shall be used.

K.2 CORPORATION STOPS. Corporation stops shall be as manufactured by the Mueller Company, or Ford or approval equal, and shall conform to the several designations shown below for the various sizes.

	WATER SERVICE CONNECTION SIZE			
	3/4"	1"	1-1/2"	2"
MUELLER CO.	H-1500	H-1500	H-1510	H-1501
FORD	F600	F600	F6125	F6125

All services shall have a flare or compression type joint for the service pipe and shall be threaded on the inlet end with an AWWA corporation stop thread.

K.3 METER SETTER YOKES. Meter setters or meter yokes shall have a built-in backflow prevention device and shall have a corrosion-resistant bronze body, dual acetyl plastic valves with natural rubber gaskets that are independently acting and capable of giving two levels of protection; stainless steel springs; a resilient O-ring end-tap seal; and full port inlet angle ball valve with brass handle. All internal parts shall be accessible without removing the valve from the line. Meters shall be installed by Water Department personnel only.

K.4 METER BOX AND LID. The meter boxes shall be high density polyethylene (HDPE) "Brooks" design or equal. Size shall be as follows unless otherwise approved by City's Representative.

PIPE SIZE	METER BOX SIZE
3/4"	17" x 11 3/4" #1419-18
1"	25" x 16" #1324-18
1 1/2" - 2"	32" x 19" #1730-18

The meter box lids shall have a hinged opening for meter reading. Lid marking shall be approved by the Water Department. A concrete collar shall be installed around the meter box in accordance with standard drawings. All meter boxes shall be placed behind sidewalks in accordance with standard drawings unless otherwise directed by City's Representative.

Any meter box covered, or damaged, during construction operations shall be uncovered, replaced, and raised to finish grade by the Contractor. In areas without sidewalks, meter boxes shall be flush, or one inch above the finish grade.

K.5 SERVICE CONNECTIONS. At all points designated by the Water Department, service connections shall be installed and shall extend from the property line to the building, unless otherwise directed by the Water Department.

Individual water services shall be one inch for dual services and three quarter (3/4) inch for a single service from the water main to the meter setter for normal domestic service. When directed by the Water Department, the water service shall be one and one half (1 1/2) or two inches in diameter. Services shall have a minimum of three (3) feet of cover and be constructed as shown in the standard drawings. For service laterals two inches in diameter and smaller, service saddles shall not be closer than twelve inches (12) from the end of the main, nor closer than eighteen (18) inches to any other service saddle or pipe joint.

A mechanical joint type tapping sleeve shall be used on all "hot taps" where the line pressure is greater than one hundred twenty five (125) psi,. The approved mechanical joint sleeves and type shall be as shown in the standard drawings.

L. MARKING WIRE. Marking wire shall be installed on all waterline installations unless otherwise approved by the Water Department. Marking wire shall conform to the following:

L.1 Marking wire shall be spliced together with "grease" nuts, or equal. Prior to installation of the wire nut, a minimum amount of wire shall be bared and twisted together with pliers to assure good contact.

L.2 Marking wire should be taped and pulled tight along the top of the pipe to ensure against breakage.

L.3 Marking wire shall extend up to all hydrants and valves. At valve clusters marking wire shall be run to all valves. The wire should be pig tailed, not looped.

L.4 Marking wire shall extend out of the valve box four (4) to six (6) inches.

L.5 It is the Contractor's responsibility to guarantee and show that the marking wire performs satisfactorily for its intended use. It is recommended that the contractor test the performance of the wire prior to installation of surface improvements.

L.6 After all the boxes are raised and prior to placing concrete collars, the Contractor shall notify the Water Department to perform the final acceptance testing.

M. FIRE HYDRANTS. Fire hydrants shall be a three-nozzle, five and one-half inch (5½) diameter Mueller, Modern Centurion, Model A-423; Kennedy, Model K-81A; or approved equal, with foot valve and six (6) inch mechanical joint connection. Fire hydrants shall conform to the latest edition of AWWA C-502, "Dry Barrel Fire Hydrants." All hydrants shall be designed for a working pressure of two hundred (200) psi and a hydrostatic pressure of three hundred fifty (350) psi. Hydrants shall be furnished with a paint finish above the ground line identical in color to the existing hydrant paint (red).

Hydrants shall be installed with a shut-off valve at the mainline. If the hydrant lateral is greater than two hundred (200) feet long, a second valve shall be installed at a location determined by the Water Department.

After the hydrant is installed and accepted, it will be the responsibility

of the Water Department to maintain the hydrant. Where applicable, the customer/property owner will allow the Water Department access for said maintenance.

Dead-end mains shall not be installed without prior approval of the Water Department. If installed they shall not exceed six hundred (600) feet in length. Hydrants shall be located at the end of dead-end mains for flushing purposes as well as for fire protection. Washout valves, in lieu of fire hydrants, are not allowed without prior approval of the Water Department.

Hydrants shall be of a flanged joint type or mechanical joint inlet. All hydrants shall be so designed as to allow the flanges at sidewalk level to separate without material damage to the main barrel section when struck by a large object, such as a vehicle. Upon such damage, the main gate valve must remain closed to avoid flooding or washout. Hydrants with a nominal five inch valve opening shall be furnished with two nominal two and one half (2½) inch National Standard Thread Hose Nozzles and one nominal four and one half (4½) inch National Standard Thread Pumper Nozzle. All nozzles shall be furnished with a cap and gasket with attaching chain. All hydrants shall open counter clockwise with a pentagon operating nut conforming in size to the specifications of the Water Department.

Fire hydrants shall be set to provide at least the minimum pipe cover for the branch supply line. Nozzles shall be at least eighteen (18) inches above finish grade. Each hydrant shall be set on a concrete foundation at least eighteen (18) inches square and four (4) inches thick. Each hydrant shall be blocked against the end of the trench with concrete. Hydrant drainage shall be provided by installing gravel or crushed rock (3/4" to 2" washed gravel) around the hydrant, and below the top of the hydrant supply line. One third (1/3) cubic yard of one and one half (1½) inch gravel shall be placed around the drain holes just above the hydrant valve casing. All hydrants shall stand plumb. The hydrant pumper nozzles shall face the street and be perpendicular to the curb line. The hose nozzle shall be parallel to the street. Hydrants shall be located inside the street utility easements or as otherwise directed by the Water Department.

N. FLOWABLE BACKFILL. Flowable backfill material for water main trenches shall be sand slurry with in-place relative density greater than ninety five percent (95%).

O. PRESSURE REDUCING VALVES. Pressure reducing valve

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installation will be constructed as per the detail shown in the standard drawings. The valves will be as manufactured by Singer and approved by the Water and Power Engineer.

P. MEGALUG SYSTEM. A megalug retainer gland system shall be used on all mechanical joints and shall meet UNI-B-13 for PVC and be UL/FM approved through twelve (12) inch diameter for both ductile iron and PVC pipe.

A megalug retainer gland system shall be used on all mechanical joints and shall meet Uni-B-13 for PVC and be UL/FM approved through twelve (12) inch diameter for both ductile iron and PVC pipe. The restraint mechanism shall consist of individually activated gripping surfaces to maximize restraint capability. Twist-off nuts, sized the same as the tee-head bolts, shall be used to ensure proper activating of restraining devices. The gland shall be manufactured of ductile iron conforming to ASTM A-536-80. The retainer-gland shall have a pressure rating equal to that of the pipe on which it is used (through fourteen inches) with a minimum safety factor of 2:1. Gland shall be Megalug by EBAA Iron, Inc. or approved equal. The type and model of retainer and amount for each connector is shown on standard drawings.

As an alternate to the megalug system, Ford Uniflange Series 1400 retainer glands and Series 1300 and 1390 joint restraints will be used. For PVC, Ford Uniflange Service 1500 retainer gland will be used. These materials listed are approved for use on the St. George City Water System.