

Special Specification 7184

Water Mains and Service Lines



1. DESCRIPTION

Provide and install a complete water main system in accordance with the plans and specifications and in compliance with the Department's Utility Accommodation Policy (UAP) (Title 43, T.A.C., Sections 21.31–21.55). The water mains will be of the sizes, materials and dimensions shown on the plans and must include all pipe, all joints and connections to new and existing pipes, all valves, fittings, fire hydrants, pipe joint restraint systems, blocking, and incidentals, as may be required to complete the work.

The abbreviations AWWA, ASA, ASTM, and ANSI, as used in this specification, refer to the following organizations or technical societies:

- AWWA – American Water Works Association
- ASA – American Standards Association
- ASTM – American Society for Testing and Materials
- ANSI – American National Standards Institute
- NSF – National Science Foundation

Where reference is made to specifications of the above organizations, it is to be construed to mean the latest standard in effect on the date of the proposal.

2. MATERIALS

All materials used in this project are to be new and unused unless otherwise specified on the plans, specifications, or the proposal. The Contractor must submit descriptive information and evidence that the materials and equipment the Contractor proposed for incorporation into the Work are of the kind and quality that meet the material requirements listed herein. The SAWS Material Specifications are part of this specification and are available on the SAWS website at http://www.saws.org/business_center/specs/matspecs/. Contractors may, when appropriate, use products that are specified in these specifications; however, a Submittal is still required that clearly indicates the applicable SAWS Material Specification. The products listed in the SAWS Material Specifications must not be considered as a pre-approved list and cannot be substituted for items called out on the Drawings or on bid form.

2.1. Ductile-Iron Pipe and Fittings

- 2.1.1. **Ductile-Iron Pipe: 3-In. through 64-In.** All ductile-iron pipes are to be manufactured by process of centrifugal casting and are to conform to ANSI/AWWA C151/A21.51.91, "American Standard for Ductile-Iron Pipe Centrifugally Cast with push-on or mechanical joints for Water or Other Liquids," or latest revision thereof, unless otherwise modified or supplemented herein.

Pipe is to conform to the following Table 1 pressure classes based on Type 3 bedding conditions, a bury depth of 6-ft., and a working pressure of 150 psi:

3" - 12"	350 psi
16" - 20"	250 psi
24"	200 psi
30" - 64"	150 psi

Dimensions and tolerances for each nominal pipe size must be in accordance with Table 51.5 (push-on) or Table 51.5 (mechanical joint) of AWWA C-151 for pipe with a nominal laying length of 20-ft.

All pipes are to have standard water works interior cement mortar lining applied in accordance with ANSI/AWWA C-104/A21.4, latest revision. No asphaltic coating will be required on the interior cement mortar lining.

Exterior coating is to consist of a nominal 1-mil thick asphaltic material applied to the outside of the pipe as described in Section 51.8 of AWWA C-151.

Rubber joint gaskets used on ductile-iron pipe are to conform to ANSI/AWWA C-111/A21.11, latest revision.

Each length of pipe must bear identification markings in conformance with Section 51.10 of AWWA C-151.

Manufacturer is to take adequate measures during pipe production to assure compliance with AWWA C-151 by performing quality-control tests and maintaining results of those test as outlined in Section 51.14 of that standard.

The San Antonio Water System may, at no cost to the manufacturer, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects or failure to meet quality standards herein will be grounds for rejecting the entire order.

Approved Manufacturers for Ductile Iron Pipe: Please see SAWS website for a list of approved manufacturers - http://www.saws.org/business_center/specs/product_submittal/

- 2.1.2. **Fittings for Ductile-Iron Pipe, PVC C-900, or PVC C-905.** This Section covers ductile-iron fittings 3-in. through 48-in. in size designed and manufactured for use with gray-iron, ductile-iron, PVC C-900 or PVC C905 pipe. Standard, compact and anchor fittings included herein are of the following types of joints: Flanged and Mechanical Joint

Unless otherwise modified or supplemented herein, the latest revision of AWWA C-110 for Gray-Iron and Ductile-Iron Fittings, 3-in. through 48-in. for Water and Other Liquids and AWWA C-153 for Ductile-Iron Compact Fittings, will govern the design, manufacture, and testing of all fittings under this specification.

For 3-in. through 24-in. size range, the pressure rating of all fittings is to be a minimum of 250 psi. The working pressure for all fittings of size greater than 24-in. is to be a minimum of 150 psi, unless a change in pressure rating is directed by purchase documents.

Fittings are to be furnished with the types of end combination specified. Flanged fittings are to be faced and drilled in accordance with ANSI Specification B 16.1, Class 125. Anchor fittings are to be furnished in size and type or length as specified.

The exterior of all fittings must be provided with a petroleum asphaltic coating in accordance with the latest revision of AWWA C110. The interior of flanged fittings supplied under this specification must be either cement-mortar lined in accordance with the latest revision of AWWA C104 or lined with a petroleum asphaltic

material in accordance with the latest revision of AWWA Standard as specified. The interior of all other fittings supplied under this specification must be cement-mortar lined in accordance with the latest revision of AWWA C104.

Two-inch fittings are to be manufacturer's standard design in accordance with applicable design standards of AWWA C-110.

- 2.2. **Concrete Steel Cylinder Pipe and Fittings: 20-in. and larger.** This Section covers prestressed reinforced concrete water pipe with a steel cylinder and wire reinforcement in sizes 20-in. and larger.

Except as otherwise modified or supplemented herein, AWWA C301, "Prestressed Concrete Pressure Pipe—Steel Cylinder Type, for Water and Other Liquids" will govern the design, component materials, manufacture, and testing of all concrete-steel cylinder pipe furnished under this specification.

Unless otherwise specified, all pipe must be AWWA Class 150 and must be designed for an internal working pressure of 150 psi and a minimum external load equivalent to 6-ft. of earth cover. Where the bury depth of the pipe is indicated to be greater than 6-ft. in the contract specifications or on the drawings the design of the pipe must be suitable for the earth loads indicated.

All data submitted by the Contractor must include a tabulated layout schedule referencing the stationing and grade lines shown on the job plans. A design summary for each size of pipe furnished must be provided for each pressure and bury depth.

Each special and length of straight pipe must have plainly marked on the inside of the bell end the class of pipe and identification marks sufficient to show the proper location of the pipe by reference to layout drawings.

Pipe 20-in. through 42-in. in size must be furnished in nominal lengths of 20-ft. to 32-ft; pipe 48-in. through 72-in. in size must be furnished in nominal lengths of 16-ft. except where modified by plan design requirements.

Each joint of pipe must be furnished with a rubber gasket and a 12-in. diaper.

- 2.3. **Steel Pipe, Fittings and Flanges.** This Section covers steel pipe 4-in. and larger in size and manufactured for the purpose of conveying water.

- 2.3.1. **Steel Pipe.** Steel pipe with nominal diameters from 4-in. through 20-in. must conform to ASTM A 106, A 53 Grade B or A 139 Grade B standard weight class as the minimum

Steel Pipe greater than 20-in. must conform to AWWA C-200 and AWWA M-11 or as required by the Engineer for special circumstances.

Pipe must be designed for a minimum of 150 psi working pressure with an additional 50% of the working pressure allowance for surge pressure unless otherwise specified. Pipe design must be in accordance with AWWA M-11.

Pipe must be designed to cover conditions as shown on the plans. The design for deflection must be in accordance with AWWA M-11.

Use of an enhanced /better soil backfill to limit deflection will be allowed with approval by the Engineer. (Criteria will be based on AWWA M-11)

Pipe for use with sleeve-type couplings must have plain ends at right angles to the axis.

Pipe joint length is to be up to 50-ft. net laying lengths except for special lengths, field trim pieces, and closure pieces as otherwise specified on the plans for location of elbows, tees, reducers, and other in-line

fittings. Manufacturer is to prepare a lay schedule showing the location of each piece by a mark number with station and invert elevation at each bell end.

- 2.3.2. **Fittings for Steel Pipe.** Unless otherwise shown on the plans, all specials and fittings must conform to the dimensions of AWWA C-208. Pipe material used in fittings must be of the same material and thickness as the pipe. The minimum radius of elbows must be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow must not exceed $11\ 1/4^\circ$ (One cut elbow up to $22\ 1/2^\circ$). If elbow radius is less than 2.5 x pipe diameter, stresses must be checked per AWWA M-11 and wall thickness or yield strength increased if necessary. Fittings must be equal in pressure design strength. Specials and fittings, unless otherwise shown on the Plans, must be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe must be checked per the requirements of AWWA C-200 Section 5.2.2.1.
- 2.3.3. **Joints.**
- 2.3.3.1. **Rolled-Groove Rubber Gasket Joint.** The standard joint must be rolled-groove rubber gasket joint unless otherwise noted on the plans. Rolled-grooved rubber gasket joints must conform to AWWA C-200 and as shown in Chapter 8 of AWWA M-11.
- The O-ring rubber gasket must have enough volume to approximately fill the area of the groove and must conform to AWWA C-200.
- The joint must be suitable for a safe working pressure equal to the class of pipe furnished and must operate satisfactorily with a deflection angle, the tangent of which is not to exceed $1.00/D$ where D is the outside diameter of the pipe in in. with a pull-out of 1 in.
- Rolled-Groove Rubber Gasket Joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure, pipe diameter, pipe length, and wall thickness that have been in successful service for a period of at least 5 years.
- 2.3.3.2. **Lap Weld.** Lap field welded joints must be used where tied joints are indicated on the plans. The standard bell must provide for a 2 1/2-in. lap. The minimum lap must be 1 in. The design maximum joint deflection or offset must be a 1-in. joint pull.
- 2.3.3.3. **Mechanical Couplings.** Mechanical couplings, where indicated on the plans, must be Smith Blair Style 411, Baker Style 200, Brico Depend-O-Loc or equal. Insulating mechanical couplings, where indicated on the plans, must be double insulated Smith Blair Style 416, Baker Style 216, or equal. Mechanical couplings must be rated to meet or exceed the working pressures and surge pressure of the pipe.
- Couplings for buried service must have all metal parts painted with Epoxy paint and conform to AWWA C-219.
- Pipe ends for mechanical couplings must conform to AWWA C-200 and M-11. The shop applied outside coating must be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings.
- Harness lugs or rings and pipe ends must be painted with one shop coat of epoxy conforming to AWWA C-210. The inside lining must be continuous to the end of the pipe.
- 2.3.4. **Flanges, Gaskets, Bolts and Nuts**
- 2.3.4.1. **Flanges.** Flanges must be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-in. through 12-in. diameter, and operating pressures to 150 psi on diameters over 12-in.; or Flanges must be AWWA C207 Class E for operating pressures up to 275 psi; or Flanges must be AWWA C207 Class F for pressures to 300 psi. (drilling matches ANSI B 16.5 Class 250) Shop lining and coating must be continuous

to the end of the pipe or back of the flange. Flange faces must be shop coated with a soluble rust preventive compound.

- 2.3.4.2. **Gaskets:** Full face, 1/8-in. thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.
- 2.3.4.3. **Bolts and Nuts for Flanges:** Bolts for flanges located indoors and in enclosed vaults and structures must be carbon steel, ASTM A-307, Grade B for class B and D flanges and nuts must be ASTM A-563, Grade A heavy hex. Bolts for class E and F flanges must be ASTM A-193 grade B7 and nuts must be ASTM A-194, grade 2 H, heavy hex.
- 2.3.4.4. **Bolts** for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures must be Type 316 stainless steel conforming to ASTM A-193, Grade B8M, Class 1 for class B and D Flanges with ASTM A-194, Grade 8M nuts. For Class E and F flanges the bolts must be ASTM A-194 grade 2H nuts with bolt and nuts to be zinc plated in accordance with ASTM B-633
- 2.3.5. **Linings and Coatings.**
- 2.3.5.1. **Polyethylene Tape Coating.** Prefabricated Multi-layer Cold Applied Tape Coating - the coating system for straight-line pipe must be in accordance with AWWA C-214. The system must consist of 3 layers of polyethylene material with a nominal thickness of 80 mils when complete.
- 2.3.5.2. **Coating Repair.** Coating repair must be made using tape and primer conforming to AWWA C-209, Type II. The tape and primer must be compatible with the tape system used for straight-line pipe.
- 2.3.5.3. **Coating of Fittings, Specials and Joints.**
- 2.3.5.3.1. **General.** Fittings, specials and joints which cannot be machine coated in accordance with above, must be coated in accordance with AWWA C-209. Prefabricated tape must be Type II and must be compatible with the tape system used for straight-line pipe. The system must consist of 3 layers consisting of the following: Alternate coating methods for fittings specials and field joints would be Shrink sleeves per C-216, or paint per C-210, C-218, or C-222. The field coating must completely encapsulate the joint bonds on O-ring joints.
- 2.3.5.3.2. **Coating Repair.** Coating repair for fittings and specials must be in accordance with the procedure described above for straight-line pipe and as recommended by the manufacturer.
- 2.3.5.4. **Other Coating Systems.** If specified must be governed by the appropriate American Water Works Association standard.
- 2.3.5.5. **Cement Mortar per AWWA C-205.**
- 2.3.5.5.1. **Cement Mortar Lining of Steel Pipe.** Except as otherwise provided in AWWA C-205, interior surface of all steel pipe, fittings, and specials must be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C-205.
- The pipe ends must be left bare where field joints occur as shown on the Plans. Ends of the linings must be left square and uniform. Feathered or uneven edges will not be permitted.
- Defective linings as identified in AWWA C-205 must be removed from the pipe wall and must be replaced to the full thickness required. Defective linings must be cut back to a square shoulder to avoid feather edged joints.
- Cement mortar lining must be kept moist during storage and shipping.
- 2.3.5.5.2. **Fittings.**
- Fittings must be lined and coated per AWWA C-205.

- 2.3.6. **Steel Casing Pipe.** Steel casing pipe must conform to ASTM A134 with a minimum thickness of 3/8 in; actual thickness will be as indicated on the plans.
- 2.3.7. **Quality Assurance.** Commercial Standards (All manufacturing tolerances referenced in the below standards apply unless specifically excluded).
- ANSI/AWWA C-200 Standard for Steel Water Pipe 6 In. and Larger.
- ANSI/AWWA C-205 Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. and Larger-Shop Applied
- ANSI/AWWA C-206 Standard for Field Welding of Steel Water Pipe.
- ANSI/AWWA C-207 Standard for Steel Pipe Flanges for Water Works Service, 4-in. - 144-in.
- ANSI/AWWA C-208 Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- ANSI/AWWA C-209 Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- ANSI/AWWA C-210 Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- ANSI/AWWA C-214 Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines.
- ANSI/AWWA C-216 Standard for Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- ANSI/AWWA C-218 Standard for Liquid Coating the Exterior of Aboveground Steel Water Pipelines and Fittings.
- ANSI/AWWA C-219 Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.
- ANSI/AWWA C-222 Standard for Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings.
- AWWA M-11 Steel Pipe - A guide for Design and Installation.
- ASTM A-106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- ASTM A-53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- ASTM E-165 Method for Liquid Penetrant Examination.
- ASTM E-709 Guide for Magnetic Particle Examination.
- ASME Section V Nondestructive Testing Examination.
- ASME Section IX Welding and Brazing Qualification.
- AWS B2.1 Standard for Welding Procedure and Welding Qualifications.
- 2.3.8. **Qualifications.** Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished must furnish all Steel pipe and fittings. The pipe and fittings must be designed,

constructed and installed in accordance with the best practices and methods and must comply with these specifications as applicable

Pipe must be the product of one manufacturer that has not less than 5-yr. successful experience manufacturing pipe in the United States of the particular type and size indicated. All pipe manufacturing including cylinder production, lining, coating and fittings must be produced by one manufacturer. The pipe manufacturer must have a certified quality assurance program. This certified program must be ISO 9001: 2000 or other equivalent nationally recognized program.

2.4. **Polyvinyl Chloride Pipe and Fittings.**

2.4.1. **Polyvinyl Chloride Pipe, 4-in. through 12-in. (C-900).** This Section covers 4-in. through 12-in. diameter polyvinyl chloride (PVC) pressure pipe made from class 1245A or 1245B compounds as determined by ASTM D1784 and providing for a hydrostatic test basis (HDB) of 4,000 psi. All pipe furnished must be in conformance with AWWA C900, or latest revision thereof.

Except as noted on the plans or procurement specifications for specific jobs, all PVC C900 pipe must be Class 150 (DR 18) with a sustained pressure requirement of 500 psi (ASTM D2241) and a minimum burst pressure of 755 psi (ASTM D1599). PVC C900 pipe installed in the SAWS High Pressure Zone must be class 200 (DR 14) with a sustained pressure requirement of 650 psi (ASTM D1598) and a minimum burst pressure of 985 psi (ASTM D1599). Pipe pressure class must be written on the pipe and as per most current applicable AWWA standards.

Dimensions and tolerances for each nominal pipe sizes must be in accordance with Section 2.2, Table 1 of AWWA C900.

Pipe must be furnished in standard laying lengths of 20-ft. (± 1 -in.) unless otherwise noted. Each pipe must have an integral bell formed on the pipe end, and be designed to be at least as strong as the pipe wall (ASTM D2472).

An elastomeric gasket must be designed with a retainer ring, which "locks" the gasket into integral bell groove and must be installed at the point of manufacture. Gasket must be in conformance with ASTM F477.

Each length of pipe furnished must bear identification markings in conformance with Section 2.6 of AWWA C900.

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundles (units) must be packaged to provide structural support to ensure that the weight of upper units must not cause deformation to pipe in lower units. No pipes bundles will be accepted which show evidence of ultraviolet radiation "sunburn" on exposed pipe as may be caused from extended unprotected storage conditions.

The manufacturer must take adequate measures during pipe production to assure compliance with AWWA C900 by performing quality-control tests and maintaining results of those tests as outlined in Section 3 of that standard. Submission of product will constitute certification of compliance with this standard.

The pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of the pipe system, after installation, is 25 to 50 years.

Inductive Tracer Detection Tape must be placed directly above the centerline of all non-metallic pipe a minimum of 12-in. below subgrade or, in areas outside the limits of pavement, a minimum of 18-in. below finished grade to aid locating pipe in the future. The tracer tape must be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape must be placed according to manufacturer's recommendations.

A 1-yr. warranty must be provided for all materials sold and delivered for use and incorporated into the San Antonio water distribution system. Such warranty will take effect on the date that the pipe is received and accepted by an authorized representative of the San Antonio Water System.

User references and a claims history must be provided for further investigation, before rendering a final decision on the acceptance of the product to be furnished.

The San Antonio Water System may, at no cost to the manufacturer, subject random lengths of pipe to testing by an independent laboratory for compliance with this specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

Approved Manufacturers for PVC C-900 Pipe: Please see SAWS website for a list of approved manufacturers- http://www.saws.org/business_center/specs/product_submittal/

- 2.4.2. **Polyvinyl Chloride Pipe, 14-in. through 36-in. (C-905).** This Section covers 14-in. nominal diameter through 36-in. nominal diameter polyvinyl chloride (PVC) potable water transmission pipe with integral bell and spigot joints. The pipe must be extruded from Class 1245-A or 1245-B PVC compound as defined in ASTM D-1784 and provide for a hydrostatic design basis (HDB) of 4,000 psi (27.58 MPa). The pipe outside diameters must conform to dimensions of cast iron pipe (CI). All pipe furnished must be in conformance with American Water Works Association (AWWA) C-905, or latest revision thereof.

Pipe must be homogenous throughout. It must be free from voids, cracks, inclusions, and other defects. It must be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces must be free from nicks and scratches. Joining surfaces of spigots and joints must be free from gouges and imperfections that could cause leakage.

Inductive Tracer Detection Tape must be placed directly above the centerline of all non-metallic pipe a minimum of 12-in. below subgrade or, in areas outside the limits of pavement, a minimum of 18-in. below finished grade to aid locating pipe in the future. The tracer tape must be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape must be placed according to manufacturer's recommendations.

- 2.4.2.1. **Definitions.** All definitions are defined according to AWWA C-905-97 Section 1.2 Definitions

Dimension Ratio (DR). The ratio of the pipe outside diameter to the minimum wall thickness. The quotient is rounded to the nearest 0.5 when necessary

Pressure Rating (PR). The nominal pressure rating of transmission pipe is determined from formulas in Section 5: Transmission-Pipe Ratings AWWA C905-97 using a safety factor of 2.0. There is no allowance for surge pressure in the pressure rating.

- 2.4.2.2. **General Requirements.** Except as noted on the plans or procurement specifications for specific jobs, all PVC C-905 pipe must have a pressure rating of 235 PSI and a dimension ratio of 18 or have the highest pressure rating available for each size of pipe.

Dimensions and tolerances for each nominal pipe size must be in accordance with Table 2 Dimensions for PVC Transmission Pipe with CI outside Diameter of Section 3 Pipe Requirements in AWWA C-905-97. All pipes must be suitable for use as a pressure conduit.

Pipe must be gauged full length and furnished in standard laying lengths of 20-ft. \pm 1-in. (6.1-m \pm 25-mm), unless otherwise noted. Each pipe must have an integral bell formed on the pipe end, and be designed to be at least as strong as the pipe wall.

An elastomeric gasket must be designed with a retainer ring, which locks the gasket into integral bell groove and must be installed at the point of manufacture. The dimensions and design of the gasket joint provided

for the PVC transmission pipe must meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket must be reinforced with a steel band and must conform to ASTM F-477.

Each length of pipe furnished must bear identification markings that will remain legible after normal handling, storage, and installation. Markings must be applied in a manner that will not weaken or damage the pipe. Markings must be applied at intervals of not more than 5 ft. (1.5 m) on the pipe. The minimum required markings are given in the list below. Marking requirements must be in conformance with Section 4.7 Marking Requirements of AWWA C-905-97.

Nominal size and OD base (for example, 24 CI).

PVC.

Dimension Ratio (for example, DR 18).

AWWA pressure rating (for example, PR 235).

AWWA designation number for this standard (AWWA C-905).

Manufacturer's name or trademark.

Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundles (Units) must be packaged to provide structural support to ensure that the weight of upper units will not cause deformation to pipe in lower units. No pipes bundles will be accepted which show evidence of ultraviolet radiation "sunburn" on exposed pipe as may be caused from extended unprotected storage conditions.

The manufacturer must take adequate measures during pipe production to assure compliance with AWWA C905-97 by performing quality-control tests and maintaining results of those tests as outlined in Section 4: Inspection and Testing of that standard. Submission of product will constitute certification of compliance with AWWA C905-97 Section 4: Inspection and Testing.

The pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of the pipe system, after installation, is 25 to 50 years.

A 1-yr. warranty must be provided for all materials sold and delivered for use and incorporated into the San Antonio Water System distribution system. Such warranty will take effect on the date that the pipe is received and accepted by an authorized representative of the San Antonio Water System.

User references and a claims history must be provided for further investigation, before rendering a final decision on the acceptance of the product to be furnished.

Test. The manufacturer must pressure test all pipe, including the joint, which is marked with the designation number of AWWA C-905-97 at $73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ($23^{\circ}\text{C} \pm 2^{\circ}\text{C}$). Each length of pipe must be proof tested at twice the pressure rating listed in Table 3 Transmission-Pipe Pressure Rating of AWWA C-905-97 Sec. 4.6 Pressure Strength and Hydrostatic Proof Testing.

Random Tests. The San Antonio Water System may, at no cost to the manufacturer, subject random lengths of pipe to testing by an independent laboratory for compliance with this specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

References. The documents listed below are referenced in this specification.

AWWA C-905-97; Polyvinyl Chloride (PVC) Water Transmission Pipe Nominal Diameters 14 in. through 36 in.

ASTM D-1784; Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

ASTM D-2122; Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings.

ASTM D-3139; Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

ASTM F-477; Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

Manufacturers. Approved Manufacturers for PVC C-905 Pipe: Please see SAWS website for a list of approved manufacturers- http://www.saws.org/business_center/specs/product_submittal/

- 2.4.3. **Polyvinyl Chloride Pipe, 4-in. through 12-in. (C-909).** This Section covers molecularly oriented 4-in. through 12-in. diameter Polyvinyl Chloride (PVC) pressure pipe manufactured from starting stock pipe made from class 12454A or 12454B compounds as determined by ASTM D1784. The starting stock materials are then oriented through circumferential expansion to provide a hydrostatic design basis of 7,100 psi. Pipe must be homogenous throughout. It must be free from voids, cracks, inclusions and other defects. It must be as uniform as commercially practical in color, density and other physical properties. Pipe surfaces must be free from nicks and scratches. Joining surfaces of spigots and joints must be free from gouges and imperfections that could cause leakage. All pipe furnished must be in conformance with AWWA C-909-02, or latest revision thereof and meet the ANSI/NSF 61 requirements. Inductive Tracer Detection Tape must be placed directly above the centerline of all non-metallic pipe a minimum of 12-in. below subgrade or, in areas outside the limits of pavement, a minimum of 18-in. below finished grade to aid locating pipe in the future. The tracer tape must be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape must be placed according to manufacturer's recommendations

- 2.4.3.1. **General Requirements.** Except as noted on the plans or procurement specifications for specific jobs, all PVC C-909 pipe must be Class 150 with a sustained pressure requirement of 500 psi (ASTM D2241) and a minimum burst pressure of 755 psi (ASTM D1599.)

Dimensions and tolerances for each nominal pipe size must be in accordance with Section 4.3 "Pipe Requirements," Table 1 of AWWA C-909.

Pipe must be furnished in standard lengths of 20-ft. (\pm 1-in.) unless otherwise noted. Each pipe must have an integral bell formed on the pipe end and be designed to be at least as strong as the pipe wall.

An elastomeric gasket that "locks" into the integral bell groove must be installed at the point of manufacture. The gasket must be in conformance with ASTM F477.

Each length of pipe furnished must bear identification markings in conformance with Section 6.1.2 Pipe of AWWA C-909.

Pipe must be bundled in pallets for ease of handling and storage. Pipe bundle units must be packaged to provide structural support to ensure that the weight of upper units will not cause deformation to pipe in the lower units.

No pipe bundles will be accepted which show evidence of ultraviolet radiation "sunburn" on exposed pipe as may be caused from extended unprotected storage conditions.

The manufacturer must take adequate measures during pipe production to assure compliance with AWWA C-909 by performing quality-control tests and maintaining results of those tests as outlined in Section 5.2 Quality- Control Records of that standard. Submission of product will constitute certification of compliance with this standard.

The pipe is intended for use as an underground, direct bury pressure pipe for transport of potable water. The expected life of the pipe is received and accepted by an authorized representative of the San Antonio Water System.

A 1-yr. warranty must be provided for all materials sold and delivered or use and incorporated into the San Antonio water system. Such warranty will take effect on the date that the pipe is received and accepted by an authorized representative of the San Antonio Water System.

User references and a claims history must be provided for further investigation before rendering a final decision on the acceptance of the product to be furnished.

The San Antonio Water System may, at no cost to the manufacturer, subject random lengths of pipe testing by an independent laboratory for compliance with this specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.4.3.2.

References.

- ANSI/AWWA C-909; AWWA Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. through 12 In. for Water Distribution
- ASTM D 1598; Test Method for Time-to-Failure of Plastic Pipe under Constant Internal Pressure.
- ASTM D 1599; Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
- ASTM D 1784; Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
- ASTM D 2122; Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
- ASTM D 2152; Test Method for Degree of Fusion of Extruded Poly Vinyl Chloride (PVC) Pipe and Molded Fittings by Acetone Immersion.
- ASTM D 2241; Specification for Polyvinyl Chloride (PVC) Pressure Rated Pipe (SDR Series.)
- ASTM D 2412; Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- ASTM D 2837; Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- ASTM D 3139; Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- ASTM F 477; Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- ANSI/NSF 61; Drinking Water System Components – Health Effects.
- PPI TR3; Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

Manufacturers. Approved Manufacturer for PVC C-909 Pipe: Please see SAWS website for a list of approved manufacturers- http://www.saws.org/business_center/specs/product_submittal/

2.5.

Joint Restraint System. This Section covers pipe joint restraint systems to be used on domestic water mains for PVC C-900 pipe sizes 4-in. through 12-in. diameter and PVC C-905 pipe sizes 16-in. through 24-in. diameter, and for Ductile Iron pipe sizes from 4-in. through 24-in. diameter. Joint restraint systems are classified as "compression," "mechanical joint," or "non-metallic restrained joint" for the specific type of pipe joint to be restrained.

2.5.1.

General Requirements. Underwriter Laboratories (U.L) and Factory Mutual (FM) certifications are required on all restraint systems.

Unless otherwise noted, restraint systems to be used on PVC C-900 and C-905 pipe must meet or exceed A.S.T.M. F1674-96, "Standard Test Methods for Joint Restraint Products for Use with PVC Pipe," or the latest revision thereof. Restraint systems used on ductile pipe must meet or exceed U.L. 194.

Non-metallic restrained joint pipe and couplings must be used specifically for PVC C-900 pipe and fittings in sizes 4-in. through 12-in.

Each restraint system must be packaged individually and include installation instructions.

2.5.2.

Specific Requirements.

Restrainer for PVC C-900/C-905 & Ductile Iron Push-on Type Connections. Pipe restraints must be used to prevent movement for push-on D.I. or PVC (C-900 & C-905) (compression type) bell and spigot pipe connections or where a transition or flexible coupling has been used to join two sections of plain-end pipe D.I. or PVC (C-900 & C-905). The restrainer may be adapted to connect a plain end D.I. or PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. The restrainer must not be directionally sensitive.

The pipe must be restrained by a split retainer band. The band must be cast ductile iron, meeting or exceeding ASTM A-536-80, Grade 65-45-12. The inside face or contact surface of the band must be of enough width to incorporate cast or machined non-directionally sensitive serration to grip the outside circumference of the pipe. The serration must provide full (360°) contact and maintain pipe roundness and avoid any localized points of stress. The split band casting must be designed to “bottom-out” before clamping bolt forces (110ft-lb minimum torque) can over-stress the pipe, but will provide full non-directionally sensitive restraint at the rated pressures.

Bolts and nuts used to attach the split retainer ring must comply with ANSI B-18.2/18.2.2, SAE Grade 5. Tee-bolts, nuts and restraining rods must be fabricated from high-strength, low-alloy steel per AWWA C-111-90.

The split ring type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Table 2 and be for both D.I. and PVC C-900.

Restraint systems sizes 6-in. through 12-in. must be capable of use for both ductile iron and PVC C-900.

The restraint system may consist of two types: the two split retainer rings and for new construction use only the one split and one solid cast backup ring.

Compression Ring Fitting Restrainer for Ductile Iron Pipe & PVC C-900. Compression ring with follower gland type of restrainer may be used in conjunction with Mechanical Joint (MJ) bell end ductile iron pipe fittings for restraining PVC C-900 and ductile iron pipe.

The system must use a Standard MJ gasket with a color-coded compression ring and replacement gland conforming to ASTM A-536-80, Grade 65-45-12.

Standard MJ fitting Tee-bolts and nuts must be fabricated from high strength steel conforming to ANSI AWWA C-111/A-21.11 and AWWA C-153/A-21.53-88.

Standard MJ gasket must be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

The restraint system must be capable of a test pressure twice the maximum sustained working pressure listed in Table 2.

Non-metallic restrained joint pipe and couplings for PVC C-900 Type Connections. Gasketed restrained coupling connections must join two sections of factory grooved PVC C-900 pipe. The restrainer coupling must not be directionally sensitive.

The coupling must incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F-477 and must be DR-14 Class 200 PVC C-900 in all applications, meeting or exceeding the performance requirements of AWWA C-900, latest revision. The inside face or contact surface of the coupling connection must be of enough width to incorporate a factory machined non-directionally sensitive groove in both pipe and coupling to grip the outside circumference of the pipe. The couplings must provide full (360°) contact and maintain pipe roundness and avoid and localized points of stress. The coupling must be designed with an internal stop to align the precision-machined grooves in the coupling and pipe before installation of a non-metallic thermoplastic restraint spleen, and will provide full non-directionally sensitive restraint at the rated pressures.

High-strength flexible thermoplastic spleens must be inserted into mating precision-machined grooves in the pipe and coupling to provide full non-directional restraint with evenly distributed loading.

The non-metallic restrained joint pipe and couplings for PVC C-900 type non-directionally sensitive restrainer system must be capable of a test pressure twice the maximum sustained working pressure listed in Table 2 and be for PVC C-900 pipe sizes 4-in. through 12-in.

Non-metallic restrained joint pipe and couplings for PVC C-900 restrained systems sizes 4-in. through 12-in. must be capable of use for both Class 150 (DR 18) and 4-in. through 8-in. for Class 200 (DR 14) PVC C-900 pipe.

The non-metallic restrained joint pipe and couplings for PVC C-900 restraint system must consist of a pipe and couplings system produced by the same manufacturer meeting the performance qualifications of Factory Mutual (FM) and Underwriters Lab (UL).

Fitting Restraint for Ductile Iron Pipe (only). Radial bolt type restrainer systems must be limited to ductile iron pipe in conjunction with Mechanical Joint (MJ) bell end pipe of fittings. The system must use a Standard MJ gasket with a ductile iron replacement gland conforming to ASTM A-536-80. The gland dimensions must conform to Standard MJ bolt circle criteria.

Individual wedge restrainers must be ductile iron heat treated to a minimum hardness of 370 BHN. The wedge screws must be compressed to the outside wall of the pipe using a shoulder bolt and twist-off nuts to insure proper actuating of the restraining system.

Standard MJ fitting Tee-bolts and nuts must be high strength steel conforming to AWWA C111/A21.11 and C153/A21.53-88.

Standard MJ gasket must be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

2.5.3. Maximum Sustained Working Pressure Requirement

Table 2 - Max Sustained Working Pressure Requirement		
Nominal Diameter	PVC C-900 / C-905	Ductile Iron
4 & 6 in.	200 psi	350 psi
8 in.	200 psi	250 psi
10 & 12 in.	200 psi	200 psi
14 & 16 in.	200 psi (C-900) / 235 psi (C-905)	200 psi
20 & 24 in.	200 psi (C-900) / 235 psi (C-905)	200 psi

Tests. The San Antonio Water System may, at no cost to the Contractor, subject random joint restraint system products to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards herein will be ground for rejecting the entire order.

Manufacturers. Please see SAWS website for a list of approved manufacturers-
http://www.saws.org/business_center/specs/product_submittal/

- 2.6. **Stainless Steel Casing Spacer/Insulators.** This Section covers casing spacers for use in water supply service. Casing spacers are used to facilitate installing a water pipe inside a casing pipe or tunnel. Casing spacers must consist of two or more segments of circular steel that bolt together forming a shell around the carrier pipe(s). Casing spacers should protect the carrier pipe and any protective coating or wrapping from damage during the installation, and properly support and electrically isolate the carrier pipe(s) within the casing or tunnel. On occasion multiple carrier pipes may be installed in one casing or tunnel.

- 2.6.1. **General Requirements.** The San Antonio Water System (SAWS) reserves the right to limit the purchase of casing spacers from the manufacturers and to the models specified as shown on the SAWS website - http://www.saws.org/business_center/specs/product_submittal/, providing such casing spacers conform to the provisions contained herein.

Casing spacers must be 8 in. long for carrier pipes up to 16-in. diameters and 12 in. long for larger carrier pipe sizes. Manufacturer's approval in writing will be required for installations exceeding 300 ft. in length, carrier pipes in excess of 48-in. diameter or multiple carrier pipes in one casing or tunnel.

Casing spacers must have a minimum 14-gauge steel band and 10-gauge steel riser when required. The band, risers and connecting studs must be welded and cleaned at the factory before the application of a fluidized bed fusion bonded PVC coating. Stainless steel (type 304) casing spacer is an acceptable alternative.

The fluidized bed fusion bonded PVC coating must be between 10-16 mils thickness. The PVC coating must provide good resistance to acids and alkalis and excellent resistance under ASTM B117 salt spray tests. The coating must have a minimum 1380 volts/mil per ASTM D149-61 short time 0.010-in. test and a Durometer-shore A @ (10 sec) of 80 per ASTM D1706-61T. Epoxy coatings are not an acceptable alternative.

The spacers must have a flexible PVC liner of 0.09-in. thickness with Durometer "A" 85-90 hardness and a minimum 58,000-volt dielectric strength (60,000-volt minimum Surge Test.) Moisture absorption must not exceed 1%.

The runners must be of high pressure molded glass reinforced polyester with a minimum compressive strength of 18,000 psi per ASTM D695, flexural strength of 25,300 psi per ASTM D790, tensile strength of 17,600 psi per ASTM D638 and Rockwell hardness (M) of 90 per ASTM D785. The riser must be designed and fabricated to place the runner (skid) in full contact with the inside surface of the casing pipe. This evenly distributes the load force to all support members. The ends of all runners must be shaped to resist hanging or sticking inside casing during installation of the carrier pipe. Polyethylene runners are not acceptable.

Runners must be a minimum of 1-in. in width and a minimum of 7-in. long for carrier pipes up to 16-in., and a minimum of 2-in. in width and 11-in. long for larger carrier pipes. Bolts on runners are not acceptable. The runners must be attached to the band or riser by 3/8 the wearing surface on the runner. The recess must be filled with a corrosion inhibiting filler. There must be 4 runners per casing spacer for carrier pipes up to 12-in. diameter, 6 runners for 14-in. through 36-in. and 8 or more runners for carrier pipes over 36-in. diameter. Number of bottom runners must be multiples of two. Number of top runners must be multiples of two.

The band section must be bolted together with 5/16-in. cadmium-plated studs, nuts and washers. There must be 6 sets per 8-in. long casing spacer and 8 sets per 12-in. long spacer. Stainless steel casing spacers must be furnished with stainless steel studs, nuts and washers.

Casing spacers must have ample riser height to limit vertical movement of the carrier pipe in the casing. A minimum of 1-in. to 2-in. clearance must be provided between the top runner and the ID of the casing or tunnel.

Continuous operating temperatures for the PVC Coated Casing Spacers should not exceed 150° F. Stainless steel casing must be used in applications where continuous operating temperatures exceed 150° F.

Unless noted otherwise, casing spacers and end seals will be required on all carrier pipes installed in casing or tunnel applications.

2.6.2.

Quality Assurance. All casing spacers are to be manufactured in accordance to NACE International Recommend Practice RP 0286-97 (Isolation Spacers.) Each casing spacer must be manufactured in the USA at a facility that has a Registered ISO 9002 Quality Management System or be in the process of achieving this certification by March 2005. Non-compliance to this registered commercial quality system requirement by March 2005 will result in removal of the manufacturer's product from the approved manufacturers.

If on receipt of casing spacers they are found to be non-compliant, the manufacturer must replace the defective casing spacer with a casing spacer that meets the San Antonio Water System's specifications, at no charge to San Antonio Water System.

If San Antonio Water System audits, product inspection and performance data review in accordance to these specifications determine excessive casing spacer Noncompliance, the manufacturer will be subject to removal by the Products Standard Committee. Copy of the current ISO 9002 registration (or written documentation of being "in the process of achieving ISO registration," before March 2005) must be provided with material submittal.

2.7. **Copper Tubing and Brass Fittings for Copper Service Lines.**

2.7.1. **Copper Tubing.** This Section covers copper tubing in nominal sizes of 3/4-in., 1-in., 1-1/2-in. and 2-in.

2.7.1.1. **General Requirements.** Copper tubing must be of the type commercially known as Type "K" soft and conforms to NSF 61, ASTM Specifications B-88, or latest revision thereof.

3/4-in. and 1-in. copper tubing must be furnished in 60-ft. coils or 100-ft. coils as specified; 1-1/2-in. must be furnished in 20-ft. lengths, 40-ft. coils or 60-ft. coils as specified, and 2-in. must be furnished in 20-ft. lengths or 40-ft. coils as specified.

Copper tubing is the only allowable material for small service lines.

2.7.2. **Brass Fittings.** This Section covers waterworks brass goods, such as corporation stops, curb stops, couplings, connectors, nipples, etc.

2.7.2.1. **General Requirements.** The brass composition must conform to ASTM Specifications B-62, or latest revision thereof, fittings must conform to ANSI/AWWA Specifications C-800, or latest revision thereof.

All brass components in contact with potable water must be "lead free" and marked by stamping, etching or casting "NL" in the main body made from either CDA/UNS Brass Alloys C89520 in accordance with ASTM B584; or C89833. Brass saddles must be made from CDA/UNS C83600.

Any brass component not in contact with potable water must be made of 85-5-5-5 brass as defined per ASTM B62, ASTM B584 and AWWA C-800.

All service fittings must be certified as suitable for contact with drinking water by an ANSI accredited organization in accordance with ANSI/NSF 61, Drinking Water Systems Components-Health affects Section 8. Proof of certification is required. The lead content of the wetted components in contact with potable water must also be verified by an ANSI accredited testing facility.

All brass fittings and valves must have the manufacturers name or trademark integrally stamped, or cast into it indicating that the product is manufactured from the low-lead alloy as specified. Another marking such as "NL", "EBII", "FD" or other commonly accepted identifier, indicating the alloy as "No-lead"; must also be cast or stamped into the fitting or valve.

Painting, printing, sticker, or decals attesting to the components "no-lead" certification will not be permitted.

All casting must have a natural, clean uniform and smooth surface, and be free from internal porosity.

All machining must be done in a workmanlike manner and within the acceptable tolerances.

2.7.2.2. **Design Criteria for Ball Type Curb Stops/Angle Valves.** All Curb Stop, Corporation and Angle valves must be ball valves. "Inverted/Ground Key," type angle valves will not be accepted.

Ball type valves will not have a stop.

All ball valves, couplings and adapters will be pressure rated to 300 psi, and will be supplied with blowout proof stainless steel stems with double SBR, NBR or EPDM O-ring steam seal.

Stem and cap assembly will be two-piece design and will withstand minimum 200 ft.-lb. of torque.

Ball seats will be made with unfilled Teflon or EPDM for resilience and minimal friction.

Ball will be lead free cast brass or stainless design. Coated ball is not permitted.

All fittings must have a lifetime guarantee against lead leachate from the casting.

The reduced port design not will be acceptable.

Pack Joints will not be accepted.

2.8. Gate Valves, Tapping Valves and Tapping Sleeves.

2.8.1. **Resilient-Seated Gate and Tapping Valves ANSI/AWWA C509-01.** This product specification covers resilient seated gate valves, with nominal diameters of 3 in., 4 in., 6 in., 8 in., 10 in., 12 in., 16 in., and 20 in. Sizes refer to the nominal diameter, in in., of the waterway through the inlet and outlet connections and the closure area. All products furnished must conform to the ANSI/AWWA C-509-01, or latest revision thereof.

2.8.1.1. **Definitions.** All definitions are defined according to ANSI/AWWA C509-01.

Cosmetic Defect: A blemish, which has no effect on the ability of the component to meet the structural design and production test requirements of this standard. Should the blemish or the activity of plugging, welding, grinding, or repairing of such blemish cause the component to fail these requirements, then the blemish will be considered a structural defect.

Flanged Joint. The flanged and bolted joint as described in ANSI/AWWA C110/A21.10.

Mechanical Joint. The gasket and bolted joint as described in ANSI/AWWA C111/A21.11.

Push-on Joint. The single rubber gasket joint as described in ANSI/AWWA C111/A21.11.

Structural Defect. A flaw that causes the component to fail the structural design or test requirement of this standard. This includes, but is not limited to imperfections that result in leakage through the walls of a casting, failure to meet the minimum wall-thickness requirement, or failure to meet production tests.

Tapping Valve. A special gate valve designed with end connections and an unobstructed waterway to provide proper alignment and positioning of a tapping sleeve, valve, and machine for tapping pipe dry or under pressure as described in AWWA C-509 Section 1.2 Definitions and MSS SP-60.

2.8.1.2. **General Requirements.** Except as otherwise modified or supplemented herein, AWWA C-509-01 or the latest revision thereof, will govern the design, component materials, construction; manufacture and testing of all resilient seated gate valves. Valves must be suitable for frequent operation as well as service involving long periods of inactivity. Valves must be NSF-61 certified.

The San Antonio Water System reserves the right to limit the purchase of resilient seat gate valves from manufacturers and to the models specified, provided such resilient seat gate valves conform to the provision contained herein. Please see SAWS website for a list of approved manufacturers-
http://www.saws.org/business_center/specs/product_submittal/

The minimum design working water pressure for gate valves with nominal diameters of 3-in., 4-in., 6-in., 8-in., 10-in., and 12-in. must be 200 psig unless otherwise specified.

The minimum design working water pressure for gate valves with nominal diameters of 16-in., 20-in., and 24-in. must be 150 psig unless otherwise specified.

Valves must be resilient-seated types, bronze mounted with non-rising stems. The closure member must be fully encapsulated by an elastomer without thin spots or voids. When open the valve must have a clear, full-port, unobstructed waterway.

Gray iron, ductile iron, steel, brass and bronze materials must meet or exceed the material requirements of Section 2: Materials of AWWA C-509-01.

Gaskets, O-rings, Coatings, and elastomers must meet or exceed the material requirements of Section 2: Materials of AWWA C-509-01.

The gate valves must be designed and constructed for installation in either a horizontal or vertical position. Valves must be designed for buried installation with stem in the vertical position and must be furnished for mounting in a horizontal pipeline, unless otherwise specified.

Valve components of brass or bronze must be manufactured to ASTM recognized alloy specifications of low zinc content bronze, as shown in Table 1 of Section 2.2.4. of ANSI/AWWA C-509-01, or the latest revision thereof. Materials for the stem have minimum yield strength of 40,000 psi. A minimum elongation in 2 in. of 12% and must be made of bronze per ASTM B763, alloy number UNS C99500. A maximum zinc content of 2% as shown in Table 2 Chemical Requirements of ASTM B763-96 or the latest revision thereof. Stem nut material must be ASTM B-62 UNS C83600 or ASTM B-584 UNS C84400. The stem must have a visible external marking at the top to indicate low-zinc, high strength material. The marking must include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

Valve ends must be either flanged, tapping valve, mechanical joint, push-on joint or any combination thereof, as specified. All mechanical joint valves must be supplied with glands, bolts, and gaskets. Valve body bolts and nuts must meet the strength requirements of ASTM A-307 with dimensions conforming to ANSI B18.2.1. The size of the bolt head must be equal to the size of the nut and must be stainless steel in accordance with ASTM 276.

All gate valves must open right (clockwise), unless otherwise specified.

The following parts of the valve must be made of either gray or ductile iron: bonnet, body, yoke, wrench nut, O-ring packing plate or seal plate, and gland follower. The gate may be made of gray or ductile iron.

If glands and bushings are used for NRS valves they must be made of ASTM B-763 bronze UNS C99500. The stem must be made of cast, forged, or rolled ASTM B-763 bronze UNS C99500. The stem nut material must be ASTM B-62 bronze UNS C83600 or ASTM B-584 bronze UNS C84400. The gate may be made of bronze ASTM B-763 bronze UNS C99500. Stem seals must be "O" ring type. The seals must be designed for dynamic applications.

The design must be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position. Materials for the "O" ring packing plate must be in accordance with Section 4.8.3 of ANSI/AWWA C509-01 or the latest revision thereof.

Enclosed and buried valves must be coated inside and outside with a fusion bonded epoxy with a nominal 8 mils dry film thickness, which meets or exceeds AWWA C-550-01 and to the maximum extent possible must be free of holidays. All coatings in contact with the potable water must be approved for potable water immersion service per ANSI/NSF 61.

The bidder must submit with his proposal 3 sets of certified drawings showing the principal dimensions, general construction and material specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished under this specification must be supplied from the San Antonio Water System approved manufacturer list shown on the SAWS website - http://www.saws.org/business_center/specs/product_submittal/. To be included on the qualified product list, the manufacturer must provide an Affidavit of Compliance in accordance with the Section 1.5 of ANSI/AWWA C-509-01 or latest revision thereof, to include compliance with San Antonio Water System Specification No. 21-02. Records of all tests performed in accordance with Section 6.1 and Section 6.2 of ANSI/AWWA C-509-01 or latest revision thereof will be made available or provided. These records will be representative test results for Section 6.1 and certificate of testing for Section 6.2. An affidavit of testing for the valve assembly as outlined in Section 6.2.2 of ANSI/AWWA C-509-01 , (350 ft.-lb.) will also be provided. A copy of the manufacturer's Quality Assurance Program will be submitted. Blueprints and parts list for the valve must also be provided.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged. (1) An internal test pressure of twice the rated design working pressure of the valve. (2) The full rated internal working pressure when the closure member is cycled once from a fully open to a fully closed position against the full rated unbalanced working water pressure. In addition to these pressure requirements, the valve assembly and mechanism must be capable of withstanding an input torque as follows: 200 ft.-lb. for a 3-in. and 4-in. nominal diameters, and 300 ft.-lb. for a 6-in. 8-in., 10-in., and 12-in. nominal diameters.. For sizes larger than a 12 in. nominal diameter, refer to the manufacturer's specifications.

Resilient seats must be applied to the gate and must seat against a corrosion resistant surface. The non-metallic seating surface must be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface must have a corrosion resistance equivalent to or better than bronze. A non-metallic surface must be in compliance with ANSI/AWWA C-550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats must be bonded. ASTM D-429 either method A or method B must prove the method used for bonding or vulcanizing. For method A, the minimum strength must not be less than 250 psi. For method B, the peel strength must be 75 lb./in.

The end flanges of flanged valves must conform to dimensions and drillings of ANSI/AWWA C-110/A21.10 or ANSI B-16.1, Class 125.

Mechanical joint bell dimensions must conform to ANSI/AWWA C-111/A21.11.

Push-on joints must conform to the requirements of ANSI/AWWA C-111/A21.11.

The tapping valves must be mechanical joints with tapping flange on the other end. The tapping valves must be furnished complete with glands, bolts, and gaskets. The tapping valve must have a clear unobstructed waterway.

The seat rings must be of a large diameter to the permit entry of the full diameter tapping machine cutters. The valve end which mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip will be dimensioned in accordance with MSS SP-60 for valves 20-in. nominal pipe size and smaller.

All interchangeable parts must conform to their required dimensions and must be free from defects that could prevent proper functioning of the valve. When assembled, valves manufactured in accordance with this standard must be well fitted and operate smoothly. All like parts of valves of the same model and size produced by the same manufacturer must be interchangeable.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements of this specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

All gate valves must be hydrostatically tested with twice the specified rated pressure applied to one side of the gate and zero pressure applied to the other side. The test is to be made in each direction across the gate. All tests are to be performed at the manufacturer's plant.

All gate valves must be operated through a complete cycle in the position for which it was designed to ensure free and proper functioning of all parts in the intended manner. Any defects in workmanship must be corrected and the test repeated until satisfactory performance is demonstrated. All tests are to be performed at the manufacturer's plant.

A hydrostatic test pressure equal to twice the rated working pressure of the valve must be applied to all assembled valves with the gates in the open position. The test must show no leakage through the metal, pressure containing joints, or stem seals. All tests are to be performed at the manufacturer's plant.

A test must be made from each direction at rated working pressure to prove the sealing ability of each valve from both directions of flow. The test must show no leakage through the metal, pressure containing joints, or past the seat. All tests are to be performed at the manufacturer's plant.

Markings must be cast on the bonnet or body of each valve and must show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, and the designation of working water pressure, for example "200 W".

The San Antonio Water System may, at no cost to the Contractor, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order and removal from the approval list.

2.8.1.3. **Workmanship.** All parts of the resilient seat gate valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C-509-01 or latest revision thereof and this specification.

All parts of the resilient seat gate valve manufactured by a given manufacturer must be interchangeable with like parts from another resilient seat gate valve of the same model and size and by the same manufacturer.

All interchangeable parts must conform to their required dimensions and must be free from defects that could prevent proper functioning of the valve.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements of this specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

The resilient seat gate valves must be well fitted. Operation of the resilient seat gate valve must be smooth. All parts must be free of structural defects. The resilient seat gate valve must be watertight.

2.8.1.4. **Painting.** All exterior and interior surfaces of the valve must be coated with epoxy, NSF 61 certified. The epoxy must have a nominal dry film thickness of 8 mils, and must be in accordance with AWWA C-550, latest revision.

Coating must be as close to holiday free as is technologically possible.

2.8.1.5. **Testing.**

Hydrostatic Test: Hydrostatic Test must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

Torque Test: Torque Test for prototype valves must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

Leakage Test: Leakage Test must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

Pressure Test: Pressure Test must be performed on the valve in accordance with Section 6.1 Proof of Design Testing of ANSI/AWWA C-509-01 or latest revision thereof.

Operation Test: Operation Test must be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision thereof.

Shell Test: Shell Test must be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision thereof.

Seat Test: Seat Test must be performed on the valve in accordance with Section 6.2 Production Testing of ANSI/AWWA C-509-01 or latest revision thereof.

An Affidavit of Compliance certifying that all required tests have been performed must be provided in accordance with Section 6.3 Affidavit of Compliance of ANSI/AWWA C-509-01.

The Affidavit of Compliance, the results of ASTM testing procedures and requirements for materials, Manufacturer's Quality Assurance Program, and the records of all tests performed on the valve must be kept and provided by the supplier/manufacturer in a single hard cover bound notebook with the bid or with the shipping documents and must be approved by the San Antonio Water System.

2.8.1.6.

Quality Assurance. Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system or is in the process of achieving this certification by June 2001. Noncompliance to this registered commercial quality system requirement by June 2001 will result in removal of the manufacturer's product from the approved manufacturers list. If on receipt of resilient seat gate valves they are found to be non-compliant the manufacturer must replace the defective resilient seat gate valves according to resilient seat gate valve size with a resilient seat gate valve that meets the San Antonio Water System's specifications. The defective resilient seat gate valve will be returned to the manufacturer, freight collect, and the manufacturer must replace the resilient seat gate valve, freight prepaid. If San Antonio Water System audits, product inspection and performance data review in accordance with these specifications determine excessive resilient seat gate valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the resilient seat gate valve becomes defective during the manufacturer's specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the manufacturer must replace the resilient seat gate valve according to size with a resilient seat gate valve that meets the San Antonio Water System's specifications. The defective resilient seat gate valve removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the resilient seat gate valve, freight prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges. **References.**

American National Standards Institute and American Water Works Association Standard C-509-01 (ANSI/AWWA C-509-01).

Manufacturers Standardization Society MSS SP-60.

2.8.2.

Reduced Wall, Resilient Seated Gate and Tapping Valves AWWA C515-01. This product specification covers reduced wall resilient seated gate valves, with nominal diameters of 4 in. through 48 in. Sizes refer to the nominal diameter, in in., of the waterway through the inlet and outlet connections and the closure area.

All products furnished must conform to ANSI/AWWA C515-01) or latest revision thereof and Manufacturers Standardization Society Standard Practice for Connecting Flange Joint Between Tapping Sleeves and Tapping Valves MSS SP-60 or latest revision thereof.

2.8.2.1. **Definitions.** All definitions are defined according to ANSI/AWWA C515-01.

Cosmetic Defect. A blemish, which has no effect on the ability of the component to meet the structural design and production test requirements of this standard. Should the activity of plugging, welding, grinding, or repairing of such blemish cause the component to fail these requirements, and then the blemish will be considered a structural defect.

Flanged Joint. The flanged and bolted joint as described in ANSI/AWWA C110/A21.10 or ANSI B16.1, Class 125.

Mechanical Joint. The gasketed and bolted joint as described in ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11, or ANSI/AWWA C153/21.53.

Push-on Joint. The single rubber gasket joint as described in ANSI/AWWA C111/A21.11.

Structural Defect. Flaws that cause the component to fail the structural design or test requirements of this standard. This includes, but is not limited to imperfections that result in leakage through the walls of a casting, failure to meet the minimum wall- thickness requirement, or failure to meet production tests.

Tapping Valve. A special gate valve designed with end connections and an unobstructed waterway to provide proper alignment and positioning of a tapping sleeve, valve, and machine for tapping pipe dry or under pressure.

2.8.2.2. **General Requirements.** Except as otherwise modified or supplemented herein, ANSI/AWWA C515-01 or the latest revision thereof, will govern the design, component materials, construction; manufacture and testing of all reduced wall resilient seated gate valves. Valves must be suitable for frequent operation as well as service involving long periods of inactivity. Valves must be NSF-61 certified.

The San Antonio Water System reserves the right to limit the purchase of reduced wall resilient seat gate valves from manufacturers and to the models specified, as shown on the SAWS website - http://www.saws.org/business_center/specs/product_submittal/, provided such reduced wall resilient seat gate valves conform to the provision contained herein.

The minimum design working water pressure for gate valves with nominal diameters of 4 in., 6 in., 8 in., 10 in., 12 in., 14 in. and 16 in. must be 200 psig unless otherwise specified.

The maximum fluid velocity for flow through the valve in full open position must be 16 ft./sec.

Valves must be reduced wall, resilient-seated types, bronze mounted with non-rising stems. The closure member must be fully encapsulated by an elastomer without thin spots or voids. When open the valve must have a clear, full-port, unobstructed waterway.

Gray iron, ductile iron, steel, brass and bronze materials must meet or exceed the material requirements of Section 4.2: Materials of AWWA C515-01 and Table 3 below.

Table 3 - Reduced Wall, Resilient Seated Gate and Tapping Valves	
MATERIAL	STANDARD
Gray Iron	ASTM A126, Class B
Ductile Iron	ASTM A536 no more than .08% phosphorous
Steel	SAE Grade 2, ASTM A307, and zinc plated
Bronze	ASTM B763 UNS C99500
Bronze Stem Nuts Only	ASTM B62 UNS C836000 ASTM B584 UNS C84400

Gaskets, O-rings, Coatings, and elastomers must meet or exceed the material requirements of Section 4.2 Materials of AWWA C515-01.

The gate valves must be designed and constructed for installation in either a horizontal or vertical position. Valves designed for buried installation must have a stem in the vertical position and must be furnished for mounting in a horizontal pipeline, unless otherwise specified.

Valve components of brass or bronze must be manufactured to ASTM recognized alloy specifications of low zinc content bronze, as shown in Section 4.2 Materials ANSI/AWWA C515-01 or the latest revision thereof. Material for the stem must have minimum yield strength of 40,000 psi. A minimum elongation in 2 in. of 12% and must be made of bronze per ASTM B763, alloy number UNS C99500. A maximum zinc content of 2% as shown in Table 2 Chemical Requirements of ASTM B763-96 or the latest revision thereof. Stem nut material must comply with the requirements shown above. The stem must have a visible external marking at the top to indicate low-zinc, high strength material. The marking must include a red plastic or neoprene washer placed around the top of the stem under the operating nut.

Valve ends must be either flanged, tapping valve, mechanical joint, push-on joint or any combination thereof, as specified. All mechanical joint valves must be supplied with glands, bolts, and gaskets. Valve body bolts and nuts must meet the strength requirements of ASTM A307 with dimensions conforming to ANSI B18.2.1. The size of the bolt head must be equal to the size of the nut and must be stainless steel in accordance with ASTM 276.

All gate valves must open right (clockwise), unless otherwise specified.

The following parts of the valve must be made of ductile iron: bonnet and body. Shell thickness must meet the minimum thickness requirements of Table 1 Minimum Thickness of Body and Bonnet of Section 4.4 Detailed Design of ANSI/AWWA C515-01. Valves larger than 16-in. must meet the performance requirements of the San Antonio Water System resilient seat reduced gate valve specification.

If glands and bushings are used for the valves must be made of ASTM B763 bronze UNS C99500. The stem must be made of cast, forged, or rolled ASTM B763 bronze UNS C99500. The gate may be made of bronze ASTM B763 UNS C99500. Stem seals must be "O" ring type. The seals must be designed for dynamic applications. The design must be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position. Materials for the "O" ring packing plate must be in accordance with Section 4.4.6 Stem Sealing of ANSI/AWWA C515-01 or the latest revision thereof.

Enclosed and buried valves must be coated inside and outside with a fusion bonded epoxy with a nominal 8 mils dry film thickness, which meets or exceeds AWWA C550-01 and to the maximum extent possible must be free of holidays. All coatings in contact with the potable water must be approved for potable water immersion service per ANSI/NSF 61.

The bidder must submit with his proposal 3 sets of certified drawings showing the principal dimensions, general construction and material specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents. The number of turns to open or close the valve must be consistent for each valve size for each approved manufacturer.

Valves furnished under this specification must be supplied from the San Antonio Water System approved manufacturer list on the SAWS website - http://www.saws.org/business_center/specs/product_submittal/.

All gate valve parts must be designed to withstand the following two pressure requirements, without being structurally damaged. (1) An internal test pressure of twice the rated design working pressure of the valve. In no case must the pressure be less than 500 psi without any visual deformation. (2) The full rated internal working pressure when the closure member is cycled once from a fully open to a fully closed position against the full rated unbalanced working water pressure. In addition to these pressure requirements, the valve assembly and mechanism must be capable of withstanding an input torque as follows: 200 ft.-lb. for a 4-in. nominal diameter, 300 ft.-lb. for a 6-in., 8-in., 10-in., and 12-in. nominal diameters, 400 ft.-lb. for a 14-in. through 20-in. nominal diameters, and 600 ft.-lb. for a 24-in. nominal diameter.

Resilient seats must be applied to the gate and must seat against a corrosion resistant surface. The non-metallic seating surface must be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface must have a corrosion resistance equivalent to or better than bronze. A non-metallic surface must be in compliance with ANSI/AWWA C550. The gate must be fully encapsulated by an elastomer without thin spots or voids. Resilient seats must be bonded. ASTM D429 either method A or method B must prove the method used for bonding or vulcanizing. For method A, the minimum strength must not be less than 250 psi. For method B, the peel strength must be 75 lb./in.

The end flanges of flanged valves must conform to dimensions and drillings of ANSI/AWWA C110/A21.10 or ANSI B16.1, Class 125.

Mechanical joint bell dimensions must conform to ANSI/AWWA C111/A21.11.

Push-on joints must conform to the requirements of ANSI/AWWA C111/A21.11.

Markings must be cast on the bonnet or body of each valve and must show the manufacturer's name or mark, the year the valve casting was made, the size of the valve, the letters "C515", and the designation of working water pressure, for example "200 W". Markings must conform to Section 6.1 Marking of ANSI/AWWA C515-01 or latest revision thereof.

The San Antonio Water System may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order and removal of the manufacturer from the attached approval list.

The tapping valves must be configured with a mechanical joint on one end and a tapping flange on the other end. The tapping valves must be furnished complete with glands, bolts, and gaskets. The tapping valve must have a clear unobstructed waterway. The seat rings must be of a large diameter to permit the entry of the full diameter tapping machine cutters. The valve end which mates with the tapping sleeve must have an alignment lip to fit the recess in the tapping sleeve flange for proper alignment. The lip will be dimensioned in accordance with MSS SP-60 for valves 20-in. nominal pipe size and smaller.

2.8.2.3. **Workmanship.** All parts of the reduced wall resilient seat gate valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C515-01 or latest revision thereof and this specification.

All parts of the reduced wall resilient seat gate valve manufactured by a given manufacturer must be interchangeable with like parts from another reduced wall resilient seat gate valve of the same model and size and by the same manufacturer.

All interchangeable parts must conform to their required dimensions and must be free from defects that could prevent proper functioning of the valve.

All castings must be clean and sound, without defects that will weaken their structure or impair their service. Plugging, welding, or repairing of cosmetic defects is allowed. Repairing of structural defects is not allowed. Repaired valves must comply with the testing requirements of this specification after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

The reduced wall resilient seat gate valve must be well fitted. Operation of the reduced wall resilient seat gate valve must be smooth. All parts must be free of structural defects. The reduced wall resilient seat gate valve must be watertight.

- 2.8.2.4. **Painting.** All exterior and interior surfaces of the valve must be coated with epoxy, NSF 61 certified. The epoxy must have a nominal dry film thickness of 8 mils, and must be in accordance with AWWA C550, latest revision.

Coating must be as close to holiday free as is technologically possible.

- 2.8.2.5. **Testing.**

Hydrostatic Gate Test: Hydrostatic Gate Test must be performed on the valve in accordance with Section 5.1 Testing of ANSI/AWWA C515-01 or latest revision thereof.

Torque Test: Torque Test for prototype valves must be performed on the valve in accordance with Section 5.1 Testing of ANSI/AWWA C515-01 or latest revision thereof. Prototype valves larger than 16-in. must meet the torque requirements of Section 2.7.2.2 above.

Leakage Test: Leakage Test must be performed on the valve in accordance with Section 5.1 Testing of ANSI/AWWA C515-01 or latest revision thereof.

Hydrostatic Shell Test: Hydrostatic Shell Test must be performed on the valve in accordance with Section 5.1 Testing of ANSI/AWWA C515-01 or latest revision thereof. Valves larger than 16-in. must be shell tested at twice the rated working pressure but at least 500 psi.

Production Test: Production Test must be performed on the valve in accordance with Section 5.1 Testing of ANSI/AWWA C515-01 or latest revision thereof. This same test must apply to valves larger than 16-in.

Operation Test: Operation Test must be performed on the valve in accordance with Section 5.1 Testing of ANSI/AWWA C515-01 or latest revision thereof.

Seat Test. Seat Test must be performed on the valve in accordance with Section 5.1 Testing of ANSI/AWWA C515-01 or latest revision thereof.

An Affidavit of Compliance certifying that all required tests have been performed must be provided in accordance with Section 6.3 Affidavit of Compliance of ANSI/AWWA C515-01.

The Affidavit of Compliance, the results of ASTM testing procedures and requirements for materials, Manufacturer's Quality Assurance Program, and the records of all tests performed on the valve must be kept and provided by the supplier/manufacturer in a single hard cover bound notebook with the bid or with the shipping documents and must be approved by the San Antonio Water System.

- 2.8.2.6. **Quality Assurance.** Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system. If on receipt of reduced wall resilient seated gate valves they are found to be non-compliant the manufacturer must replace the defective reduced wall resilient seated gate valves according to reduced wall resilient seated gate valve size with a reduced wall resilient seated gate valve that meets the San Antonio Water System's specifications. The defective reduced wall resilient seated gate valve will be returned to the manufacturer, freight collect, and the manufacturer must replace the reduced wall resilient seated gate valve,

freight prepaid. If San Antonio Water System audits, product inspection and data review in accordance with these specifications determine excessive reduced wall resilient seated gate valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the reduced wall resilient seated gate valve becomes defective during the manufacturer's specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the manufacturer must replace the reduced wall resilient seated gate valve according to size with a reduced wall resilient seated gate valve that meets the San Antonio Water System's specifications. The defective reduced wall resilient seated gate valve removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the reduced wall resilient seated gate valve, freight prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges.

2.8.2.7.

References.

American National Standards Institute and American Water Works Association C509-01 (ANSI/AWWA C509-01).

Manufacturers Standardization Society MSS SP-60.

2.8.3.

Tapping Valves and Tapping Sleeves. This Section covers tapping sleeves installed on pipe from 4-in. and larger nominal pipe diameter.

2.8.3.1.

General Requirements. Band must conform to the minimum OD size ranges and lengths specified in Table 8 The flange must be manufactured in compliance with AWWA C-223-07, Class D ANSI B.16.1 drilling, recessed for tapping valves MSS-SP60. Mechanical Joint tapping sleeve outlet must meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint x mechanical joint resilient wedge gate valves per ANSI/AWWA C-509-94.

2.8.3.2.

Tapping sleeves from 4-in. through 12-in. nominal pipe diameter.

Entire fitting to be stainless steel type 304 (18-8). The body, lug and gasket armor plate to be in compliance with ASTM A-240. The flange must be cast stainless steel in compliance with ASTM A-743. The MJ outlet must be one-piece casting made of stainless steel. The test plug must be 3/4-in. NTP in compliance with ANSI B2.1 and must be lubricated or coated to prevent galling. All metal surfaces must be passivated after fabrication in compliance with ASTM A-380.

The gasket is to provide a 360-sealing surface of such size and shape to provide an adequate compressive force against the pipe after assembly, to affect a positive seal under combinations of joint and gasket tolerances. The materials used must be vulcanized natural or synthetic rubber with antioxidants and antioziant ingredients to resist set after installation. No reclaimed rubber should be used. A heavy-gauge-type 304-stainless armor plate must be vulcanized into the gasket to span the lug area.

The lugs are to be heliarc welded (GMAW) to the shell. Lug must have a pass-through-bolt design to avoid alignment problems and allow tightening from either side of the main. Bolts must not be integrally welded to the sleeve. Finger Lug designs are not approved; it is the intent of these specifications to allow tapping sleeve that has a lug design similar to the approved models.

Bolts and nuts must be type 304 (18-8) stainless steel and lubricated or Teflon coated to prevent galling or seizing. Bent or damaged unit will be rejected.

Quality control procedures must be employed to ensure that the shell, Lug, (4-in. and larger nominal pipe diameter) armor plate, gasket and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working pressure rating up to 200 psi, and a test pressure of 250 psi.

The sleeve construction must provide a positive means of preventing gasket cold flow and extrusion.

Each sleeve must be stenciled, coded or marked in a satisfactory manner to identify the size range. The markings must be permanent type, water resistant that will not smear or become illegible.

2.8.3.3. Tapping Sleeves 16-in. and larger nominal pipe diameter.

The body must be in compliance with ASTM A285 Grade C or ASTM A36. Test plug must be 3/4-in. NPT conforming to ANSI B2.1.

The gasket is to provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket will insure a positive seal under all combinations of joint and gasket tolerances. Gasket should be formed from vulcanized natural or synthetic rubber with antioxidants ingredients to resist set after installation. No reclaimed rubber should be used.

Bolts and nuts must be type high strength, corrosion resistant, low alloy per AWWA C-111, ANSA A21.11

Quality control procedures must be employed to ensure that the shell, gasket and related hardware are manufactured to be free of any visible defects. Each unit, after proper installation, must have a working pressure rating up to 150 psi, and a test pressure of 200 psi.

Unless otherwise noted, unit must be protected by fusion Epoxy 8-10 mil line and coat per AWWA C-213.

Units for concrete steel cylinder pipe must be furnished with load bearing set screws on the gland flange to transfer loads on the outlet away from the steel cylinder and onto the sleeve. Epoxy-coated tapping sleeves do not require grout seal cavity. (AWWA Manual of Practice M-9)

Each sleeve must be stenciled, coded or marked in a satisfactory manner to identify the size range. The markings must be permanent type, water resistant that will not smear or become illegible.

See Table 4 for Standard Dimension Ranges:

Nominal Dia. (in.) x Min Length (in.)	Flange Outlet (in.)	Range	Min OD Range (in.)**
4 x 16	4	A	4.75 – 4.95
		B	4.90 – 5.10
6 x 16	4	A	6.70 – 7.10
		B	7.00 – 7.40
		C	7.35 – 7.75
6 x 16	6	A	6.80 – 7.15
		B	7.05 – 7.40
		C	7.40 – 7.75
8 x 16	4 & 6	A	9.00 – 9.45
		B	9.35 – 9.70
		C	9.70 – 10.10
8 x 20	8	A	9.00 – 9.35
		B	9.35 – 9.70
		C	9.70 – 10.00
10 x 16	4 & 6	A	11.03 – 11.47
10 x 20	8	B	11.60 – 12.00
10 x 24	10*		

12 x 16	4 & 6	A	13.00 – 13.40
12 x 20	8	B	13.40 – 13.80
12 x 24	10	C	14.10 – 14.50
12 x 32	12*		
16 x 12	4 & 6		17.33 – 17.87
16 x 16	8		18.62 – 19.19
16 x 20	10*		
16 x 24	12*		
16 x 36	16*		
20 x 12	4 & 6	A	21.51 – 22.15
20 x 16	8	B	23.46 – 24.16
20 x 20	10*		
20 x 24	12*		
20 x 36	16*		
20 x 40	20*		
24 x 12	4 & 6	A	25.71 – 26.41
24 x 16	8	B	28.14 – 28.84
24 x 20	10*		
24 x 24	12*		
24 x 36	16*		
24 x 40	20*		
24 x 48	24*		
30 x 12	4 & 6	A	29.78 - 30.48
30 x 16	8	B	31.52 – 32.22
30 x 20	10*		
30 x 24	12*		
30 x 36	16*		
30 x 40	20*		
30 x 48	24 x 30*		

*Range to be specified when ordered

**Ranges may be broadened by not narrowed. For concrete steel cylinder pipe the OD of the pipe and cylinder must be supplied with the order.

For pipe larger than 30 in. nominal diameter, tapping sleeves must be custom fabricated to fit nonstandard ranges, in conformance with the intent of these specifications.

The San Antonio Water System may, at no cost to the manufacturer, subject random units to testing by an independent laboratory for compliance with these standards. Any visible defect of failure to meet the quality standards herein will be ground for rejecting the entire order.

Please see SAWS website for a list of approved manufacturers-
http://www.saws.org/business_center/specs/product_submittal/.

2.9.

Butterfly Valves. This Section covers class 150/250 rubber-seated butterfly valves, 4 in. through 54 in. All products furnished must be in conformance with ANSI/AWWA C504 or latest revision thereof; however, the body construction of the valve must exceed the ANSI/AWWA C504 by the values specified herein. All

coatings in contact with potable water must be certified to NSF 61. A proof of design certification must be provided upon request.

2.9.1. **Definitions.** All definitions are defined according to ANSI/AWWA C-504.

Actuator: A device attached to the valve for the purpose of rotating the valve disc to an open, closed, or intermediate position; preventing disc over travel; and maintaining the disc in any position.

Butterfly Valve: A valve that uses a disc rotatable through an angle of approximately 90° as a closure member. The valve is closed when the disc is perpendicular to the flow way, open when parallel to the flow way, or used for throttling when positioned between open and closed.

Disc: The closure member that is positioned in the flow stream to permit flow or to obstruct flow (depending on closure position) and that rotates through an angle of 90° from full open to full shutoff.

Rubber Seat: A rubber ring around the inside of the valve body to affect a seal against the metal seating surface when the disc is closed or resilient seats must be located on the valve disc and must provide a 360° continuous, uninterrupted seating surface. Seats must be mechanically retained with a stainless-steel retaining ring and stainless steel Nylok cap screws, which must pass through both the resilient seat and the retaining ring.

The resilient seat's mating surface must be to a 360° continuous, uninterrupted stainless steel body seat ring. The retaining ring must be continuous or investment cast with overlapping sections serrated grooves, and shoulders.

2.9.2. **General Requirements.** Except as otherwise modified or supplemented herein, AWWA C504 or the latest revision thereof, will govern the design, component material construction, manufacture and testing of all butterfly valves.

The San Antonio Water System reserves the right to limit the purchase of butterfly valves from manufacturers and to the models specified on the SAWS website - http://www.saws.org/business_center/specs/product_submittal/, provided such butterfly valves conform to the provisions contained herein.

Valves must be Class 150/250 of the short-body type with a 150/250 psig bi-directional shut-off rating, a 500 psig hydrostatic body shell test and a maximum upstream line velocity rating according to Table 5 listed below unless specified otherwise.

Diameter	Velocity
3-in. through 20-in.	16 ft./sec.
24-in. through 72-in.	8 ft./sec.

Valve must be in the same alignment as a horizontal pipe and must be for buried service, unless otherwise specified. Valve must be configured with a horizontal valve shaft and a vertical actuator shaft with standard 2-in. AWWA operating nut. The actuator must be side mounted.

Valve body must be of cast iron conforming to ASTM Specification A-26, Class B, or Ductile Iron ASTM A536, grade 65-45-12.

Valve body ends must be flat-faced flanged in accordance with ANSI B16.1, Class 150/250. All cast iron valves must exceed minimum body shell thickness AWWA C504 Class 150B/250B, Table 2 of Section 3.1 Valve Bodies.

Laying lengths for flanged and wafer valves and minimum body shell thickness for all body types by the following: Sizes 3-in. through 10-in. - 15% or greater, Sizes 12-in. through 24-in. - 20% or greater, and Sizes 30-in. through 54-in. - 50% or greater. Ductile iron valve body thicknesses must conform to the table below. Ductile iron and cast iron laying lengths must be as specified in tables 12 and 13 below unless otherwise specified.

Table 6 –Ductile Iron Valves Laying Length		
Ductile Iron Valve Diameter (In.)	Ductile Iron Thickness (In.)	Ductile Iron Laying Lengths (In.)
3	0.37	5
4	0.40	5
6	0.43	5
8	0.46	6
10	0.54	8
12	0.58	8
14	0.63	8
16	0.68	8
18	0.79	8
20	0.83	8
24	0.93	8
30	1.10	12
36	1.22	12
42	1.35	12
48	1.48	15
54	1.63	15
60	1.89	15
66	2.00	18
72	2.375	18

Table 7 –Cast Iron Valves Laying Length		
Cast Iron Valve Diameter	Cast Iron Thickness	Cast Iron Laying Length (In.)
6"	Per specification	6
8" through 12"	Per specification	8
14" through 30"	Per specification	12
36" through 54"	Per specification	15

Valve must be of such design that the disc will seat at 90° with the pipe axis.

Valve must be of such design that the disc will not flutter or vibrate when operated in a throttled position.

Valves disc must be of Cast Iron A-48, Cast Iron A-126, class B or Ductile Iron ASTM A-536, grade 65-45-12 and must be of disc design to provide 360° uninterrupted seating.

The valve seat must be natural or synthetic rubber and may be applied to the disc or body. For valves 24 in. or larger, the rubber seat must be capable of mechanical adjustment in the field and must be field replaceable. Special tools required for seat adjustment must be provided with the valve. Special tools required for seat replacement must be furnished with the replacement seat. Mechanical adjustment or attachment of the seat and seat ring does not include welding. The mating seat surface must be type 304 or type 316 stainless steel, ni-chrome or monel. Sprayed or plate mating seat surfaces are not acceptable.

Valve shafts must be type 630 stainless steel conforming to ASTM A-564 condition H-1100 and must have a diameter equal to or greater than that shown for Class 150B in Table 3 of AWWA C504. Shafts must conform to the requirements of Section 3.3, Valves Shaft of AWWA C504 for one-piece or stub shaft types. Connection between the shaft and disc must be dowel, taper pins, or torque plugs, which are mechanically secured.

The valve assembly must be furnished with a factory-set, non-adjustable disc shaft thrust bearing that insures the valve disc is centered within the valve body seat at all times.

Valve shaft bearings must be permanent, self-lubricated bearings which provide continuous, low-friction maintenance-free operation. Shaft bearing must be contained in integral hubs of the valve body.

Valve shaft seal must consist of O-ring, V-type, or U-cup type packing where the shaft projects through the valve body for the actuator connection.

The valve must be provided with a fully enclosed, permanently lubricated actuator of the traveling nut or worm gear design. The actuator must be connected to the valve shaft by means of a key and keyway connection.

All actuators must have adjustable, mechanical stop limits in accordance with AWWA C504 Section 3.8.2. All 4-in.-54-in. valve actuators must be capable of withstanding 450 ft-lb. of input torque against the open or closed stops without damage.

Valves for below ground applications must be provided with an AWWA wrench nut. The wrench nut must have an arrow cast thereon, indicating the direction on of opening. The wrench nut must be suitably fastened to the actuator input shaft. If the shaft is smooth, the wrench nut must be fastened to the input shaft by means of a minimum 5/16-in. diameter steel pin passing entirely through the shaft and the wrench nut. Key with keyway will be acceptable. If the shaft is splined, the wrench nut must be formed to fit the splined shaft. The actuator must be designed to produce the specified torque with a maximum input of 150 ft-lb. applied to the wrench nut.

Valves for aboveground applications must be provided with a handwheel. The handwheel must have an arrow thereon, indicating the direction of the opening. The handwheel must be suitably fastened to the actuator input shaft. Actuators equipped with handwheels must be designed to produce the specified torque with a maximum pull of 80 lbs. of the handwheel rim.

The requirement for either wrench nut or handwheel and the direction of opening will be specified on each purchase order.

The bidder must submit with his proposal 3 sets of certified drawings showing the principal dimensions, general construction and material specification of the valve proposed. The number of turns to open (close) must be clearly noted in the valve information submitted with the proposal documents.

The supplier/manufacturer must provide Affidavit of Compliance with applicable sections of AWWA C504 to include the following: Results of ASTM testing procedures and requirements for materials will be provided to the Owner upon request, Manufacturer's Quality Assurance Program, leak-tightness testing and proof of design testing of representative actuators in accordance with AWWA C504 Section 3.8.5.2 as modified

herein (450 ft.-lb.). Compliance assurance will be required in accordance with AWWA C504 Section 5.1.2, Affidavits. Results of performance tests, proof of design test, AWWA C504 Section 5.2.4, hydrostatic test, leakage test, and Affidavit of Compliance must be provided with the bid or with the shipping documents and must be approved by the San Antonio Water System.

- 2.9.3. **Workmanship.** All parts of the butterfly valve must be designed and manufactured to the tolerances specified in ANSI/AWWA C509 or latest revision thereof and this specification.

All parts of the butterfly valve manufactured by a given manufacturer must be interchangeable with like parts from another butterfly valve of the same model and size and by the same manufacturer.

- 2.9.4. **Painting.** All interior and exterior ferrous surfaces of the valve, including the disc, must be coated with epoxy, NSF 61 certified or fusion bonded epoxy, NSF 61 certified. The epoxy (or fusion bonded epoxy) must have a nominal thickness of 8 mils, and must be in accordance with AWWA C550, latest revision.

Coating must be as close to holiday free as is technologically possible.

- 2.9.5. **Testing and Inspection.**

Performance Tests: Performance tests must be performed on each valve in accordance with Section 5.2.1 Testing of ANSI/AWWA C504 or latest revision thereof.

Leakage Tests: Leakage tests must be performed on each valve in accordance with Section 5.2.2 Testing of ANSI/AWWA C504 or latest revision thereof.

Hydrostatic Tests: Hydrostatic tests must be performed on each valve in accordance with Section 5.2.3 Testing of ANSI/AWWA C504 or latest revision thereof.

Proof-of-Design Tests: Proof-of-Design tests must be performed on each valve in accordance with Section 5.2.4 Testing of ANSI/AWWA C504 or latest revision thereof.

An Affidavit of Compliance certifying that all required tests have been performed must be provided.

The Affidavit of Compliance and the records of all tests performed on the valves must be kept and provided in a single hard cover bound notebook.

- 2.9.6. **Quality Assurance.** Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system. If on receipt of butterfly valves they are found to be noncompliant the manufacturer must replace the defective butterfly valves according to butterfly valve size with a butterfly valve that meets the San Antonio Water System's specifications. The defective butterfly valves will be returned to the manufacturer, freight collect, and the manufacturer must replace the butterfly valve, freight prepaid.

If San Antonio Water System audits, product inspection and performance data review in accordance with these specifications determine excessive butterfly valve non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the butterfly valve becomes defective during the Manufacturer's specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing non-conformance the manufacturer must replace the butterfly valve according to size with a butterfly valve that meets the San Antonio Water System's specifications. The defective butterfly valve removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the butterfly valve, freight prepaid. If the nonconformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges.

- 2.9.7. **References.**

American National Standards Institute and American Water Works Association C504 (ANSI/AWWA C504).

- 2.10. **Valve Boxes.** This Section covers cast-iron valve box assemblies.

- 2.10.1. **General Requirements.** Each valve box assembly must be of cast-iron and must consist of a base, top section, and lid as shown on the plans.

Valve boxes must be of a single size with a nominal diameter of 6 in.

The valve box lid must be labeled "water" and must be so designed so that it will remain firmly seated in place when subjected to vehicular traffic.

The valve box assembly must be of sufficient toughness and strength to withstand impact loads and shock resulting from vehicular traffic.

The valve box assembly must be coated with a standard bituminous coating of either coal tar or asphalt basic applied to all inside and outside surfaces.

- 2.11. **Meter Boxes.** This Section covers meter boxes for 5/8-in., 3/4-in., 1-in., 1-1/2-in., and 2-in. meters.

- 2.11.1. **General Requirements.** For non-traffic bearing locations, the meter box assembly for 5/8-in. through 1-in. meters must be made from 100% high-quality recycling plastic. The meter box and lid must be black and constructed out of modified polyethylene material for maximum durability and corrosion resistance. The black material is for maximum UV protection. The black material must be uniform throughout the meter box and lid for maximum longevity and not have a foaming agent that creates air pockets within the plastic wall. The body and lid must withstand 20,500 lbs. loading in a non-deliberate and incidental traffic.

For traffic bearing locations, the meter box assembly for 5/8-in. through 2-in. meters must consist of a cast-iron rectangular box and a steel checkered plate rectangular cover with raised lug pattern as shown on the plans.

- 2.11.2. **Specific Requirements.**

- 2.11.2.1. **Plastic Lid.** Must have the following:

"Water Meter" and "SAWS" molded into the lid

Seat securely and evenly inside the meter box and must not overlap the top edge of the meter box

"Overlap" and securely and evenly on the existing SAWS cast iron meter box with like dimensions.

A diamond pattern for skid resistance and an AMR Slide Mount molded into the lid on the underneath side and off center for placement for an AMR transponder to help in the protection of the radio antenna.

A brass worn gear lock that will secure the existing SAWS cast iron meter box of like dimensions and secure the plastic meter box. See detail on plans.

A molded receptacle for placement of SAWS key.

One (1) piece of 1/2-in. rebar secured in lid. See detail.

- 2.11.2.2. **Plastic body.** Must have the following:

A crush resistant ribbing along the outside of box.

A flange around the top opening to help prevent setting and aide in adjustment to grade.

Designed to accommodate all plastic lids.

- 2.11.2.3. **Cast Iron Rectangular box for Traffic Bearing Locations.** Must have the following:

Ultimate tensile strength of 25,000 psi and must not be brittle.

"As cast" clean smooth surface and be free from internal porosity, castings that are made smooth by grinding will not be considered.

Be dipped in a coal tar at a temperature of 350° and the metal must be at a temperature of 300° before dipping. The casting should be dipped and cured independently and the coating must have ceased to be "tacky" within 72 hours after dipping.

The steel checkered plate rectangular cover is to be hot dip galvanized after fabrication.

- 2.11.3. **Quality Assurance.** If on receipt of meter box(s) or lid(s) they are found to be non-compliant, the manufacturer must replace the defective box(s) or lid(s) with a replacement that meets the San Antonio Water System's specifications, at no charge to San Antonio Water System. Any visible defect or failure to meet the quality standards herein will be ground for rejecting the entire order.

Product that is non-compliant will be returned to the manufacturer, freight collect and the manufacturer will replace the defective product, freight prepaid within thirty (30) days from receipt of the defective product.

- 2.12. **Fire Hydrants.** This Section covers post-type, dry-barrel fire hydrants with compression shut off (opening against pressure) or gate shutoff for use in water supply service in all climates, including those where freezing occurs. All products furnished must conform ANSI/AWWA C502-05 or latest revision thereof and must be UL approved.

- 2.12.1. **Definitions.** All definitions are defined according to ANSI/AWWA C502-05.

Cosmetic Defect. A blemish that has no effect on the ability of a component to meet the structural design and production test requirements of this standard. Should the blemish or the activity of plugging, welding, grinding, or repairing such blemishes cause the component to fail these requirements, and then the blemish must be considered a structural defect.

Structural Defect. A flaw that causes a component to fail the structural design or test requirements of this standard. This includes but is not limited to imperfections that result in leakage through the walls of a casting, failure to meet minimum wall thickness requirements, or failure to meet production tests.

Bury. The length of bury is the distance measured to the nearest ½ ft. from the bottom of the connecting pipe to the ground line of the hydrant.

- 2.12.2. **General Requirements.** The San Antonio Water System reserves the right to limit the purchase of fire hydrants from manufacturers and to the models specified, as shown on the SAWS website - http://www.saws.org/business_center/specs/product_submittal/, provided such fire hydrants conform to the provision contained herein.

Each hydrant must be designed for a minimum working pressure of 200 psig.

All parts of the hydrant must be designed to withstand, without being functionally impaired or structurally damaged, a hydrostatic test of not less than 400 psig or twice the rated working pressure, whichever is greater, with the hydrant completely assembled and pressurized as follows:

With the nozzle caps in place, the main valve open, the hydrant inlet capped, and the test pressure applied to the interior of the hydrant.

With the main valve closed, the hydrant inlet capped, and the test pressure applied at the hydrant inlet.

The design safety factor of the operating mechanism must not be less than 5 and must be based on the ft.-lbs. of torque required for the closing and opening of the hydrant at a working pressure of 200-psig. Hydrants must be functional and capable of being opened or closed without difficulty following an application of an operating torque of 200 lbf.-ft. at the operating nut in the opening direction with the hydrant fully opened and the closing direction with the hydrant fully closed. The torque requirements apply only to hydrants of 5-ft. bury or less.

The length of bury must be as specified but not less than 4-ft. The fire hydrant must have 2 hose nozzles and 1 pumper nozzle. The nominal inside diameter of the hose nozzle must be 2.5-in. The nominal inside diameter for the pumper nozzle must be 4-in. The outlet-nozzle threads are to conform to the National Fire Protection Association (NFPA) 2003, Standard for Fire Hose Connections. The nominal diameter of the main valve opening must be 5.25-in. The hydrant shoe must be provided with a 6-in. mechanical joint connection to fit the connecting pipe. The fire hydrant must open right (clockwise). The color of the finish paint above the ground line must be aluminum; however, fire hydrants for private use must be painted red. The fire hydrant must have a non-rising stem. No more than one 6-in. stem extension must be provided if required to make the base of the fire hydrant grade level.

The bonnet section must be designed so all bearing surfaces and stem threads are sealed in a lubricant reservoir. If oil is used as a lubricant, the reservoir must be designed to allow for easy filling through a fitting or plug. Where grease is used as a lubricant, the reservoir will be sealed. The reservoir will be adequately sealed with "O" rings or other suitable sealing system approved by the San Antonio Water System.

The fire hydrant must have a safety flange or breakaway flange at the ground line as stipulated in Section 3.1 General Design of ANSI/AWWA C-502-05 or latest revision thereof.

Fire hydrant nozzle cap chains will be required and must be attached permanently to the fire hydrant as stipulated in Section 3.2 Detailed Design of ANSI/AWWA C-502-05 or latest revision thereof.

Parts that require lubrication and come into contact with water must be lubricated with a non-toxic food grade lubricant that does not pose a health hazard to the public if consumed.

- 2.12.3. **Workmanship.** All foundry and machine work must be performed in accordance with good standard practice for the class of work involved and in conformance with accepted drawings, if required. When assembled, hydrants manufactured in accordance with this specification must be well fitted and must operate smoothly. The body and shaft must be watertight.

All parts must conform to the required dimensions and must be free from defects that could prevent proper functioning of the hydrant.

All castings must be clean and sound without defects that will weaken their structure or impair their service.

- 2.12.4. **Paint.** The exterior surface of the hydrant must be coated with a coating that must meet or exceed the requirements of Federal Specification TT-C-494b. A second coat of water based or oil-based enamel paint aluminum in color will then be applied from the top of the hydrant to a point 18-in. to 20-in. below the centerline of the pumper nozzle or down to the traffic safety flange connection at the ground line.

All interior surfaces, machined surfaces, such as the threaded portion of the stem or stem nut, which must fit closely with the adjacent parts, must be coated with a coating that must meet or exceed Federal Specification TT-C-494b. Stem surfaces contained within a lubricant reservoir and not in contact with potable water may be free of coating.

The interior and exterior of the hydrant shoe must be coated with a fusion-bonded epoxy with a nominal dry film thickness of 8-mils, conforming to ANSI/AWWA C-550-05, and certified to NSF 61.

Coating must be as close to holiday free as is technologically possible.

- 2.12.5. **Testing and Inspection.** Each assembled hydrant must be subjected to two shop tests under a hydrostatic pressure of 400 psig or twice the rated working pressure, whichever is greater. One test must be made with the entire interior of the hydrant under pressure and another test made with the main valve closed and the base under pressure from the inlet side. Under the test procedure, there should be no leakage through the main valve or seals or through the castings or the joints of the assembled hydrant. Under the test conditions, the leakage through the drain valves must not exceed 5 fl oz./min. Other leakage or other imperfections found in either test must be corrected or the hydrant retested. The tests must be conducted for enough time to allow a check of all points of possible leakage and for a minimum of 30 sec. after all air has been exhausted.

Each assembled hydrant must be operated through a full open-close cycle when not under pressure. The torque required for performing this operation must not exceed 20 lb.-ft.

All fire hydrant tests and inspections must conform to ANSI/AWWA C-502 Section 5.1 Production Testing, ANSI/AWWA C-502 Section 5.2 Prototype Testing, and ANSI/AWWA C-502-05 Section 5.3 Inspection and Rejection.

The manufacturer must provide an Affidavit of Compliance conforming to Section 1.7 Affidavit of Compliance of ANSI/AWWA C-502-05 or latest revision thereof.

- 2.12.6. **Quality Assurance.** Manufacturers must have an ASME or I.S.O. 9001 registered commercial quality system or is in the process of achieving this certification by June 2001. Noncompliance to this registered commercial quality system requirement by June 2001 will result in removal of the manufacturer's product from the approved manufacturers list. If on receipt of fire hydrants they are found to be noncompliant the manufacturer must replace the defective fire hydrants according to fire hydrant size with a fire hydrant that meets the San Antonio Water System's specifications. The defective fire hydrants will be returned to the manufacturer, freight collect, and the manufacturer must replace the fire hydrant, freight prepaid. If San Antonio Water System audits, product inspection and performance data review in accordance with these specifications determine excessive fire hydrant non-compliance, the manufacturer will be subject to removal by the Products Standards Committee. If the fire hydrant becomes defective during the manufacturer's specified warranty period a San Antonio Water System quality assurance and manufacturer review will ensue. If the review determines manufacturing nonconformance the manufacturer must replace the fire hydrant according to size with a fire hydrant that meets the San Antonio Water System's specifications. The defective fire hydrant removed from the field will be returned to the manufacturer, freight collect, and the manufacturer must replace the fire hydrant, freight prepaid. If the non-conformance product amounts are excessive and result in increased product replacement by San Antonio Water System field staff the manufacturer may be subject to time and material charges.

- 2.12.7. **Maintenance Kits.** The San Antonio Water System will attempt to use fire hydrant maintenance kits in the repair of the approved hydrants. Please see SAWS website for a list of approved manufacturers-
http://www.saws.org/business_center/specs/product_submittal/

- 2.12.8. **References.**

American National Standards Institute and American Water Works Association C-502-05 (ANSI/AWWA C-502-05).

American National Standards Institute and American Water Works Association C-550-05 (ANSI/AWWA C-550-05).

- 2.13. **Polyethylene Wrapping Material.** This Section covers polyethylene-wrapping material for use in encapsulating ductile and cast iron pipe.

General Requirements. Polyethylene wrapping for ductile and cast iron water mains is to consist of a 4 mil tubular section of cross-laminated high-density polyethylene, which has a high dielectric and tensile strength, for use in insulating cast-iron and ductile-iron pipe from the electrolytic action encountered in highly active soils. Polyethylene wrapping is to consist of opaque cross-laminated high-density polyethylene sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 7 for size and length chart, in accordance with AWWA C-105 (Table 1) for minimum requirements. When supplied in specific pipe lengths, the tubes are to contain a minimum of 4-ft. over the actual pipe length to allow for overlap.

The polyvinyl sheet of film for the tubular wrapping is to be of virgin resins meeting raw and physical properties of ASTM D-1248 and AWWA C-105, latest edition. The material is to be 4 mil cross-laminated high-density polyethylene of uniform film thickness and be free of imperfections such as pin holes, etc., after being thermally seamed into tubular form. The finished product will have a nominal thickness of 4 mils, with tolerances of minus 10%.

The polyethylene wrapping material is to have no volatile constituents, the loss of which may affect ductility. The material is also to have the following properties:

Mechanical: The polyethylene film is to have a tensile strength per latest ASTM D-882 test, of 6300 psi min. The film is to have an elongation of not less than 100% of the test strip per latest ASTM D-882 test. The film is to have an impact resistance 800 gram min per (ASTM D-1709 Method B). The film is to have a propagation tear resistance of 250 gf minimum in machine and transverse direction (ASTM D1922).

Dielectric: The film is to have a dielectric strength of 800 volts per mil thickness per latest ASTM D-149.

Inspection and Certification by Manufacturer:

Quality control and inspection. The manufacturer must establish the necessary quality control and inspection practice to ensure compliance with this standard.

Manufacturer's statement. The manufacturer must, provide a sworn statement on each lot purchased that the inspection and all applicable material requirements of Section 2.13.1 have been met and that all results comply with the requirements of this standard.

Freedom from defects. All polyethylene film must be clean, sound, and without defects that could impair service.

- 2.13.1. **Marking Requirements.** The polyethylene film supplied must be clearly marked, at a minimum of every 2-ft. along its length, containing the following information.

Manufacturer's name or trademark

Year of manufacture

ANSI/AWWA C-105/A21.5

Minimum film thickness and material type.

Applicable range of nominal pipe diameter size(s).

Warning-Corrosion Protection-Repair any Damage.

The San Antonio Water System may at no cost to the Contractor, subject random testing by an independent laboratory for compliance with this Specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

<p>Table 7 – 4 MIL POLYETHYLENE WRAPPING MATERIALS</p>

SIZE & LENGTH (All sizes lay flat size)	
Pipe Size	Product Size Width x Length
4", 6" & 8"	20" x 200/500
8", 10" & 12"	27" x 200/500
16" & 18"	37" x 200/500
20"	41" x 200/500
24"	54" x 200/500
30"	67" x 140/500
36"	81" x 120/500
48"	95" x 100/500
54"	108" x 100/500

2.14. **Standard/Wide Range Ductile Iron Couplings.** This Section covers ductile iron couplings for use in connection of smooth end joints of cast iron, ductile iron, asbestos cement, steel, PVC or other types of pipe. The couplings must be capable of fitting this variety of pipes with one set of follower flanges or end rings.

2.14.1. **General Requirements.** Sleeve or center ring must be nominal O.D. size range and length specified. Sleeve must be of Ductile Iron ASTM A536. Ends must have a smooth inside taper to provide uniform gasket seal. Sleeve must be given a shop coat of oil-modified urethanes, corrosion-resistant paint, or epoxy coating.

Follower flanges or end rings must be of the thickness determined by the coupling size, and must be ductile iron, ASTM-536. Flanges must be identified by a color-coded shop coat finish as described in Section 2.14.1.

Gaskets must be compression – type, formed with Virgin Styrene Butadiene Rubber (SBR,) ASTM D2000 3 BA715, and compounded with ingredients to produce permanence and resistance to set after installation. O.D. range must be imprinted/molded on the gasket in permanent ink (Minimum.)

Bolts and Nuts must be of high-strength, low-alloy steel, with nominal coarse thread, and hex nuts with black finish. Dimensions and minimum stress values must be in accordance with AWWA/ANSI C111/A21.11.

Where specification states a cast transition or reducing coupling in place of a straight coupling, the sleeve and follower flange must be of the same manufacturer and compatible for the specific use intended.

Quality control procedures must be employed to ensure that the sleeve, follower flanges and gaskets are properly fabricated and free of any visible defects. Each coupling must have a working-pressure rating not less than the following:

Pipe Size (In.)	Minimum Working Pressure Rating (PSI)
16 and smaller	175
20	150
24	150

2.14.2. **Straight Coupling Ranges.**

Nominal Diameter x Minimum Length	O.D. Range*
4" x 6"	4.80"-5.10"
6" x 6"	6.90"-7.22"
8" x 6"	9.05"-9.45"
10" x 6"	11.10"-11.60"
12" x 6"	13.20"-13.50" 13.78"-14.38"
16" x 6"	17.40"-17.80" 18.46"-19.00"
20" x 7"	21.35"-21.75" 21.75"-22.25"
24" x 10"	25.00"-25.80" 26.10"-26.32"

Coupling Size	O.D. Range*
3"	3.40" – 4.20"
4"	4.20" – 5.33"
6"	6.25" – 7.45"
8"	8.40" – 9.79"
10"	10.70" – 12.12"
12"	12.75" – 14.38"

The San Antonio Water System may, at no cost to the manufacturer, subject random couplings to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

*Ranges may be broadened, but not narrowed.

- 2.14.3. **Approved Manufacturers.** Please see SAWS website for a list of approved manufacturers-
http://www.saws.org/business_center/specs/product_submittal/
- 2.15. **Air Release, Vacuum, and Combination Air Valves.** This specification covers automatic valves installed on water mains to vent accumulated air under system pressure, and to provide air exhaust during initial fill or to prevent a vacuum during draining or water column separation of the system.
- 2.15.1. **General Requirements.** Valves furnished under this specification must conform to ANSI/NSF 60 for direct additives and ANSI/NSF 61 for indirect additives. Cast Iron Valve Body and cover must be in accordance with ASTM A48-35 or ASTM A126 class B. Non-Metallic Valve Body must be fabricated from fiberglass reinforced nylon. Inlet sizes through 2-in. must be screwed (NPT). Pipe sizes 3-in. and above must have flanged inlets (125# ASNSI B 16.1). A protective hood or cowl must be installed on the outlet of flange-bodied valves.

Metallic Internal seat trim float arm and pivot pin must be stainless steel type 303, 304 or 316. Metallic Floats must be stainless steel ASTM A 240. Other stainless steel metal internal parts must be stainless steel ASTM A240 or ASTM A276.

Non-metallic floats must be foamed polyethylene with stainless steel type 316 fasteners.

Valves requiring Internal seats or orifice buttons must be Buna-N rubber compounded for water service. For valves requiring cover gaskets, the cover gasket must be composition type, equal to Armstrong CS-231,

Garlock 3000, or Lexide NK-511. If an O-Ring is used to seal the cover, it must be on NSF 61 certified rubber. Cover bolts must be alloy steel. Rolling seals must be furnished for non-metallic valves 2-in. and below.

Valve body must have a test pressure rating of 300 psi and working pressure rating of 150 psi.

All components in contact with potable water must be "lead free" and marked by stamping, etching, or casting "NL" in the main body.

- 2.15.2. **General Operation Requirements.** The air release valve must be designed to vent accumulated air automatically. The outlet orifice must be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve must be simple-lever, compound-lever, ball and orifice or rolling seal depending upon volume requirements and the design of the valve.

The air and vacuum valve must be designed with the inlet and outlet of equal cross-sectional area where applicable. The valve must be capable or automatically allowing large quantities of air to be exhausted during the filling cycle and also capable of automatically allowing air to re-enter the system to prevent a negative pressure at water column separation or during the draining cycle. The float must be guided to minimize premature closure by air and to provide proper alignment for normal closure by floating on the water surface.

Combination air and vacuum relief valves must provide for both automatic air release under system pressure and to allow air movement during filling or draining operations or water column separation. The combination valve may be housed in a single casting. The housing must be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sized (4-in. and larger) may be furnished in a dual housing. When dual casings are used a bronze manual isolation valve must be installed if indicated by the manufacturer. This will allow the air release valve to be serviced when the system is under pressure. Field service of the valve may also be performed by closing the isolation valve between the air valve and the pipe connection.

- 2.15.3. **Tests.** The San Antonio Water System may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failures to meet the quality standards herein will be grounds for rejecting the entire order.

Quality Assurance. The manufacturers must provide certification that products furnished under this specification are manufactured in an ISO 9001 certified facility or documentation from an accredited facility that ISO 9001 certification is in process.

Please see SAWS website for a list of approved manufacturers -
http://www.saws.org/business_center/specs/product_submittal/

- 2.16. **Reinforced Concrete Vaults.**

- 2.16.1. **General Requirements.** Concrete used should be transit mix and must have a 28-day compressive strength of 3,000 psi with a maximum slump of 6-in. and a minimum slump of 3-in. The use of admixtures will not be permitted unless approved by the Engineer. Cement should be Type I or Type III and must conform to the requirements of the latest provision of ASTM C-150 and C-156, or most applicable approved equal provision.

- 2.17. **Blow-off Assemblies.** The materials required for both permanent and temporary 2-in. and 4-in. blow-off assemblies must conform to the specifications contained herein and as shown on the plans.

- 2.18. **Backfill.**

- 2.18.1. **Bedding/Initial Backfilling.** The bedding and initial backfill materials for concrete steel cylinder pipe (CSC), ductile iron pipe (DI), HDPE Pipe, Wrapped Steel Pipe, and Polyvinyl Chloride Pipe (PVC) in all nominal diameters must be composed of well graded crushed stone or gravel conforming to the following Table 11 requirements unless modified by the Engineer.

Retained on ½" sieve	0%
Retained on 3/8" sieve	0 – 5%
Retained on No. 4 sieve	20 – 80%
Retained on No. 10 sieve	75 – 100%
Retained on No. 20 sieve	98 – 100%

The quantity and thickness of lifts and compaction of initial backfill materials is to be in accordance with Section 3.3 of this specification.

Where copper services (¾-in. – 2-in.) are installed, initial backfill must be sand conforming to the following requirements: Natural sand or sand produced from crushed gravel or crushed rock maximum ¼-in.; 95% must pass No. 4 sieve, free from clay and organic material, with a maximum 8% passing the No. 200 sieve. Larger services utilizing ductile iron pipe or PVC C-900 pipe must be backfilled the same as mains.

- 2.18.2. **Secondary Backfill for Water Mains.** Secondary backfill is defined as backfill from 1-ft. above the top of the pipe to the top of the trench or bottom of pavement section. Secondary backfill must be constructed in accordance with details shown in the construction documents.

Secondary backfill must generally consist of materials removed from the trench and should be free of brush, debris and trash. Rock or stones with a dimension larger than 6 in. at the largest dimension must be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material should be primarily composed of compactible soil materials. The secondary backfill material must be placed in maximum 12 in. loose lifts or as directed by the Design Engineer or Inspector.

- 2.19. **Asphalt.** All asphaltic concrete used in the replacement of pavement over the trench line is to conform to Department Item 341, "Dense-Graded Hot-Mix Asphalt (QC/QA), Type "C", except when the use of 6-in. of asphalt treated base is directed., unless otherwise specified on the plans.

- 2.20. **Concrete.** All concrete used as the trench cap and in sidewalks and blocking mains is to conform to Department Item 421, "Hydraulic Cement Concrete". Class "A" concrete is to be used in sidewalks and for blocking concrete steel cylinder mains; Class "D" concrete is to be used for the trench cap and for blocking all other types, unless otherwise specified on the plans.

- 2.21. **Reinforcing Steel.** All bar reinforcement is to be Grade 60, conforming to the requirements of Department Item 440, "Reinforcement for Concrete".

- 2.22. **Affidavit of Compliance.** Unless otherwise directed, the Contractor is to furnish a manufacturer's affidavit of compliance for each of the materials used in this project. The affidavit is to certify that factory inspection and all specified tests have been made and that the material furnished complies with the requirements outlined herein.

- 2.23. **Recycled Water System.** All material used in the improvement, adjustment, removal or construction of the recycled water system must meet these standards (i.e., uses of CSC pipe, trenching and excavation, etc.), except as otherwise noted, and must be wrapped or painted with pantone 512 color.

- 2.24. **Grouting of Water Mains.** This Section will govern the grouting of existing water mains with diameter of larger than 4 in. for the purposes of abandonment underneath roadways, paved areas, and at other designated locations. The location of this Work is as shown on the Contract Document plans or as encountered in the field during construction. The Contractor must, unless otherwise specified, furnish all labor, materials, equipment, tools and all other appurtenances necessary to abandon water lines segments in place by filling them with flowable cementitious low strength grout including plugs, bulkheads, excavation and

backfill at locations as required to completely fill the line to be abandoned in place to protect against future collapse of the line.

Submittals for Grouting Water Mains:

Proposed Mix Design Report for grout

Submit manufacturers data for proposed plugs and detail of bulkhead

Technical information for equipment and operations procedures including projected injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design and number of stages of grout application.

Submit project specific plan for abandonment at least 15 days before commencing grouting activities, describe proposed sequence, access points and other information pertinent for completion of Work.

Materials for Grouting Water Mains:

Cement-based grout/flowable fill with self-leveling and non-shrink characteristics.

Unconfined compressive strength: Minimum 100 psi at 56 days as determined based on average of 3 tests for same placement. Present at least 3 acceptable strength tests for proposed mix design in mix design report.

3. CONSTRUCTION

3.1. **Excavation.** Excavation (trenching) as required to complete the water main installation is to be performed in accordance with Department Item 400, "Excavation and Backfill for Structures", as outlined herein, as shown on the plans and as directed.

3.1.1. **Trenches.** Trench walls must be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Engineer's or Inspector's direction. In special cases, where trench flaring is required, the trench walls must remain vertical to a depth of at least 1-ft. above the top of the pipe.

The trench bottom must be square or slightly curved to the shape of the trenching machine cutters. The trench must be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed upon the bedding material. Bell holes and depressions for joints should be dug after the trench bottom has been graded and bedding installed. The pipe should rest upon the new bedding material for its full length

Where over-excavation occurs, the under-cut trench must be restored to grade at no cost to the Department by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

3.1.2. **Width of Trench.**

Minimum Width of Trench. The minimum width of pipe trenches, measured at the crown of the pipe, must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench must be not less than 12 in. greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width must be exclusive of trench supports and not greater than the width at the top of the trench.

Maximum Width of Trench. The maximum allowable width of trench for pipelines measured at the top of the pipe must be the outside diameter of the pipe (exclusive of bells or collars) plus 24 in. A trench wider than the outside diameter plus 24 in. may be used without special bedding if the Contractor, at his sole expense, furnishes pipe of the required strength to carry additional trench load. Such modifications must be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Engineer, the Contractor, at his sole expense, must encase the pipe in concrete from trench wall to trench wall, or other

pipe bedding material approved by the Engineer. Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's sole expense.

- 3.1.3. **Classification of Excavated Materials.** No classification of excavated materials will be made. Excavation and trench work is to include the removal and subsequent handling of all materials excavated in accordance with Department Item 400, "Excavation and Backfill for Structures".
- 3.1.4. **Grade of Trench Bottom.** The trench is to be over-excavated to a depth of 6-in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe is to then be met by the addition of a layer of approved bedding material as directed.
- 3.1.5. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits specified in Section 3.1.4., "Grade of Trench Bottom", is to be corrected with approved material and compacted by mechanical tamping or other means which must provide a stable foundation for the pipe. Should excessive over-excavation occur, except at bell holes, the grade is to be restored in accordance with the methods described in Section 3.1.6, "Unstable Conditions at Grade", at no cost to SAWS.
- 3.1.6. **Unstable Conditions at Grade.** Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials which in the judgment of the Engineer should be removed, the Contractor is to excavate and remove such unsuitable material to a depth at least 6-in. below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3-in. before mechanical compaction to provide stable foundation. The layers are to be slightly moistened and thoroughly compacted so as to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade is to be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints.
- 3.1.7. **Trench Excavation Protection.** All trench excavation required on this project is to be accomplished as required by the provisions of Department Item 402, "Trench Excavation Protection".
- 3.1.8. **Caution in Excavation.** The Contractor is to proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and utilities may be determined whether shown on the plans or not. Machine excavation is not permitted closer than 12-in. on either side of other existing underground utilities. The Contractor is to be responsible for the repair of such structures and utilities when broken or damaged. He is also to be responsible for adjusting alignment and trench grades with reference to such structures to obtain specified clearance for the water main construction.

Whenever the Engineer determines that it is necessary to explore and excavate to determine the location of existing underground structures and utilities, the Contractor is to make explorations and excavations for such purposes at his expense.

- 3.1.9. **Protection and Restoration of Underground Structures and Facilities.** The Contractor is to furnish temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work. All underground structures and utilities which are disturbed are to be restored by the Contractor at his expense. Materials and methods used for restoration are to be in accordance with current building codes with local amendments, the Department's Utility Accommodation Policy (UAP) (Title 43, T.A.C., Sections 21.31-21.55), and the requirements of the utility agency involved.

If a sanitary sewer is broken by the Contractor's operations the release of sewage into the trench is to be immediately intercepted by the insertion of a section of sheet metal tubing known as a "tin-horn" between the broken ends of the sewer. All leakage at the ends of the "tin-horn" is to be effectively stopped. The "tin-horn" is to remain in place until permanent repairs can be made. It is to be the responsibility of the Contractor to determine sufficiently in advance of his trenching operations the size of all sanitary sewer lines and services which will require this treatment.

All sanitary sewer lines crossing the excavation, whether bridged or replaced, are to have proper support consisting of sound timber supports with a minimum 2-in. nominal thickness and a minimum 6-in. nominal width placed with the width horizontal and extending a minimum of 12-in. into the trench wall on either side.

In all cases where a sewer pipe is replaced or bridged, the backfill material is to be thoroughly compacted to the bottom of the pipe and compacted by hand from this point to a distance of 6-in. above the top of the sewer line being replaced.

The locations of all sewer lines crossing excavations, whether replaced or bridged are to be properly marked, and care is to be taken to avoid damage to the pipe by a hydra tamping machine or other mechanical equipment. The Contractor is to be liable for the failure of such lines due to negligence or poor workmanship.

3.1.10. **Backfill Material Derived from Excavation.** Any excess excavated material, not used after all fill requirements have been met, must become the responsibility of the Contractor. The Contractor must transport and dispose of it outside the limits of the rights-of-way or easements of this project and of public thoroughfares and water courses, to a permitted fill site in conformity with all applicable City, County, State and Federal codes and ordinances and without liability to SAWS or any individual.

3.1.11. **Trench Restoration.** The surface of the backfilled trench must be restored to match the previous existing conditions. This will include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained grass), or other unprepared and prepared surfaces.

Trenches in alleys actively being used by vehicles (such as trash pickup, vehicle parking, etc.) must be restored by grading and compacting to 98% or higher with a minimum of 4 in. of flex base materials for the entire width of the alley. Asphaltic materials must have a compaction density of 95%. Alleys not actively used by vehicles must be graded and compacted to 98% or higher from the top of the initial backfill to the bottom of the pavement section, then spread grass seed for entire width of the alley.

Trenches in paved streets must be covered with a temporary all weather surface to allow for vehicular traffic until the final asphalt/concrete paving is complete. This surface must be a minimum of 4 in. compacted and rolled asphaltic black base, either hot-mix or cold-mix applied. It is the Contractor's responsibility to maintain this surface until the final street restoration is complete. Temporary street striping may also be required. This surface must be removed before final asphaltting.

All street work must be done in accordance with the latest DEPARTMENT construction specifications. Included in this requirement is replacement of any curbs or sidewalks damaged or removed during the construction.

No separate payment for the surface restoration is permitted. The cost for this work must be included in the appropriate bid item.

3.1.12. **Pavement.** The Contractor is to remove pavement and surfaces as a part of the trench excavation. The removal of pavement and surfaces and their restoration is to be based on the minimum trench widths as specified, plus 6-in. either side or as otherwise provided herein. The Contractor is to use such methods as sawing, drilling, or chipping to assure the breaking of the pavement along straight lines.

If the Contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces are to be restored at the expense of the Contractor.

Where water line construction necessitates cutting through existing streets outside the limits of new street construction, said streets are to be replaced in kind as directed.

Where, in the opinion of the Engineer, it is necessary to maintain traffic across a trench, the Contractor is to install temporary metal bridges as necessary to facilitate the movement of traffic.

The street surface adjacent to the trench is to be kept free of surplus spoil. Construction materials are to be placed at locations that will minimize interference with the traveling public.

- 3.1.13. **Concrete Sidewalks, Driveways, Etc.** All concrete sidewalks, driveways, etc., are to be cut with a concrete saw. When transverse expansion or "dummy" joints are encountered, the concrete is to be removed to the nearest transverse joint on each side of the trench and restored. The depth of cut is to be such that upon removal of the concrete, the sides of the cut are to be straight and square.

Existing reinforcing wire fabric or bars are to be cut and removed to permit completion of trench excavation, pipe laying, and backfill operations. When the backfill operations have been completed, the existing reinforcement is to be replaced in its original position and satisfactorily spliced before the replacement of concrete over the new trench alignment.

Transverse "dummy" joints are to be made by a jointing tool or other means acceptable, and are to match in depth and thickness in the existing transverse joints.

Expansion joint material is to be provided where new construction abuts the existing curb or driveway if the Engineer deems it necessary.

Concrete is to be spaded, tamped, and thoroughly compacted until mortar entirely covers the surface and has a monolithic finish. The top surface is to be floated, troweled, and finished to match the existing concrete surface.

Immediately after finishing, the concrete surface is to be protected by a membrane compound curing agent, or by wetted cotton or burlap mats. Either method is to be subject to approval.

- 3.1.14. **Dewatering.** Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

The Contractor must not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversion outside excavation limits. Do not use trench excavations as temporary drainage ditches.

Dewatering devices must be provided by the Contractor with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Engineer must order immediate shutdown, and remedial measures will be responsibility of the Contractor.

Upon completion of the dewatering work, the Contractor must remove all equipment and leave the construction area in a neat, clean, condition that is acceptable to the Owner.

The Contractor must maintain ground water table at least 12 in. below the finished excavation subgrade.

Performances of the dewatering system for lowering ground water must be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these must be documented at least daily. The Contractor must maintain a log of these readings and submit them to the Owner.

No direct payment will be made for costs associated with dewatering. All costs in connection therewith will be included in the applicable contract price for the item to which the work pertains.

- 3.2. **Pipe Laying.**

- 3.2.1. **General Requirements.** The Contractor is to start his work at a tie-in point, unless otherwise indicated on the plans. Pipe is to be laid with bell ends facing the direction of lying, unless otherwise authorized or directed by the Owner. Under no circumstances is pipe to be laid in water and no pipe is to be laid under unsuitable weather or trench conditions. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe is to be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations.

Spigots are to be centered in bells or collars, all valves and hydrant stems are to be set plumb, and fire hydrant nozzles are to face as shown on the plans or as directed by the Owner. No valve or other control on the existing system is to be operated for any purpose by the Contractor unless a representative of SAWS is present.

The Contractor is to maintain a neat and orderly work area. Complete cleanup is to be maintained at all times as closely behind the pipe laying operations as possible, but in no case is such cleanup be permitted to lag more than 1,000-ft. behind the pipe laying, unless otherwise directed.

The Contractor is to maintain service to water connections, whether connected to the existing or proposed water lines, at all times for the duration of the construction, unless directed otherwise by the Engineer.

- 3.2.2. **Crossing other Underground Lines.** New water mains crossing other utilities are to have a minimum of 30-in. of cover over the top of the pipe, unless otherwise waived or modified by the Engineer. Excavation around other utilities is to be done by hand for at least 12-in. all around. Any damage to the protective wrap on gas lines or electrodes is to be reported immediately to CPS Energy, phone (210) 353-4357. Any damage to other utilities must be reported to their proper governing entity. In any case of utility damage, Contractor must also promptly notify the Inspector.

- 3.2.3. **Pipe Separation – Parallel Lines.** Where a new potable waterline parallels an existing, non-pressure or pressure-rated wastewater main or lateral and the licensed Professional Engineer licensed in the State of Texas is able to determine that the existing wastewater main or lateral is not leaking, the new potable waterline must be located at least 2-ft. above the existing wastewater main or lateral, measured vertically, and at least 4-ft. away, measured horizontally, from the existing wastewater main or lateral. Every effort must be exerted not to disturb the bedding and backfill of the existing wastewater main or lateral.

Where a new potable waterline parallels an existing pressure-rated wastewater main or lateral and it cannot be determined by the licensed Professional Engineer if the existing line is leaking, the existing wastewater main or lateral must be replaced with at least 150 psi pressure-rated pipe. The new potable waterline must be located at least 2-ft. above the new wastewater line, measured vertically, and at least 4-ft. away, measured horizontally, from the replaced wastewater main or lateral.

Where a new potable waterline parallels a new wastewater main, the wastewater main or lateral must be constructed of at least 150 psi pressure-rated pipe. The new potable waterline must be located at least 2-ft. above the wastewater main or lateral, measured vertically, and at least 4-ft. away, measured horizontally, from the wastewater main or lateral.

- 3.2.4. **Pipe Separation – Crossing Lines.** Where a new potable waterline crosses an existing, non-pressure rated wastewater main or lateral, one segment of the waterline pipe must be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least 9-ft. horizontally from the centerline of the wastewater main or lateral. The potable waterline must be at least 2-ft. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral is disturbed or shows signs of leaking, it must be replaced for at least 9-ft. in both directions (18-ft. total) with at least 150 psi pressure-rated pipe.

Where a new potable waterline crosses an existing, pressure-rated wastewater main or lateral, one segment of the waterline pipe must be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least 9-ft. horizontally from the centerline of the wastewater main or lateral. The potable waterline must be at least 6 in. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. If the existing

wastewater main or lateral shows signs of leaking, it must be replaced for at least 9-ft. in both directions (18-ft. total) with at least 150 psi pressure-rated pipe.

Where a new potable waterline crosses a new, non-pressure-rated wastewater main or lateral and the standard pipe segment length of the wastewater main or lateral is at least 18-ft., one segment of the waterline pipe must be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least 9-ft. horizontally from the centerline of the wastewater main or lateral. The potable waterline must be at least 2-ft. above the wastewater main or lateral. Whenever possible, the crossing must be centered between the joints of the wastewater main or lateral. The wastewater pipe must have a minimum pipe stiffness of 115 psi at 5.0% deflection. The wastewater main or lateral must be embedded in cement stabilized sand for the total length of one pipe segment plus 12-in. beyond the joint on each end.

Where a new potable waterline crosses a new, non-pressure-rated wastewater main or lateral and a standard length of the wastewater pipe is less than 18-ft. in length, the potable water pipe segment must be centered over the wastewater line. The materials and method of installation must conform with one of the following options:

Within 9-ft. horizontally of either side of the waterline, the wastewater pipe and joints must be constructed with pipe material with a minimum pressure-rating of at least 150 psi. An absolute minimum vertical separation distance of 2-ft. must be provided. The wastewater main or lateral must be located below the waterline.

All sections of wastewater main or lateral within 9-ft. horizontally of the waterline must be encased in an 18-ft. (or longer) section of pipe. Flexible encasing pipe must have a minimum pipe stiffness of 115 psi at 5.0% deflection. The encasing pipe must be centered on the waterline and must be at least two nominal pipe diameters larger than the wastewater main or lateral. The space around the carrier pipe must be supported at 5-ft. (or less) intervals with spacers or be filled to the springline with washed sand. Each end of the casing must be sealed with watertight non-shrink cement grout or a manufactured watertight seal. An absolute minimum separation distance of 6-in. between the encasement pipe and the waterline must be provided. The wastewater line must be located below the waterline.

- 3.2.5. **Pipe Grade.** Water mains 16-in. or smaller must have a minimum of 60-in. of cover from the proposed final finish ground/street elevation and 60-in. of cover when the main is installed in a parkway or under the pavement where there are no existing/proposed curb or existing drainage facilities. Water mains 20-in. and above must have a minimum of 60-in. of cover over the top of the pipe from the proposed final finish ground/street elevation unless otherwise waived or modified by the Engineer.

Contractor is responsible for maintaining line grade with an electronic grade maintaining laser device. Pipe grades are to be as required on the plans, or as directed in writing. Grades are to be met as specified by Sub article 3.1, "Excavation". If Contractor fails to maintain grade all cost to reestablish grade must be borne by the Contractor. Care is to be taken to ensure that the pipe barrel has uniform contact with the bedding material for its full length except at couplings. The coupling is not to be in contact with the original trench bottom before backfill. Bedding material is to be placed under the coupling and compacted by hand before backfilling so as to provide an even bearing surface under the coupling and pipe. Change in grade is to be made only at joints.

- 3.2.6. **Bedding and Bedding Materials.** Before placing pipe in a trench, the trench is to have been excavated to the proper depth as required in Section 3.1, "Excavation". Approved imported materials or Engineer-approved materials selected from suitable fines derived from the excavation must be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

- 3.2.7. **Structures to Support Pipe.** When either the Inspector or Engineer note that the material at the bottom of a trench at subgrade consists of material that is notably unstable and conditions are such that the existing material cannot be reworked to make it stable then the trench subgrade must be over excavated, filled with approved material and properly compacted in place to provide a suitable base to support the pipe. If it is

determined by the Engineer that this method cannot be used to stabilize the trench subgrade the Contractor must then construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer. Extra compensation will be allowed for the Contractor for the additional work done. Coordinate with Engineer for approval of extra compensation before beginning work.

3.2.8. **Lowering Materials into Trench.** Proper implements, tools and facilities satisfactory to the Engineer are to be approved and used by the Contractor for the safe and convenient execution of work. All pipe, fittings, valves, and hydrants are to be carefully lowered into the trench piece by piece by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and lining. Under no circumstances are water main materials to be dropped or dumped into the trench. Take care to avoid damaging polywrap films. Use of chains or slings is not allowed unless entire sling is wrapped with a protective nylon web sock.

3.2.9. **Installing Pipe.** Take precautions to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions, extended period of time or otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign type material entering. Leave the cap/plug in place until a connection is made to the adjacent pipe. Inspect the interior of each pipe for defects and reject if defects are found.

After placing a length of pipe in the trench, the jointed end is to be centered on the pipe already in place, forced into place, brought to correct line and grade, completed in accordance with the requirements specified herein. Pipe must be installed in a continuous bedding envelope which should extend the full trench width to a depth of at least 6 in. below the pipe and to a depth at least 12 in. above water pipe. The pipe is to be secured in place with approved bedding placed in lifts not exceeding 8 in. loose thickness and compacted thoroughly to provide uniform support for the pipe barrel and to fill all voids around the pipe. Pipe and fittings which do not allow a enough and uniform space for joints will be rejected and are to be replaced with pipe and fittings of proper dimensions. Precautions are to be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is not in progress close the open end of pipe in the trench by a watertight plug or other means approved. Pipe in the trench which cannot temporarily be jointed is to be capped or plugged at each end to make it watertight. This provision is to apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal is to remain in place until the trench is completely dry. The Contractor must provide plug and caps of the various sizes required.

3.2.9.1. **Steel Pipe.** The Contractor must furnish all steel piping including fittings, couplings, specials, pipe supports, eyebolts, nuts, and accessories which are shown on the plans and as required for proper connection to existing piping. The Contractor must pay close attention to the fact that the exact location and elevation of existing piping must be determined in the field before fabrication of connecting piping.

All steel pipe and specials may be either mill pipe or fabricated pipe and, in either case, must be fabricated to the sizes, dimensions and shapes as indicated on the plans and as shown on the plans. Unless otherwise indicated on the plans, all steel pipe, bends, or specials must have an outside diameter minimum wall thickness and unit weights as shown on plans.

Any pipe section, fitting, or special which shows dents, kinks, abrupt changes of curvature other than specified, or any other damage will be rejected. Any pipe section, fittings, or special section that has been dropped from a truck or crane will be rejected. The Contractor must, at his own expense, replace or recondition each rejected section. All reconditioning procedures must first be presented to the Engineer for review and approval.

Ends of Sections: Ends of pipe sections, bends, and specials must be beveled for field welding, unless shown otherwise on the plans.

Seams: All piping must be made from steel plate rolled into cylinders or sections thereof, with not more than two longitudinal butt welds, or must be spirally formed and butt welded. Girth seams must be butt welded and not be closer than 6-ft. apart except in specials and bends.

Length tolerance: Standard and special section must be within 1/16 in. (\pm) of the specified or theoretical lengths.

Welded Joints: Except where ends are shown on the plans to be joined by mechanical couplings, all joints for steel pipe installed on a bridge structure and in open trench must be welded.

Welders appointed to do welding on steel pipe must be certified with 4F and 5G certification. All welds must be sound, free from embedded scale and slag, must have a tensile strength across the weld not less than that of the thinner of the connective sections, and be water tight. Use butt welds for all welded joints in line-pipe assemblies and in the fabrication of bends and other specials. All welds must be subject to pre-manufacturing inspection and available to the Inspector and Engineer upon request.

Welding for field joints must conform to the applicable requirements of the AWWA "Standard Specification for Field Welding of Steel Water Pipe Joints, C-206." Parties involved in the construction of mains must pay special attention to the AWWA "Standard Specification for Field Welding of Steel Water Pipe Joints, C-206, Control of Temperature Stresses." After welding, the joints must be prepared, primed and painted, or wrapped in accordance with this specification.

Repair leaks in welds by chipping out defective material and re-welding. Hammering is not permitted.

3.2.9.2. **PVC (C-900 and C-905).** Lay PVC mains to the depths and grades shown on plans. Lay pipe by inserting spigot end into bell flush with insertion line or as recommended by manufacturer. At no time is bell end allowed to go past "insertion line". A gap between end of spigot and adjoining pipe is necessary to allow for expansion and contraction.

3.2.10. **Defective or Damaged Material.** Pipe and accessories are to be inspected for defects before being lowered into the trench. Any pipe section, fitting, or special which shows dents, kinks, abrupt changes of curvature other than specified, or any other damage will be rejected. Any pipe section, fittings, or special section that has been dropped from a truck or crane will be rejected. The Contractor must, at his expense, replace or recondition each rejected section. Reconditioning procedures must be acceptable to the Engineer. Any defective, damaged, or unsound material is to be repaired or replaced as directed.

Should a damaged piece of pipe furnished by the Contractor be placed in the water main, the Contractor is to furnish, at his expense, all labor and materials required for removing and replacing the defective pipe and restoring the street to its condition just before the failure of the pipe. Should the Contractor damage the pipe after installation, the Engineer may permit the damaged section to be cut from the length unless it is the opinion of the Engineer that the entire length was damaged. The cost and replacement of broken pipe is to be at the expense of the Contractor.

3.2.11. **Holes at Bells and Collars.** Bell holes of sufficient size are to be provided at each joint to permit the joints to be made properly. For mechanical type joints the minimum clearance between the bell and natural ground is to be 6-in. in all directions. Bell holes for concrete steel cylinder pipe are to be of sufficient size to properly joint the pipe and place the required grout. Subject to the above provisions the length of excavation for bell holes below grade of the trench bottom is to be kept to a minimum.

3.2.12. **Deviations in Line or Grade.** Wherever obstructions, not shown on the plans, are encountered during the progress of the work and such obstructions interfere to such an extent that an alteration on the plan is required, the Engineer is to have the authority to change the plans and direct a deviation from the line and grade or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstruction. Any deviation from the line is to be accomplished by the use of appropriate bends unless such requirements are specifically waived by the Engineer. These deviations must clearly and accurately be reflected in the Contractor's submittal of their redline drawings for permanent recording purposes.

Whenever it is necessary to deflect pipe from a straight line the deflection is to be as directed. In no case are the amounts shown in Table 12, "Maximum Deflections of Ductile-Iron Pipe" and Table 13, "Maximum Deflections of Concrete-Steel Cylinder Pipe", to be exceeded.

Table 12- Max Deflections of Ductile-Iron Pipe						
4.5. Nominal 4.6. Pipe 4.7. Diameter	4.8. Max 4.9. Joint 4.10. Open	4.11. Max 4.12. Defl 4.13. Angle	4.14. Max Deflection in In. 4.15. with Pipe Length of:		Approximate Radius of Curve in Ft. Produced by Succession of 4.16. Joints with Pipe Length of:	
4.17. (In.)	4.18. (In.)	4.19. Deg /Min	4.20. 18 ft.	4.21. 20 ft.	18 ft.	4.22. 20 ft.
6	0.58	4/25	16.7	18.5	234	260
8	0.65	3/51	14.6	16.2	268	297
10	0.75	3/42	14.0	15.5	279	310
12	0.75	3/08	11.9	13.2	327	363
16	0.75	2/21	8.8	9.7	440	488
20	0.75	1/55	7.2	8.0	540	600
24	0.75	1/35	6.0	6.7	648	720

4.23. Table 13 - Max Deflections of Concrete-Steel Cylinder Pipe					
4.24. Nominal 4.25. Pipe 4.26. Diameter	4.27. Max 4.28. Deflection 4.29. Angle	4.30. Max 4.31. Deflection in In. with Pipe Length of:		Approximate Radius of Curve in Ft. Produced by Succession of 4.32. Joints with Pipe Length of:	
(In.)	Deg/Min	16 ft.	20 ft.	16 ft.	20 ft.
16	2/20	-	9.8	-	500
20	1/52	-	7.8	-	600
24	1/34	-	6.6	-	750
30	1/16	-	5.3	-	900
36	1/02	-	4.3	-	1,100
42	0/54	-	3.8	-	1,300
48	0/47	2.6	-	1,170	-
54	0/44	2.5	-	1,237	-
60	0/54	3.0	-	1,024	-

- 3.2.13. **Cutting Pipe.** The cutting of pipe for inserting valves, fittings or closure pieces is to be accomplished so as to produce a smooth end at right angles to the axis of the pipe. Strictly follow the recommendations of the pipe manufacturer. Under no circumstances is a workman not equipped with proper safety goggles and helmet and other required safety attire permitted to engage in this work.

Asbestos-Cement (AC): No field cutting will be allowed on asbestos-cement pipe. Repairs to AC pipe must be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC or Ductile Iron pipe and fittings. Information about handling AC pipe can found in Sections 3.2.19 and 3.2.20 of this Special Specification.

All cuts made on ductile-iron pipe are to be done with a torch or power saw. The cuts are to be made at right angles to the pipe axis and are to be smooth. The edges of the cut are to be finished smoothly with a hand or machine tool to remove all rough edges. The outside edge of pipe should be finished with a small taper at an angle of about 30°.

Field Cut PVC (C-900 and C-905 and C-909) using a power saw with a steel blade or abrasive disc depending on the size of pipe. If a bevel is needed after field cutting, it should be in accordance with the latest Uni-Bell recommendations.

To facilitate future repair work on water mains, no sections less than 3-ft. in length between fittings is allowed.

- 3.2.14. **Coating and Wrapping Underground Pipe.**

- 3.2.14.1. **Steel Pipe.** Steel pipe, bends and special are to be prepared, primed, painted or wrapped in the field as follows.

Exterior Surface Above Ground: Exterior surfaces of new pipe and appurtenances installed are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods approved by Engineer, given a single coat of industrial grade rust inhibitive primer and two finish coats of aluminum paint.

Exterior Surfaces Underground: Exterior surface of steel pipe, bends and specials installed in open trench are to be thoroughly cleaned to bare metal by high speed wire brushing, scraping or other suitable methods approved by Engineer, given a single coat rust inhibitive primer and wrapped with polyvinyl tape in accordance with AWWA C-203-91 "Protective Coatings for Steel Water Pipelines," (Appendix C), or most applicable approved equal provision.

The procedure for coating flanged joints and mechanical coupling joints when used with steel pipe is to be as specified.

Field Welded Joints: After installation of pipe, bends, and specials, all ends of pipe adjacent to welded field joints, including the weld proper, must be cleaned, primed, painted or wrapped as specified for the pipe adjacent to the weld.

Interior Surfaces: The interior surfaces of all steel pipe, fittings and specials must be cleaned by sandblasting and then primed and coated with a cement mortar lining. Cement mortar-lined and coated steel pipe must be used for transmission mains 4 in. and larger.

All cement-lined steel pipes must be prepared with the following processes:

Steel pipe must not be tested until the factory-applied mortar lining and coatings on all piping and specials have been in place for a minimum of 14 days. Steel piping with cement mortar field applied to the interior of the pipe must not be filled with water until a minimum of 8 hours has elapsed after the final placement of cement mortar, unless otherwise approved by the Engineer.

Contractor to submit details of all specials, and of the lining and coating.

Use lining conforming to the latest provision of AWWA C205 or most applicable approved equal provision, except as is noted otherwise in the contract documents.

Cement used in mortar lining must be Portland Cement, per the latest provision of ASTM C150 or most applicable approved equal provision, Type II or V for lining.

Pipe must be cement mortar lined in the shop by the centrifugal process, in accordance with the latest provision of AWWA C205 or most applicable approved equal provision.

Cement mortar-lined pipe must be braced as required to maintain roundness during the shipping and handling activities and must have ends capped before shipment. For pipes with 14-in. nominal diameter and larger, the finished ID after lining must be the nominal size. For pipes with 12-in. nominal diameter and smaller, standard OD pipe sizes must be furnished.

3.2.14.2. **Ductile-Iron Pipe.**

3.2.14.2.1. **Open Trench.** Ductile-iron pipe to be installed in a trench is to be protected in the following manner. Each pipe joint is to be covered with a 4 mil thick polyethylene sleeve that is 2-ft. longer than the pipe joint. The sleeve is to cover the full length of the pipe joint, lap over 1-ft. on each end of the adjoining pipe joints and be secured with a minimum of two circumferential turns of pressure sensitive polyvinyl tape. Excess material should be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of pieces of pressure sensitive tape at approximately 5-ft. intervals. After assembling the joint, the polywrap tube from the previously installed pipe is to be pulled over the joint and secured by the Contractor. The polywrap tube from the new joint is to be pulled over the first tube and secured to provide a double seal.

Cast iron and ductile-iron fittings are to be completely wrapped in 8 mil thick polyethylene films with a minimum of 1-ft. overlap on each end and appropriately taped. Laps are to cover joints with adjoining pipe joints or fittings when installed. Fire hydrant barrel from the surface to the valve is to be wrapped as specified herein.

Any damaged areas in the polyethylene film are to be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1-ft. minimum in any direction and appropriately taped. Take care at service to locations to ensure that tape extends beyond corporation and onto service line pipe 1-ft.

Before placing pipe in the trench, a cushion of approved materials is to be placed in the trench as required by Section 3.3., Backfill material is to be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

The Contractor must use care to protect and preserve the polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around the pipe over the polywrap in the area to be tapped. The tap is to be made through the tape and polywrap. It is not necessary to remove and replace poly wrap. All exposed pipe, the corporation, and the first 3-ft. of the service must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8-in. above the main.

3.2.14.2.2. **In Casing.** Where ductile-iron pipe is installed in a bore, the pipe is to be thoroughly clean down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used is to then be applied to the pipe. Following application of prime coat, wrap pipe with Scotchrap, Trantex V-10 polyvinyl tape, or approved equal. Tape must not be applied until prime coat is completely dry.

The tape must be spirally and tightly wrapped on each section of the pipe with a 50% lap. The wrap must be made to the bell on the bell end and to a point 6 in. from the spigot end. The joint must be protected with tape 6 in. in width on pipe 12 in. or less in size and with tape 8 in. in width on pipe greater than 12 in. in size.

3.2.15. **Protective Coating and Wrapping on Joints.** All bolts and nuts installed for underground service on valves, fire hydrants, cast-iron mechanical joint fittings, pipe joints, and other ferrous metal appurtenances are to be

packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to proper tension, the joint including glands, flanges, bolt heads, and nuts are to be covered with an approved coating. Such protective coating is supplemental to anti-corrosive sand embedment. Asphaltic coatings such as Talcote is not allowed. Coating and wrapping of joints will not be paid for directly.

Steel Pipe Field Welded Joints: After installation of pipe, bends and specials, all end of pipe adjacent to welded field joints, including the weld proper, must be cleaned, primed, painted or wrapped as specified for the pipe adjacent to the weld.

3.2.16. **Joint Assembly.**

Rubber Ring Joints: The installation of pipe and the assembly of rubber ring joints for ductile-iron pipe, concrete-steel cylinder pipe and asbestos cement pipe, is to conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as "stabbing" is not permitted with pipe larger than 6-in.in size. Spigot ends of pipe larger than 6-in. in size must be properly inserted in the joint by means of suitable pushing or pulling devices, or an approved manufacturer's method.

Mechanical Couplings: The installation of mechanical couplings is to be assembled and installed according to the standards recommended by the manufacturer. Before the installation of the mechanical coupling, the pipe ends are to be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe is to be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts are to be drawn up finger tight. Uniform pressure on the gaskets is to be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Final tensioning is to be accomplished with a torque wrench and in a manner similar to the tightening procedure. The coupling is to then be left undisturbed for 24 hours to allow the gaskets to "pack-in". Final torque check is to then be made before coating and wrapping the joint. Table 14, Torque for Mechanical Couplings, sets forth the proper torque for various sized mechanical couplings and is included for the convenience of the Contractor.

Restrained Joints: Install restraint joints as shown on plans or as directed by Engineer. Install in accordance with manufacturer's recommendations.

Coupling Size	Bolt Diameter	Torque
2" to 24"	5/8"	75 ft.-lb.
2" to 24"	3/4"	90 ft.-lb.
30" and 36" (1/4" x 7" Middle Rings)	5/8"	65 ft.-lb.
30" thru 36" (3/8" & heavier Middle Rings)	5/8"	70 ft.-lb.
30" to 48"	3/4"	80 ft.-lb.
48" to 72"	3/4"	70 ft.-lb.

3.2.17. **Gray Iron and Ductile Iron Fittings.** Fittings 6-in. through 12-in. in size are to be either mechanical joint, push-on joint short body, or push-on joint compact body unless otherwise stated on the plans. Fittings must be installed with the thrust blocking or joint restraint shown on the plans. Fittings 16-in. through 24-in. in size are to be mechanical joint type unless otherwise specified on the plans. Adaptors are to be used where necessary to provide a transition between asbestos-cement pipe and the fittings. Restraint or thrust blocking is to be provided as specified on the plans or as directed. Anti-corrosion embedment incidental to all installed cast-iron fittings must be provided as specified in and no separate payment will be made for this embedment.

Cleaning Ductile Iron: All lumps, blisters, and excess coal-tar coating is to be removed from the ends of ductile-iron pipe fittings. The outside of the spigot and the inside of the bell is to be wire-brushed and wiped clean, dry, and free from oil and grease before the pipe is laid. The interior of the pipe is to be blown clean with compressed air or swabbed out clean and dry as directed. Immediately before placing any pipe in the trench the interior is to be cleaned by an approved brush or swab or with compressed air to remove all dirt and foreign materials. All pipe and fittings are to be inspected by the Contractor for defects while suspended above ground.

- 3.2.18. **Corrosion Protection for Ferrous Pipe, Fittings, and Valves.** Except as otherwise shown on plans or as direct, anticorrosion embedment is to be provided for all ductile-iron pipe, fittings, and valves and at all valve fittings or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material is to be Modified Grade 5 gravel washed sand which conforms to the requirements set forth in Section 2.18.

Prepare the trench in accordance with applicable provisions of Section 3.1. After subgrade has been prepared, lay pipe to grade in accordance with plans and specification. Pipe, fitting or valve are to be firmly embedded in and surrounded by an insulating blanket of embedding material. The minimum thickness of this blanket is to be 6 in. in every direction

- 3.2.19. **Tie-in to Existing Mains.** The Contractor must make tie-ins from new water mains to existing water mains as shown in the contract documents or as directed. The Contractor must be responsible for all shutdowns and isolation of the existing mains; cutting pipe for the connection; dewatering the excavation; customer notification of the shutdown; and all other requirements as directed by the Inspector to provide completion of this effort in a safe and secure manner. Work performed by the Contractor on mains 16 in. and larger, will require operation of any valves by SAWS forces. Therefore ample coordination beforehand (2 work days) must be provided by the Contractor for this interaction to occur. All tie-ins must be done after normal work hours, (8 A.M.-5 P.M.). During construction, the planned shutdown and tie-in work must be coordinated through and approved by the Inspector with a minimum of two weeks prior notice of such activity and accomplished at a time which will be at the least inconvenience to the customers. No additional compensation will be provided for tie-ins accomplished after normal working hours.

Tying in to existing mains of asbestos cement (AC) pipe, the Contractor will comply with the requirements of Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. At each location shown on the plans and/or identified by the Contractor to involve AC pipe, the Contractor will comply with the requirements of Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges for the removal of the necessary amount of AC pipe required to make the connection without creating any friable material. Excavate to the top of the AC water line to allow a separate contractor hired by the State to remove the AC water line. The excavation for the AC water line removal is subsidiary to the work that created the need for the removal (excavation for structures, roadway, a new line, tie-ins, etc.). The third party contractor will remove whole sections of AC pipe so that the Contractor can make the tie-in at the nearest joint.

- 3.2.20. **Asbestos Cement (AC) Pipe Removal.** AC pipe removal quantities shown within plans are estimated and are to be field verified. Estimated quantities for removal are based on removal required to perform tie-ins to existing AC mains (as described in Section 3.2.19) and locations where existing AC pipe is in conflict with proposed TxDOT storm drains, proposed TxDOT culverts, proposed TxDOT streets, proposed TxDOT grading, proposed TxDOT retaining walls, and proposed TxDOT traffic signal foundations. The Contractor will comply with the requirements of Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Excavate to the top of the AC water line to allow a separate contractor hired by the State to remove the AC water line. The excavation for the AC water line removal is subsidiary to the work that created the need for the removal (excavation for structures, roadway, a new line, tie-ins, etc.). The third party contractor will remove whole sections of AC pipe.

- 3.2.21. **Abandonment of Old Mains and Valves.** Regarding planned main abandonment, the Contractor must accomplish all cutting, capping, plugging, and blocking necessary to isolate those existing mains retained in service from those abandoned. The open ends of abandoned mains and all other openings or holes in such mains occasioned by cutting or removal of outlets must be blocked off by manually forcing cement grout or concrete into and around the openings in enough quantity to provide a permanent substantially watertight

seal. Abandonment of old, existing water mains will be included in the work required, and no direct payment will be made.

When specified or shown otherwise in the contract documents, Contractor must remove the main and all related appurtenances that are to be replaced, or will no longer be in service, and all effort to accomplish this requirement will be included in the work required, and no direct payment will be made.

Abandoned Valves: Valves abandoned in the execution of the work must have the valve box and extension packed with sand to within 8 in. of the street surface. The remaining 8 in. must be filled with 2,500 psi concrete or an equivalent sand-cement mix and finished flush with the adjacent pavement or ground surface. The valve covers must be salvaged and returned to the Owner.

New/Existing Valves: At no time during the project work must any valves be covered or rendered inaccessible for operation due to any activities by the Contractor. Any work during construction activities will be suspended until this requirement is met. No claims for cost or schedule delays will be accepted.

3.2.22.

Jacking, Boring, or Tunneling Pipe.

Jacking: Suitable pits or trenches must be excavated for the purpose of jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work must be securely sheeted and braced. Jacking operations must in no way interfere with the operation of railroads, streets, highways or other facilities and must not weaken or damage such facilities. Barricades and lights must be furnished as directed to safeguard traffic and pedestrians.

The pipe to be jacked must be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material must be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided.

The excavation for the underside of the pipe, for at least $\frac{1}{3}$ of the circumference of the pipe, must conform to the contour and grade of the pipe. A clearance of not more than 2 in. may be provided for the upper half of the pipe.

The distance that the excavation must extend beyond the end of the pipe will depend on the character of the material, but it should not exceed 2 ft. in any case.

The pipe should be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will be as shown on the plans or as determined by the Engineer.

Any pipe that cannot be repaired to its original condition or is damaged in jacking operations must be removed and replaced at the Contractor's expense. Jacking pits must be backfilled immediately upon completion of jacking operations.

Excavation: Excavation for "Boring" pits and installation of shoring will be as outlined under "Jacking." Boring operations may include a pilot hole which should be bored the entire length of crossing and must be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade must apply as specified under "Jacking."

Tunneling: Tunneling may be used when the size of the proposed pipe would make the use of tunneling more satisfactory than "Jacking" or "Boring." The excavation for pits and the installation of shoring must be as specified under "Jacking." The lining of the tunnel must be of the material shown on the plans.

Access holes for grouting annular space should be spaced a maximum of 10-ft.

Joints: Joints for pipe for "Jacking," "Boring," or "Tunneling," must be as specified in these specifications, or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

Grouting of Bores or Tunnels: Annular Space between casing pipe and limits of excavation (borehole) must be pressure grouted, unless otherwise specified on the plans.

- 3.2.23. **Cutting-in Valves.** The work involved in cutting a valve into an existing main is to consist of excavation and backfilling with approved selected material; hauling and disposition of surplus excavation and other materials; installation of the valve, valve box assembly, all pipe cut used to complete cut-in; reaction blocking; polyethylene wrapping where required.

- 3.2.24. **Tapping Sleeves and Valves.** Size on size taps are not permitted.

The work involved in the installation of a tapping sleeve and valve is to consist of excavation, backfilling the excavation with approved selected material, installing the tapping sleeve, reaction blocking, tapping valve, valve box assembly, concrete collar (where subjected to street traffic), and a cast iron lid. New taps will not be permitted closer than 2-ft. of a joint or existing tap. The use of a shell type cutter will be required with tapping sleeves and valves. Whenever working on potable or recycled water system, disinfect the shell cutter with bleach before start of work. The cutting edge is to be sharp and round. Inspector will reject defective cutters.

Air test tapping sleeves to 50 psi before tapping main line.

The valve box must be placed in such a manner to prevent shock or stress from being transmitted to the valve. Valve boxes must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed by the Inspector. Valve boxes located in streets or other areas subject to vehicular traffic must be provided with concrete collars as shown in the accompanying standard drawings. Collars around such valve boxes must be formed and finished off neatly and in a sound workmanlike manner.

- 3.2.25. **Cutting-in Tees.** The work involved in cutting in a tee is to consist of excavation, shut-down and isolation of existing main to which the new main is to be connected, cutting pipe for connection, dewatering the excavation, customer notification of service interruption where required, installation of all pipe used to complete the connection, all necessary tie-ins (connection to existing or new main), fittings, approved reaction blocking required and backfilling the excavation with approved selected materials or flowable backfill if required. Where the installation of a valve is required, payment will be for valve accordance with this specification.

The processes associated with disturbing and restoring pavements (any type), curbs, sidewalks, backfilling to final grade, flowable backfill (if required) and sodding for the installation of a cut-in tee will be included in the work and must comply with the applicable Department Specification, any other governing entity's specifications, and applicable street cut policies, ordinances, or permits.

- 3.2.26. **Pipe Joint Restraint System.** Pipe joint restraints must be used to prevent movement for PVC push-on bell and spigot pipe connections. The restrainer may be adapted to connect a plain end PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. Joint restraint is to be non-directional and installed to fully restrain system. All pipe and fitting systems with restrained joints must be identified by applying an adhesive-backed warning tape to the top of the pipe and for the full length of the pipe, regardless of the type of pipe. For plastic pipes the warning tape must be applied directly to the top of the pipe. For metal pipes and fittings the warning tape must be applied to the top of the polyethylene film wrap.

- 3.2.27. **Concrete Encasement, Cradles, Saddles and Collars.**

Concrete Encasement: When concrete encasement is shown on the plans or when directed, the trench is to be excavated and fine graded to a depth conforming to the details and sections shown on the plans. The pipe is to be supported by pre-cast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement concrete is to be placed to a depth and width conforming to details and sections shown on the plans.

Concrete Cradles: When concrete cradles are shown on the plans or when directed, the trench is to be prepared and the pipe supported in the same manner as described above. The cradle must be constructed in accordance with details and sections shown on the plans. Strap/Tie Downs must be No. 4 rebar diameter minimum or better as determined by the Water System Inspector.

Concrete Saddles: When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with Section 3.3. of this specification to the spring line and concrete placed for a depth and width conforming to details and sections shown on the plans.

Concrete Collars: When shown on the plans or when directed, concrete collars are to be constructed in accordance with details and sections shown on the plans.

3.2.28.

Fire Hydrants. Hydrants are to be connected to the main as shown on the plans or as directed. They are to be installed in a manner which will provide complete accessibility and in a safe location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

When the hydrant is placed directly behind the curb the hydrant barrel is to be set so that no portion of the hydrant will be less than 12 in. no more than 7-ft. from the back of the curb.

When the hydrant is set in the lawn space between the curb and the sidewalk or between the sidewalk and the property line no portion of the hydrant or nozzle cap is to be within 6-in. of the sidewalk. Setting final grade of fire hydrants to match proposed or existing field conditions is the responsibility of the Contractor.

Hydrants are to be set in accordance with plans and details are to be set plumb and are to have their nozzles parallel with or at right angles to the curb with the pumper nozzle facing the curb. Drainage and concrete pad are to be provided at the base of the hydrant as shown on the plans. No fire hydrant drainage system or pit is to be connected to a storm sewer or to a sanitary sewer.

Restrained Joints: Restrained mechanical joints that require field welding or groove cuts into the pipe barrel for restraint will not be accepted. Restrained joints must be furnished for pipe at all changes in direction at indicated on plans, details, or as directed. Restrained mechanical joints must be locked mechanical joints. Joints must be capable of test pressure twice the maximum sustained working pressure of 350 psi for ductile iron pipe and PVC.

Replacing and Relocating Existing Fire Hydrants: When existing fire hydrants are to be replaced or relocated, the work is to be accomplished by either of the following:

Cutting or installing a tee of the size and type indicated on plans or as directed.

Using a tapping sleeve and valve of the size and type indicated on plans to install a new fire hydrant to an existing or new water main. Size on size taps is not permitted.

Relocating the existing fire hydrant by closing the existing fire hydrant, extending the fire hydrant branch and installing the existing fire hydrant as specified herein.

Salvage the existing fire hydrant and other materials as designated in the field by the Construction Inspector and deliver to Water System material storage yard located at 3930 East Houston Street, San Antonio, Texas. Fire hydrant branches are to be abandoned by cutting and capping fire hydrant cast iron tee at the service main and surface restored to its original condition.

After the fire hydrant has been set, paint hydrant with suitable primer and finish with oil-based aluminum paint from top of hydrant to a point 18-in. to 20-in. below centerline of the pumper nozzle and apply to all exposed metal surfaces above the hydrant base flange. The payment for fire hydrant painting is to be included in the unit cost for installing the fire hydrant.

Installation on Water Mains: Ductile iron pipe, cast iron and ductile iron fittings, and valves used in the placement of fire hydrants and connections to the main will be considered part of the fire hydrant installation and not a part of the main construction. No separate payment will be made for this pipe. Hydrants should be connected to the mains as shown in the contract documents or as directed. Hydrants must also be installed

in a location where there is accessibility and in a safe location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

- 3.2.29. **Gate Valves, Valve Boxes, Adjustments.** Gate valve installation should include valve, reaction blocking, cast iron boot, valve box extension (with ductile iron riser pipe), valve box, concrete collar (where subjected to vehicular traffic), and valve box lid. Gate valves constructed in the terrace must be constructed with No. 3 bars all around.

The valve box must be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6-ft. and deeper must include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems, on all valves located between 6-ft. and 13-ft. Adjustable valve box and valve key extension systems must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed. Valve boxes located in streets or other area subject to vehicular traffic must be provided with concrete collars as shown in these standard drawings. Collars around such valve boxes must be formed and finished off neatly and in a sound workmanlike manner.

Valve pits must be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box must be set flush with the finished pavement surface or at other finish elevations as may be specified. Pits should be constructed in such a manner to permit minor valve repairs and provide protection to the valve and pipe from impact (where penetrating through pit walls).

In Pressure Zones 9-16, all valves 6 in. and larger must be supported on a concrete pad in accordance with details shown on the plans.

Existing valve boxes located within the limits of new street construction which are in conflict are to be adjusted to match proposed finish grades.

- 3.2.30. **Air Release Assembly.** Air release valves and appurtenant items are to be installed at the locations shown on the plans unless otherwise directed.

Install air release assemblies in open trench in accordance with plans and details. Assemblies include the valve, valve box, tapping saddle, pipe fittings, accessories and appurtenances. It also includes service line and tap to main. Air release assemblies installed in parkways or easements and outside of street pavement must be installed in accordance with plans.

Air release assemblies installed on steel pipe attached to bridge structure includes the outlet on the steel pipe, valve, valve box, pipe fittings, security enclosure, accessories and appurtenances.

- 3.2.31. **Blow-offs.** Permanent and temporary blow-off assemblies should be installed where shown on the plans or at locations designated by the Engineer/Owner and at the end of all dead end mains in accordance with the Texas Administrative Code (TAC) rules to include 30 TAC § 290.44 (d)(5), (6).

The permanent blow-off will consist of the following: all galvanized iron pipe, valve, and fittings of the various sizes shown on the plans, 6-in. valve box assembly and concrete collar around the valve box. The temporary blow-off will consist of the following; all galvanized iron pipe, valve and fittings of the various sizes shown on the plans. Valve box must be raised or installed to finished grade and installed in accordance with the details.

- 3.2.32. **Anchorage and Blocking.** Suitable reaction blocking or anchorage is to be provided at all dead ends, plugs, caps, tees, crosses, valves and bends as shown on the plans. All mechanical (joint) restraints are to be bidirectional. Anchor blocks are to be constructed solidly behind the fitting and symmetrical with the axis of resultant thrust except where this is not possible as in the case of gravity anchorage for vertical bends. Special ties and anchor fittings may be used in conjunction with blocking when shown on the plans or as directed.

Thrust blocking is to be a minimum of Class "A" (3,000 psi), concrete placed between solid ground and the fitting except as otherwise shown on the plans. The area of bearing in contact with solid ground is to be that shown on the plans or as directed.

All thrust blocking placed in conjunction with mains and appurtenances constructed in Pressure Zones 9 through 15 should be as shown on the plans. In all cases, the design of thrust blocking must be of sufficient size to withstand a soil pressure of 3,000 psf, unless specified otherwise in the job plans or specifications. The maximum soil lateral load bearing capacity that will be allowed for the design of thrust blocking must be 5,000 psf. When soil lateral load bearing capacities of 4,000 psf or 5,000 psf are recorded for design of thrust blocks, copies of soil tests made for determining the bearing value of the soil in question should be submitted to the Engineer for verification.

The blocking is to be placed so that pipe and fitting joints will be accessible. Pipe polywrap is to be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a tee is to be poured separately from the block across the back of the tee. If they are poured simultaneously, a rigid partition is to be placed between the blocks.

Valves 12-in. and larger in size are to be supported on a concrete pad extending vertically from 12-in. below the bottom of the valve to the lower quarter point of the hub and laterally from face to face of hubs and transversely from wall to wall of the trench.

3.2.33.

Butterfly Valves. Butterfly valve installation will include: butterfly valve, coated and wrapped steel pipe nipple with reaction stop ring, concrete reaction blocking, cast-iron boot, valve box extension (ductile iron riser pipe), valve box and lid, concrete collar where subjected to vehicular traffic, all couplings and all coupling adapters required to complete the connection. The entire valve, except for the operating nut, must be coated with an approved SAWS sewer structural coating, and wrapped with Polywrap. Butterfly Valves constructed in a terrace must be constructed with No. 3 bars all around.

The valve box must be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6-ft. and deeper must include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems on all valves located between 6-ft. and 13-ft. Adjustable valve box and valve key extension systems must be centered over the valve's operating nut with the box cover flush with the finished pavement surface or located at another level as directed. Valve boxes located in streets or other areas subject to vehicular traffic must be provided with concrete collars as shown on the plans. Collars around such valve boxes must be formed and finished off neatly and in a workmanlike manner.

3.2.34.

Reinforced Concrete Vaults.

Forms. Forms should be designed to produce hardened concrete having the shape, lines, and dimensions shown on the plans.

Surfaces which will be exposed to view when construction is completed should be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. The forms must produce finished surfaces that are free from off-sets, ridges, waves, and concave or convex areas.

Plywood or lined forms will not be required for surfaces which are normally submerged or not ordinarily exposed to view. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not restricted to plywood or lined forms and may be used as backing for form linings.

Before concrete is placed, a film of light form oil must be applied to the forms.

Forms should be substantial and sufficiently tight to prevent leakage of mortar. Form must be thoroughly cleaned, braced, or tied to maintain the desired position, shape, and alignment during and after concrete placement.

Form ties must be corrosion resistant and must have enough strength and rigidity to support and maintain the form in proper position and alignment.

Form Removal. Form must be removed after 24-hrs., provided that the exposed surfaces can be immediately and effectively sealed to prevent loss of moisture. Otherwise, the forms should remain in place for 48-hrs. Precautions should be taken in form removal to avoid surface gouging, corner or edge breaking, and other damage to the concrete.

Reinforcing Steel. Reinforcing steel should be accurately formed and must be free from loose rust, scale, and contaminants which reduce bond. Unless otherwise shown on the plans, bar reinforcement must be deformed and conform to the general requirements of Department Item 440, "Reinforcement for Concrete."

Reinforcing Steel Placement. Reinforcing steel should be accurately positioned on supports, spaces, hangers, or other reinforcements and must be secured in place with wire ties or suitable clips. All bars must be shop fabricated and bent cold.

Concrete Placement. Concrete should be placed as nearly as practicable in its final position to avoid segregation due to re-handling. When the concrete pour has commenced, it should be carried on as a continuous operation until the placing of the panel or section is completed as a whole. All concrete must be thoroughly compacted by suitable means during pouring operations and must be thoroughly worked around reinforcement bars and into the corners of the forms. Mechanical vibration or other acceptable means should be used to completely embed the reinforcement and eliminate honeycomb. Finished surfaces should be brought to proper grade, struck off, and completed in a workmanlike manner. No honeycombing, rough spots, or protruding stones should be left exposed.

Curing. Concrete must be protected from loss of moisture for at least 7 days after placement. Curing of concrete should be by methods which will keep the concrete surfaces adequately wet during the specified curing period.

Water Curing: Water saturation of concrete surfaces should begin as quickly as possible after the initial set of the concrete. The rate of water application should be regulated to provide complete surface coverage with a minimum of runoff.

Membrane Curing: Chlorinated, rubber-type, membrane curing compound may be used instead of water curing on concrete which will not be covered later with mortar or additional concrete. Membrane curing compound should be spray applied at coverage of not more than 300-sq. ft. per gal. If forms are removed before the end of the specified curing period, curing compound must be immediately applied to the formed surfaces before they dry out.

Curing compound should be suitably protected against abrasion during the curing period.

Finishing Surfaces. Fins and other surface projections should be removed from all formed surfaces. All exposed exterior surfaces should have a rubbed finish. The floor surface should be brush finished, unless otherwise specified.

Repairing Defective Concrete. Defects in formed concrete surfaces must be repaired to the satisfaction of the Engineer within 24-hr., and defective concrete must be replaced within 48-hr. after the forms have been removed. All concrete which is honeycombed or otherwise defective should be cut out and removed to sound concrete with edges square cut to avoid feathering.

Concrete repair work should be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work must be adequately cured.

Painting. All exposed metallic surfaces such as the cover plate, hinges, handles, and other exposed hardware, must be primed and painted with one coat of primer and one coat of aluminum paint of approved and compatible quality.

Backfill. The Contractor should cover the openings at each end of the vault with 1/4-in. plywood placed outside the vault. Selected backfill (consisting of job excavated materials, finely divided and free from debris, organic material and stones larger than 2-in. in greatest dimension) must be placed in uniform layers not exceeding 8-in. in uncompacted thickness and must be carefully compacted around the sides of the vault until level with the surrounding ground.

3.3. **Backfill.**

- 3.3.1. **Initial Backfill.** Initial backfill is defined as backfill with a thickness in its compacted state from the surface of the bedding to a point 1-ft. above the top of pipe. The first lift of initial backfill is to be inspected and approved before placement of the second lift. The second lift of initial backfill material is to extend from the spring line of the pipe with a minimum of 1-ft. above the top of the pipe. The second lift is to be evenly spread in a similar manner as the first lift.

For diameters 24-in. and larger, simultaneously spread initial backfill material alongside, under the lower quadrant of pipe and over the pipe in 12-in. lifts to a point sufficient to a minimum of 1-ft. above the top of pipe.

Consolidate initial backfill material to assure it is incorporated. A handheld vibrator, commonly used for concrete work, can be used for this purpose. The vibrator must be inserted every 3-ft. on each side of pipe.

- 3.3.2. **Secondary Backfill.** Secondary backfill is defined as backfill from 1-ft. above the top of pipe to the top of the trench or bottom of pavement section. Secondary back fill is to be constructed in accordance with details shown on plans and these specifications.

Secondary backfill material should be placed in maximum 12-in. loose lifts or as directed.

- 3.3.3. **Sand Backfilling of Cross Trenches and Open Holes.** Blow-offs, tie-ins, air release valves, and service lines, meter boxes, or other specials are to be backfilled with sand and thoroughly consolidated by saturating with water, unless otherwise directed. The use of mechanical tamping equipment for compaction of backfill will not be permitted at such locations. Disposal of surplus excavated material and placement of sand is to be included in the trenching and backfilling and will not be paid for directly.

- 3.3.4. **Trench Backfill Across Traffic Arteries.** Any trench in or across traffic arteries is to be backfilled immediately after the pipe is installed unless the Engineer determines unusual conditions exist that render immediate backfilling unfeasible.

- 3.3.5. **Flowable Backfill.** Instead of normal backfill materials, the Contractor is to backfill the trench with flowable backfill with fly ash material at the locations shown on the plans or at locations directed. The flowable backfill material and operation is to be in accordance with Department Item 401, "Flowable Backfill".

3.4. **Flushing and Testing Mains.**

- 3.4.1. **Flushing.** Immediately upon completion of water main work, the Contractor must flush all mains affected by the scope of the work. This flushing will consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed. The flow-through should continue until it is determined all dust, debris, or foreign matter that may have entered during pipe laying operations has been flushed out. All new mains must then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses should be used to direct flushing water from the main into suitable drainage channels or sewers. The Contractor is to coordinate with the Inspector before flushing.

- 3.4.2. **Operation of Valves.** No valve in the distribution system is to be operated by the Contractor without prior permission of the Inspector. The Contractor must notify the Inspector when a valve is to be operated and must only operate the valve in the presence of the Inspector.
- 3.4.3. **Hydrostatic Tests.** After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a hydrostatic pressure followed by a leakage test will be performed. Except in the high pressure sections of the water distribution system (Pressure Zones 9-16) where test pressures will exceed 150 psi, all new mains must be hydrostatically field tested at a maximum test pressure of 150 psi before acceptance by the Engineer or Inspector. Where designated as "High Pressure Area," all new mains must be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance by the Engineer or Inspector. It is the intent of these Specifications that all joints be watertight and that all joints which are found to leak by observation during any test must be made watertight by the Contractor. When repairs are required, the hydrostatic field test must be repeated until the pipe installation conforms to the specified requirements and is acceptable to the Engineer/Inspector. The Contractor must insure that the Engineer/Inspector be present for the duration of the pressure test.
- 3.4.4. **Test Procedures.** After the new main has been laid and backfilled as specified, but before chlorination and replacement of pavement, it is to be filled with water for a minimum of 24 hours and then subjected to a hydrostatic pressure test.

The specified test pressure is to be supplied by means of a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters are to be furnished by the Contractor. Unless otherwise specified, the Water System Company will furnish water for filling lines and making tests through existing mains. Before applying the specified test pressure, all air is to be expelled from the main. To accomplish this, taps are to be made, if necessary, at the points of highest elevation and afterwards tightly plugged at no cost to the Department. At intervals during the test, the entire route of the new main is to be inspected to locate any leaks or breaks. If any are found, they are to be stopped or repaired. The test is to be repeated until satisfactory results are obtained. The hydrostatic test is to be made so that the maximum pressure at the lowest point does not exceed the specified test pressure.

The duration of each pressure test is to be a minimum of 4 hours for new mains in excess of 1,000-ft. and a minimum of 1 hour for new mains less than 1,000-ft after the main has been brought up to test pressure. The test pressure is to be measured by means of a tested and properly calibrated pressure gauge acceptable to Engineer. All pressure tests are to be continued until the Engineer is satisfied that the new main meets the requirements of these specifications.

Should any test of pipe in place disclose leakage greater than listed in Table 15 and 16, Hydrostatic Test Leakage Allowances, the Contractor is to, at his expense, locate and repair the defective joints until the leakage is within the specified allowance. Leakage is defined as the quantity of water supplied into the newly laid main, or any valve section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled. The Contractor is to notify the Engineer before beginning the test, and the Water System Company's Inspector is to be present during the pressure test.

PVC pipe leakage allowances must conform to DI leakage allowances listed on Tables 27 and 28, Hydrostatic Test Leakage Allowances.

4.33. Table 15 - Hydrostatic Test Leakage Allowance (Max) @ 150 psi

4.34. Nominal Diameter and Pipe Material	4.35. Allowable Leakage in Gallons per Hour (gph) **													
	4.36. 00 LF	4.37. 00 LF	4.38. 00 LF	4.39. 00 LF	4.40. 00 LF	4.41. 00 LF	4.42. 00 LF	4.43. 00 LF	4.44. 00 LF	4.45. 000 LF	4.46. 000 LF	4.47. 000 LF	4.48. 000 LF	4.49. 000 LF
6" DI*	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	2.20	3.30	4.40	5.50
8" DI*	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47	2.94	4.41	5.88	7.35
12" DI*	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	4.40	6.60	8.80	11.00
16" DI*	0.29	0.59	0.88	1.18	1.47	1.76	2.06	2.35	2.65	2.94	5.88	8.82	11.76	14.70
20" DI*	0.39	0.74	1.10	1.47	1.84	2.21	2.55	2.94	3.31	3.68	7.63	11.04	14.72	18.40
20" CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79	1.58	2.37	3.16	3.95
24" DI*	0.44	0.88	1.32	1.76	2.21	2.65	3.09	3.53	3.97	4.41	8.82	13.23	17.64	22.05
24" CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95	1.90	2.85	3.80	4.75
30" DI*	0.55	1.10	1.66	2.21	2.76	3.31	3.86	4.42	4.97	5.52	11.04	16.56	22.08	27.60
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18	2.36	3.54	4.72	5.90
36" DI*	0.66	1.32	1.99	2.65	3.31	3.97	4.63	5.30	5.96	6.62	13.24	19.86	26.48	33.10
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42	2.84	4.26	5.68	7.10
42" DI*	0.77	1.54	2.32	3.09	3.86	4.63	5.40	6.18	6.95	7.72	15.44	22.16	30.88	38.60
42" CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66	3.32	4.98	6.64	8.30
48" DI*	0.88	1.77	2.65	3.53	4.42	5.30	6.18	7.06	7.95	8.83	17.66	26.16	35.32	44.15
48" CSC	0.19	0.38	0.57	0.76	0.95	1.13	1.32	1.51	1.70	1.89	3.78	4.98	6.64	8.30
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89					
60" CSC	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16					

* PVC pipe must be tested to DI pressures. DI Pipe includes mechanical and push-on joints.

** GPH for CSC Pipe are manufacturer's maximum.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

4.50. Table 16 - Hydrostatic Test Leakage Allowances (Max) @ 200 psi										
4.51. Nominal Diameter and Pipe Material	4.52. Allowable Leakage in Gallons Per Hour (gph) **									
	4.53. 1 00 LF	4.54. 2 00 LF	4.55. 3 00 LF	4.56. 4 00 LF	4.57. 5 00 LF	4.58. 6 00 LF	4.59. 7 00 LF	4.60. 8 00 LF	4.61. 9 00 LF	4.62. 1 000 LF
6" DI*	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8" DI*	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12" DI*	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.30	2.55
16" DI*	0.34	0.68	1.02	1.36	1.70	2.04	2.38	2.72	3.06	3.40
20" DI*	0.43	0.85	1.28	1.70	2.13	2.55	2.98	3.40	3.83	4.25
20" CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79
24" DI*	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.10
24" CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95
30" DI*	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.73	6.37
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18
36" DI*	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42
42" DI*	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
42" CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66
48" DI*	1.02	2.04	3.06	4.08	5.10	6.11	7.13	8.15	9.17	10.19
48" CSC	0.19	0.38	0.70	0.76	0.95	1.13	1.32	1.51	1.70	1.89
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
60" CSC	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30

* PVC pipe must be tested to DI pressures. DI Pipe includes mechanical and push-on joints.

** GPH for CSC Pipe are manufacturer's maximum.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

- 3.5. **Disinfection of New Mains Utilizing Machine Chlorination.** After the new mains have successfully passed the pressure test specified in Section 3.4.3, "Hydrostatic Tests", the San Antonio Water System will disinfect those mains shown on the plans or otherwise indicated as "Machine Chlorination". This disinfection is to include chlorination, flushing, and placing the mains in service. All other disinfection requirements must be accomplished by the Contractor. Disinfection by the Contractor is limited to sections of pipe less than 800-ft. in length between sections.
- 3.5.1. **Operation of Valves.** During and after disinfection of mains less than or equal to 16-in. in diameter, the Contractor must be notified by the Inspector sufficiently in advance (2 work days) to enable the Contractor to have a competent representative present whenever valves are to be operated that will affect the pressure in any part of the work for which the Contractor is responsible.
- 3.5.2. **Contractor's Personnel and Equipment.** The Contractor is to supply labor and equipment necessary to make all excavations required for chlorination, equipment connections, subsequent flushing, and placing the mains in service.
- 3.5.3. **Safeguarding and Backfilling Open Holes.** The Contractor is to be responsible for safeguarding any open holes excavated or left open for flushing and disinfection purposes. Following completion of disinfection, the Contractor is to backfill such holes in accordance with appropriate provisions of Section 3.3, "Backfill".
- 3.5.4. **Disinfection of Mains Utilizing Dry Calcium Hypochlorite.** Mains are to be disinfected with dry Calcium Hypochlorite (HTH) where shown on the plans or as directed and must not exceed a total length of 800-ft. This method will also be followed for main repairs. Contractor must use appropriate safety measures to protect personnel during disinfection operation.
- 3.5.5. **Dosage.** The Contractor is to disinfect the new or replaced mains with Calcium Hypochlorite (HTH) of 70% available chlorine. Sufficient Calcium Hypochlorite (HTH) is to be used to obtain a minimum chlorine concentration of 50 ppm. The following Table 17, Chlorine Dosage, is included for the convenience of the Contractor:

4.63. Table 17 - Chlorine Dosage	
4.64. Diameter of Pipe 4.65. In.	4.66. Oz./Ft. 4.67. To Obtain 50 ppm Chlorine 4.68. Dosage
6	0.0138
8	0.0233
10	0.0364
12	0.0523
14	0.0708
16	0.0934
18	0.1175
20	0.1455
24	0.2080
30	0.3270
36	0.4690
42	0.6370
48	0.8330
54	1.0575
60	1.308

A heaping tablespoon holds approximately 1/2 oz., and a standard measuring cup holds approximately 8 oz.

3.5.6. **Filling the Main.** Those sections of main to which dry Calcium Hypochlorite (HTH) has been applied is to be filled slowly to allow for the even distribution of the disinfecting material. The manipulation of valves is to be under the direction of the Engineer in accordance with Section 3.5.1, "Operation of Valves".

3.5.7. **Holding Time.** The length of time that sections of main disinfected with Calcium Hypochlorite (HTH) is to be allowed to stand undisturbed will depend upon the particular job and Texas Commission on Environmental Quality (TCEQ) criteria.

When circumstances permit a shutdown with no customers out of service, the required minimum detention time will be 24 hours with a 50 ppm chlorine dosage.

When customers are out of service during a shutdown with no leakage past valves, the required minimum detention time will be 3 hours and the chlorine dosage will be 300 ppm.

When customers are out of service during a shutdown with some leakage past valves, the required minimum detention time will be 30 minutes with a 500 ppm chlorine dosage.

- 3.5.8. **Flushing.** Following the expiration of the specified holding time, the treated section of main is to be flushed thoroughly by the Contractor in accordance with the applicable provisions of Section 3.4, "Flushing and Testing Mains". Flushing is to continue until no chlorine remains detectable by taste or odor or until the chlorine residual is less than 0.3 ppm. The Contractor must make provisions for the disposal and runoff of the flushing operations to minimize erosion or impact to residents.
- 3.5.9. **Preventing Reverse Flow.** Valves are to be manipulated so that the strong chlorine solution in the line being treated will be flushed out of the main and will not flow back into the line supplying the water.
- 3.5.10. **Supervision.** All disinfection is to be done as is done under the general supervision of the San Antonio Water System.
- 3.5.11. **Additional Treatment.** Should the new main fail to meet minimum public health standards for bacteriological quality after flushing, further treatment is to be as directed. If further disinfection is required, chlorination is to be done in accordance with Section 3.5, "Disinfection of New Mains Utilizing Machine Chlorination". In no case, however, is the new line to be acceptable as complete and satisfactory until the bacteriological quality of the water taken from the main meets the Standards of the TCEQ.

If an open hole is unsafe and does not have proper trench protection, owner's chlorination crew will not chlorinate project until acceptable trench protection is provided.

- 3.6. **Service Supply Lines.** Service supply lines and fittings, meter boxes and appurtenances must conform to material specifications and must be installed by the Contractor as specified herein, or as directed by the Engineer and in accordance with plans. Service supply lines in High Pressure Zones should be installed with two strap service saddle clamps.
- 3.6.1. **Designation of Service Supply Lines.** A service supply line located between the Water main and the inlet side of the water meter is designated as a "water service line". A service supply line located between the outlet side of the water meter to the point of connection within the limits of the Customer's lot or property is designated as "Customer's yard piping". Services 2-in. and smaller are designated "small services"; services 4-in. and larger are designated "large services".

Service Relays: New transfer main(s) to which services are to be relayed and are on the same side of the streets as the Customer's meter are defined as "short relays". New transfer main(s) to which services are to be relayed and are on the opposite side of the street from the Customer's meter are defined as "long relays".

Service Reconnects: New transfer main(s) to which services are to be reconnected and on the same side of the street as the old main are defined as "service reconnects". Existing services on the opposite side of the street to the new main will be defined as a "long reconnects".

Service Relocates: Service Relocates are defined as services that are relocated from an alley to a side or front street. New transfer main(s) to which services are to be relocated and are on the same side of the street as the Customer's new meter box location, are designated as "short relocates". New transfer main(s) to which services are to be relocated and are on the opposite side of the street from the Customer's new meter box location, are designated as "long relocates".

New Services: If a new main is required to be extended to provide water service for new Customers, the service lines laid to the new main will be designated as "new services." New laid main(s) to which new services are on the same side of the street as the Customer's new meter box location, are designated as "new short services." New laid main(s) to which new services on the opposite side of the street from the Customer's new meter box location, are designated as "new long services."

New Un-metered Services: New Un-metered services are defined as services that are installed on existing mains or new mains to provide service to Customers platted vacant lots. Where the new main or existing main to which new un-metered services are being installed is on the same side of the street as the Customer's new or existing meter box location, (Inspector to set location of new meter box if no existing

meter box is set), the services to be laid are designated "new un-metered short services." Where the new main or the existing water main to which new un-metered services are installed is on the opposite side of the street from the Customer's new or existing meter box location, (Inspector to set location of new meter box if no existing meter box is set), the services to be laid are designated "new un-metered long service". New un-metered long services and new un-metered short services will not include "Customer's yard piping" and no meter will be set.

Tap Holes: Tap holes are defined as excavations at existing mains, which are required in association with replacements of water service lines by pulling, boring or jacking operations.

All backfill material will be as specified for main and service line trench excavation.

For service lines and tap holes, payment for bedding, initial backfill and secondary backfill will be included in the various sizes of each service placed.

Service Line Installation: Unless otherwise notified, service relays, service reconnects, service relocates and new services will be installed as described herein, and in plans. Unless otherwise indicated, existing meter and meter box relocation will be included in the service line installation.

All service line installation will include a dielectric union to be installed within the meter box on the outlet side of the meter, as shown in plans.

Cutting, excavation, backfill and replacement of pavement will be done as specified herein and in accordance with applicable sections of this specification and the contract documents. The minimum trench width for small service lines will be 8-in., while the minimum trench width for large service Lines will be the nominal pipe diameter plus 16-in., except when specified otherwise by the Engineer. For 3/4-in. to 2-in. Service lines, minimum bury depth will be 3 ft. For services greater than 2-in., minimum depth of bury will be 4 ft.

All service lines should be installed in accordance with plans, and specifications, except that two strap service saddle clamps must be installed for all tap connections made on water mains located within boundaries of Pressure Zones (formally known as Service Levels) 9 through 16.

The Contractor must use precaution to protect and preserve the polyethylene wrap around Ductile-Iron (DI) water mains when installing service corporations. The required method is, wrap pipe tape around the pipe, over the polywrap, in the area to be tapped. The tap should be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, corporation and the first 3-ft. of the service, must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of 8-in. above the main.

Small service lines must be embedded in sand in accordance with specification

When approved by the Construction Inspector, the Contractor may lay the new service line from the corporation stop to the curb stop or angle valve. Upon completion, the Contractor must isolate the new service line by closing the curb stop or angle valve until the meter box is set.

Splicing: A long service line single splice may be permitted by means of a 3-part compression or flared coupling only when approved in advance by the Engineer, provided the location of the splice is not under pavement or concrete. The segment added is required to be the same material as the existing service line, unless otherwise directed by the Engineer. Splicing short service lines will not be permitted.

Boring or Jacking Service Lines: Service lines which cross paved streets may be installed at the Contractor's option by boring or jacking operations. Where it becomes necessary to widen the main trench section to accommodate a bore pit, such widening must not extend more than 1 additional ft. into the traffic side of the street.

Tapping Asbestos Cement (AC) Water Mains: All necessary service line tapping of AC pipe must be completed during the period immediately before or after hydrostatic pressure testing operations so that subsequent flushing will maximize the elimination of contaminants associated with the tapping process. Direct tapping will not be allowed. Service saddles must be used when tapping AC pipe. Drill tools should be used for services less than 2-in. Shell type drills should be used for all services 2-in. and greater.

Tapping of AC pipe must be done in accordance with manufacturers' recommendation and done only with tap machine with a built in flush valve and the flush valve must be open during the entire procedure.

Abandonment of Service Lines: The Contractor should accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those abandoned, including service lines designated on the plans as "tap plug" and "tap kill." The corporation stop for an abandoned service line tapped on a ferrous main must be removed, and the tap at the main must be plugged with an appropriately sized brass plug. For a non-ferrous main, the corporation stop must not be removed from the main. Instead, the corporation stop must be closed and the flared nut should be removed from the corporation stop. After the appropriately sized copper disc is inserted inside the flared nut, replace the flared nut on the corporation stop. The Contractor should salvage copper service line tubing, brass fittings, and other materials as directed by the Inspector and return them to the Owner.

Tapping PVC C-900: Tapping of PVC must be done in accordance with Uni-Bell procedures. Direct Tapping will not be allowed. All drill cutting tools must be the "shell type" with internal teeth or double slots which will retain the coupon. The shell cutters must be designed for C-900 pipe, thus having enough root depth to handle the heavier walled pipe.

Small Service Lines: Copper tubing should be used for 3/4-in. through 2-in. service lines. Brass fittings for 3/4-in. and 1-in. service lines should be of the flared or compression type for the use with Type 'K' soft annealed copper tubing. Brass fittings for 1.5-in. and 2-in. lines should be of the flared or compression type for use with Type 'K' soft annealed copper tubing, except as modified by this specification.

Copper tubing must be cut squarely by using an approved cutting tool and by avoiding excessive pressure on the cutting wheels which might bend or flatten the pipe walls. Following the copper tubing cut, but before flaring, a reamer should be used to remove the inside rolled lip from the tubing. Flared ends should be expanded by the use of a flaring tool using care to avoid splitting, crimping, or overstressing the metal. Pipe adjacent to the fittings must be straight for at least 10 in. Bending of tubing should be accomplished by using an appropriate sized bending tool. No kinks, dents, flats, or crimps will be permitted, and should such occur, the damaged section should be cut out and replaced. When compression fittings are used, the copper tubing should be cut squarely before insertion into the fitting. Final assembly must be in accordance with the manufacturers' recommendations.

Small Service Lines on New Mains: Installation of new copper service lines will consist of all excavation through miscellaneous material encountered; trench excavation protection; drilling and tapping the new main with an approved tapping machine; setting the curb stop or angle valve at the meter; laying the new copper service line at the specified depth between the main and the meter and its tie-in at the corporation and the curb stop or the angle valve; relocating the existing meter and installing a new meter box where required in accordance with this specification, herein; backfilling the trench with approved selected material and disposal of surplus excavated material; capping the tap hole with asphalt treated base, including the outer limits of the main trench line with service line trench; cutting and replacing pavements, curbing and sidewalks of all types over the limits of the main line trench and the completed service line trench.

Reconnecting Service Lines: Both old and new water mains at existing service line connections as shown on the plans must be exposed. The old main must be exposed for the purpose of gaining access to the existing service corporation stop and the new main for the purpose of installing the new corporation stop. The new main must be exposed for the purpose of being drilled and tapped with an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose enough length of the existing service line to provide slack to bend it to position for tying to the new corporation stop. After suitable notification to the Customer, the Contractor should "kill" the existing service by closing the corporation stop, removing the existing flare nut, inserting the existing flared nut on the corporation stop if the

main is non-ferrous, or plugging the existing service line at the main if the main is ferrous. The Contractor must then immediately open the stop and restore water service to the Customer. Where it is not possible to obtain enough length in the existing service to tie directly to the new main, at the direction of the Engineer, the Contractor must splice the necessary length of new tubing and tie it to the existing service by means of a compression coupling at a point as close as practicable to the new main.

Cutting and bending of the tubing, introduction of slack to compensate for soil movement, and completion of the installation will be as specified herein.

Where old and new mains are on opposite sides of the street, service lines may be installed under the street pavement by boring rather than trenching.

Relaying Service Lines: The existing or new mains shown on plans must be exposed opposite location stakes placed on site at the direction of the Engineer. The existing or new main should be drilled and tapped with an approved tapping machine, a new corporation stop installed, and the trench extended laterally to the location specified for the meter box. The existing meter must be reset and the meter box and base must be installed at its staked location and perpendicular to the corporation stop in the water main. The meter box location should not vary more than 24 in. in any direction from its staked location. The service line must be installed with enough slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line should be extended from the main to the existing meter, a new curb stop installed at the end of the service line, and connected to the inlet side of the meter. If disturbed, the existing meter box must be reset to correct grade. Long service relays may be placed under the street pavement by boring or jacking rather than trenching.

Single Service Line - Dual Meters: The single service line - dual meter installation will consist of a 1-in. copper service line reducing to two 3/4-in. copper service lines at a tee which should be set in line with the front edge of meter boxes for 5/8-in. and 3/4-in. meters. A single service line with dual meters should be installed in those new residential developments where new 5/8-in. and 3/4-in. meters are required and in main replacement work where it is necessary to change the location of existing 5/8-in. and 3/4-in. meters. Single service line - dual meter materials and installation requirements must conform to requirements established herein.

Small Service Lines on Existing Mains: The work involved in the installation of new copper service lines on existing mains will consist of jacking, boring, tunneling, and, where authorized, open trench operations all excavation through whatever material encountered; trench excavation protection; using the existing corporation when approved by the Engineer; tapping the existing main and installing the new corporation and setting the curb stop or angle valve at the meter; relocating the existing meter and installing a new meter box where required in accordance with this specification; abandoning the existing corporation stop, removing the existing flared nut, inserting inside the existing flared nut an appropriately sized copper disc and replacing the existing flared nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous; installing the new service line at the same grade as the existing service line or at the specified grade between the main and the existing meter and its tie-in at the corporation and the curb stop; disposal of surplus excavated material; capping the tap hole with asphalt treated base including the outer limits of the main line trench and the service line trench; cutting and replacing all surfaces of whatever type encountered over the completed service line trench; restoration of the site.

Large Service Lines: DI pipe and cast-iron fittings used for metered service lines and non-metered fire service lines larger than 2-in. must be installed in accordance with the applicable provisions of this specification, except where otherwise approved by the Engineer.

Large Service Lines on New Mains: Work involved in the installation of a new metered service lines and non-metered fire service lines will consist of all excavation through whatever material encountered; trench excavation protection, installing tees, pipe and fittings of various sizes including main line and service line valves, valve boxes, DI pipe, fittings, in accordance with plans and reaction block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

Large Service Lines on Existing Mains: The work involved in the installation of the new metered service lines and non-metered fire service lines will consist of all excavation through whatever material encountered, trench excavation protection, cutting-in tees and installing tapping sleeves and valves, pipe and fittings of various sizes including main line and service valves; valves boxes, DI pipe, fittings and reaction block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

- 3.6.2. **Meter Boxes.** Physical movement of existing meters and meter boxes to new locations may be required where service lines are transferred to new mains in conjunction with main replacement work. Unless specified otherwise, the Contractor should move existing meters and meter boxes and reconnect and adjust customer's yard piping as part of transferring service lines. A dielectric coupling PVC Schedule 80 must be installed within the meter box between the meter and the customer's yard piping.

Round and oval meter boxes with round covers should be salvaged and returned to the Owner by the Contractor. The Contractor must also replace the salvaged meter boxes with the new, appropriately styled oval plastic meter box with oval cover, or rectangular meter box. Unless otherwise specified, the old service line should be abandoned after the existing meter has been reset in the existing or new meter box.

Where meter boxes are installed in sidewalks or driveways, the Contractor should install a number one meter box (2 pieces) as shown on plans.

New meters will be set by the Owner where mains are extended and new services lines are installed for new or initial customer service. Instead of the new meter, the Contractor should furnish and install a meter template in accordance with plans.

Meter and meter box configuration should have the meter set horizontal, approximately 6 in. below the top of meter box, so that the meter is above the bottom of the meter box and in line with the meter box lid opening. The top of the meter box should be flush with the existing ground surface. All excess soil above the meter coupling, meter flange and meter nuts inside the meter box should be removed so that the meter register is clearly visible. The Contractor must exercise special precautions during excavation at the existing meter location to minimize the disturbance of the customer's yard piping. However, if the existing meter elevation is low, the Contractor must raise the existing meter to conform to the correct configuration indicated herein. Adjustment of meter to proper grade is incidental to the construction and will not be paid for separately.

Where required, pressure reducing valves should be installed by the customer in accordance with the Uniform Plumbing Code and must be placed beyond the outlet side of the meter, but not within the Owner's meter box. The pressure reducing valve will be the property of the water user who will be responsible for its installation, maintenance, and replacement as required.

The meter box adjustment must not exceed 10 ft. from the existing box.

- 3.6.3. **Water Service for Fire Lines.**

Start of Work. Three working days' notice will be given to the assigned Inspector before start of a project after permit has been issued. The Contractor must start his work at a tie-in or point designated by the Engineer. Pipe must be laid with bell ends facing in the direction of laying, unless otherwise authorized or directed by the Engineer. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe must be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations. Spigots must be centered in bells or collars, all valves and hydrant stems must be set plumb, and fire hydrant nozzles must face as shown on the plans or as directed. No valve or other control on the existing system should be operated for any purpose by the Contractor unless a representative of the San Antonio Water System is present.

Crossing Other Underground Lines. New fire line services crossing any other utilities must have a minimum of 48 in. of cover over the top of the pipe unless otherwise waived or modified by the Engineer. Excavation around other utilities must be done by hand for at least 12 in. all around. Any damage to other utilities must be reported to the governing entity/owner of said utility as well as the Inspector.

Pipe Grade. Fire line services must have a minimum of 48 in. of cover for mains 16-in. and below, and 60-in. for mains 20" and above, over the top of the pipe unless otherwise waived or modified by the Engineer. Pipe grades must be as required by the plans or as directed. Grades must be met as specified. Precautions must be taken to ensure that the pipe barrel has uniform contact with the Modified Grade 5 for its full length except at couplings. Couplings should not be in contact with the original trench bottom before backfilling. Modified Grade 5 material should be placed under the coupling and compacted by hand before backfilling so as to provide an even bearing surface under the coupling and pipe. Changes in grade should be made only at joints.

Modified Grade 5 Materials. Before placing pipe in a trench, the trench should have been excavated to the proper depth as required herein. Approved imported materials or Engineer approved materials selected from suitable fines derived from the excavation should be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

Structures to Support Pipe. When either the Inspector or Engineer note that the material at the bottom of a trench is unstable or unsuitable, and conditions are such that the existing material cannot be reworked to make it stable then the trench subgrade should be over-excavated, with approved material, and properly compacted in place to provide a suitable base to support the pipe. If it is determined by the Engineer that this method cannot be used to stabilize the trench subgrade, the Contractor should then construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer. Extra compensation will be allowed for the Contractor for the additional work done. Coordinate with Engineer for approval of extra compensation before beginning work.

Lowering Materials into Trench. Proper implements, tools, and facilities satisfactory to the Engineer must be provided and used by the Contractor for the safe and convenient completion of work. All pipe, fittings, valves, and hydrants must be carefully lowered into the trench piece by piece, by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to water service materials and protective coatings and linings. Under no circumstances should water service materials, pipes, fittings, etc., be dropped or dumped into the trench. Extreme care must be taken to avoid damaging polywrap films. No chains or slings should be allowed unless the entire sling is wrapped with a protective nylon web sock.

Laying of Pipe. Every precaution must be taken to prevent foreign material from entering the pipe during its installation. Under adverse trench conditions, work stoppage for more than 24 hours or as otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign material from entering the pipe. The cap/plug must be left in place until a connection is made to the adjacent pipe. The interior of each pipe must be inspected for foreign material or defects, and the pipe must be cleaned or rejected if any foreign debris or defects are found, respectively.

After placing a length of pipe in the trench, the jointed end should be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with the requirements herein. The pipe should be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow a sufficient and uniform space for joints will be rejected by the Engineer or Inspector and must be replaced with pipe and fittings of proper dimensions. Precautions must be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is halted, the open end of pipe in the trench must be closed by a watertight plug or other means approved by the Engineer. Pipe in the trench which cannot temporarily be joined must be capped or plugged at each end to make it watertight. This provision will apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal must remain in place until the trench is pumped completely dry. The Contractor must provide all plugs and caps of the various sizes required.

Deviations in Line or Grade. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to an extent that an alteration in the plan is required, the Construction Inspector will have the authority to change the plans and direct a deviation from the line and grade or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstructions. Any deviation from the line should be accomplished by the use of appropriate bends unless such

requirement is specifically waived by the Construction Inspector. These deviations must be clearly and accurately reflected in the Contractor's submittal of redline drawings for permanent recording purposes.

Whenever it is necessary to deflect pipe from a straight line, the deflection must be as directed by the Construction Inspector and as described herein. In no case should the amounts exceed those shown in Table 18 "Maximum Deflections of Ductile-Iron Pipe" for ductile-iron pipe

Table 18 - Max Deflections of Ductile-Iron Pipe					
Nominal Pipe Diameter	Max Deflection Angle	Max Deflection in In.		Approximate Radius of Curve in Ft.	
		18 Ft.	20 Ft.	18 Ft.	20 Ft.
6"	4°25'	16.7	18.5	234	260
8"	3°51'	14.6	16.2	268	297
10"	3°42'	14.0	15.5	279	310
12"	3°08'	11.9	13.2	327	363
16"	2°21'	8.8	9.7	440	488
20"	1°55'	7.2	8.0	540	600
	1°35'	6.0	6.7	648	720

Cutting Pipe. The cutting of pipe for inserting valves, fittings, or closure pieces must be accomplished in a neat manner so as to produce a smooth end at right angles to the axis of the pipe. The recommendations of the pipe manufacturer should be strictly followed by the Contractor. Only qualified and experienced workmen must be used and, under no circumstances, should a workman not equipped with proper safety goggles, helmet and all other required safety attire be permitted to engage in this work.

Asbestos-Cement (AC). No field cutting, breaking, or crushing will be allowed on AC pipe. Installation of fire line services to AC pipe mains must be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC or Ductile Iron pipe and fittings.

All cuts made on ductile-iron pipe must be done with a power saw. The cuts should be made at right angles to the pipe axis and must be smooth. The edges of the cut must be finished smoothly with a hand or machine tool to remove all rough edges. The outside edge of pipe should be finished with a small taper at an angle of about 30°. Solid sleeves or cast couplings must be allowed on precast/prefab vaults only. All other fire line services should be installed with full joints of pipe.

To facilitate future repair work on water mains, no sections less than 3-ft. in length between fittings will be allowed.

Joint Assembly.

Rubber Ring Joints: The installation of pipe and the assembly of rubber ring joints for Ductile-Iron pipe must conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as "stabbing" will not be permitted. Spigot ends of pipe must be properly inserted in the joint by means of suitable pushing/pulling devices or a manufacture approved method.

Mechanical Couplings: Mechanical couplings must be assembled and installed according to the standards recommended by the manufacturer.

Mechanical coupling consists of a cylindrical steel middle ring, two steel follower rings, two rubber compound gaskets, and a set of steel bolts. The middle ring is flared at each end to receive the wedge-shaped gasket which is compressed between the middle ring flare and the outer surface of the pipe by pressure exerted on the follower rings through the bolt circle.

Before the installation of the mechanical coupling, the pipe ends must be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe must be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts should be drawn up finger tight. Uniform pressure on the gaskets should be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Soap and final tensioning should be accomplished with a torque wrench and in a matter similar to the tightening procedure after 15 minutes.

Restrained Joints: Restrained Joints should be installed as shown on the plans or as directed by the Construction Inspector. Installation must conform to the manufacture's recommendations.

3.7. **Installation of the Nonmetallic Pipe Detection System.** The nonmetallic pipe detection system is to be installed concurrently with the proposed pipe placement. Tracer wire will be used for location purposes and taped directly to the pipe. The tracer wire must be solid core (14 gauge insulated) and should be taped to the main in 10-in. increments. Wire should also come up to the top of valve extensions and fire hydrant stems, as directed by the Inspector.

3.8. **High Pressure Zone.** Work performed for construction of a high pressure water distribution system, including water mains, services, fire hydrants, and all related appurtenances, is to be done in accordance with this specification. This Section applies solely to the construction of high pressure water systems and will govern when in conflict with of sections of this specification.

High Pressure Systems. Each water distribution system that furnishes water in Pressure Zone 9 through Pressure Zone 16 will be designated as a high pressure system. The static water pressure in each in each Service Level must be not less than 35 psi nor exceed 175 psi with no fire hydrants in use.

Locations of High Pressure Levels. Geographically, boundaries of Pressure Zones 9 through 16 conform to the surface contour tabulation shown in Table 19, High Pressure Levels. Most of the area within Pressure Zones 9 through 16 is located north of Loop 1604 between IH-35 North and Bandera Road.

Static Gradient Service Level	Max Ground Elevation (ft.)	Ground Elevation (ft.)	Ground Elevation 110 psi (ft.)	Ground Elevation 150 psi (ft.)	Ground Elevation 175 psi (ft.)
9	1,125	1,000	870	780	720
10	1,290	1,160	1,040	940	880
11	1,400	1,270	1,150	1,050	1,000
12	1,520	1,390	1,270	1,170	1,120
14	1,630	1,500	1,380	1,280	1,230
15	1,860	1,730	1,600	1,510	1,460
16	1,990	1,860	1,740	1,640	1,590

3.9. **Recycled Water System.** The installation of any recycle water system components will be done in accordance with these Specifications, except as otherwise noted. Recycled Water mains must also be installed at the TCEQ required separation distance between sewer and water mains as required by Texas Administrative Code (TAC) rules to include: The latest provision of 30 TAC § chapters 210, 290, and 217, or most applicable approved equal provision.

3.10. **Grouting of Water Mains.** Abandoning and grouting of water lines must not occur until all existing water mains and services have been transferred to a relocated water line or another line as designated in the Contract Documents. The Contractor will be responsible for the satisfactory coordination of the pipe abandonments with other construction and activities in the area. Delays in work resulting from lack of coordination will not be cause for additional compensation. Any work involving or impacting asbestos concrete pipe must be in accordance with the specifications.

Remove all water line appurtenances, such as hydrants, valves and valve casing and castings. Return these appurtenances to the designated utility representative or dispose of properly. Make cuts, install bulkheads, vents to allow for air release. Remove any free standing water before starting grout placement.

Place grout/flowable fill using concrete or grout pumps capable of continuous delivery at planned placement rate to fill volume between placement points not to exceed 500 ft. at a time. Pump grout/flowable fill through bulkheads constructed for placement of PVC pipes or other methods to contain grout in line to be abandoned. These pipes will be used for injection points or vents during placement. Place grout/flowable fill under pressure into properly vented open system until grout emerges from vent pipes indicating pipe is completely filled. Pumping must be completed under enough pressure to overcome friction and to fill water main from downstream to upstream end. Remediate areas where grout/flowable fill did not fill voids in water main by pressure grouting from inside water main or from surface if necessary. Plug each end of the water main being abandoned. Ensure that concrete is placed around plug/bulkhead and around pipe including bedding area, such that it is not penetrable by groundwater and that bedding at this location is not a conduit for groundwater. The method of installation must be able to meet the requirement of completely filling the existing water main and any voids adjacent to it.

Backfill to grade above pipe left in place. Place and compact backfill in compliance with Section 3.3 "Backfill".

Remove, transport, and, dispose of spoils. Spoils including pipe, unused grout/flowable fill and other unsuitable materials must be hauled to a facility permitted to accept the material. The abandonment method should provide for the release of air. When intermediate points are required to be constructed for the abandonment of the system, they will be a part of the abandonment project process. The method should provide for the isolation of water mains to be grouted from water mains that are abandoned in place without grouting as shown on the plans.

Water mains that are not under proposed pavement are generally not required to be grouted unless it is specified in the contract documents. Mains to be abandoned should be grouted only if required by the contract documents and payment as per these specifications is provided.

- 3.11. **Cutting and Replacing Concrete Sidewalk, Driveway, etc.** The Contractor will cut and replace concrete sidewalks, driveways, etc. per the plans.
- 3.12. **Cutting and Replacing Concrete Sidewalk (Asphalt).** The Contractor will cut and replace concrete asphalt sidewalks per the plans.
- 3.13. **Cutting and Replacing Asphalt Pavement.** The Contractor will cut and replace asphalt pavement per the plans.
- 3.14. **Cutting and Replacing Concrete Curb.** The Contractor will cut and replace concrete curb per the plans.
- 3.15. **Cutting and Replacing Asphalt Pavement with 6-in. Asphalt Treated Base.** The Contractor will cut and replace Asphalt Pavement with 6-in. Asphalt Treated Base, per the plans.

4. MEASUREMENT

- 4.1. Water main installed as: "Pipe Water Main (DI)", "Pipe Water Main (PVC)", "Pipe Water Main (CSC)", "Pipe Water Main (PVC Casing) (Open Cut)", "Pipe Water Main (Steel Casing) (Open Cut)" for water pipe of the various sizes shown on the plans, will be measured by the foot as follows:

From the centerline intersection of runs and branches of tees to the end of the valve of a dead-end run.

Between the centerline intersections of runs and branches of tees, and where the branch is plugged for future connection, the measurement will include the entire laying length of the branch or branches of the fitting.

The measurement of each line of pipe of each size will be continuous and is to include the full laying lengths of all fittings and valves installed between the ends of such line except that the laying lengths of reducers will be divided equally between the connected pipe sizes. Lines leading to a tapping connection with an existing main will be measured to the center of the main tapped.

Excavation and installation of the nonmetallic pipe detection system will not be measured for payment.

- 4.2. "Fire Lines" will be measured by the foot for each size and type from the centerline intersection of the fire line with the main distribution line to the property line. The measurement will include the entire laying length of the branch or branches of the fitting and valves. Line leading to a tapping connection with an existing main will be measured to the center of the main tapped.
- 4.3. "Water (Jacking, Boring or Tunneling)" will be measured by the foot of bore or tunnel as measured from face to face of jacking pits.
- 4.4. Carrier pipe used in bores and tunnels or jacked into place will be measured by the foot of pipe installed from end to end of pipe to the limits shown on the plans.
- 4.5. Carrier pipe installed in open trenches, where required by the plans, will be measured by the foot of pipe installed from end to end of pipe to the limits shown on the plans.
- 4.6. Casing or liners used in bores and tunnels, where required by the plans, of the size and material required will be measured by the foot actually installed in accordance with plans.
- 4.7. Casing installed in open trenches, where required by the plans, of the size and material required will be measured by the foot actually installed in accordance with plans.

- 4.8. "Butterfly Valve and Box (Complete)" will be measured as each assembly of the various sizes installed to finished grade.
- 4.9. "Gate Valve and Box (Complete)" will be measured as each assembly of the various sizes installed to finished grade.
- 4.10. "Tapping Sleeve, Valve and Box (Complete)" will be measured as each assembly of the various sizes installed.
- 4.11. "Cut-in Tee (Complete)" will be measured by the unit of each such assembly of the various sizes of tee installed.
- 4.12. "Adjust Valve Box" will be measured as each assembly adjusted to correspond to finish grade.
- 4.13. "Removal Transport and Disposal of AC" will be measured by the unit linear foot of AC water main removed regardless of size, to the limits shown on the plans. The measurement shown on the plans is for contractor's information only and the work will be performed by a third party contractor as per Item 6 of the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.
- 4.14. "Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars" for pipe will be measured by the cubic yard of accepted work, complete in place. Reinforcing, if required, will not be measured for payment.
- 4.15. "Fire Hydrant Assembly" will be measured as each fire hydrant assembly installed. Also included will be enough pipe, valve, box and fittings.
- 4.16. "Tapped Fire Hydrant" will be measured as each fire hydrant including the various sizes of tapping sleeves, valves, and boxes installed.
- 4.17. "Relocate Fire Hydrant" will be measured as each fire hydrant relocated.
- 4.18. "Permanent Blow-off (Complete)" will be measured as each assembly of the various sizes installed.
- 4.19. "Temporary Blow-off (Complete)" will be measured as each assembly of the various sizes installed.
- 4.20. "Air Release Valve (Complete)" will be measured as each assembly of the size installed.
- 4.21. "Trench Excavation Protection" will be measured by the foot along the centerline of trench where the depth of trench exceeds 5-ft.
- 4.22. "Tie-In (Complete)" will be measured as each of the various sizes and types completed.
- 4.23. "New Short Service" will be measured as each of the various sizes and types of new service lines installed.
- 4.24. "New Long Service" will be measured as each of the various sizes and types of new service lines installed.
- 4.25. "New Unmetered Short Service" will be measured as each of the various sizes and types of new unmetered service lines installed.
- 4.26. "New Unmetered Long Service" will be measured as each of the various sizes and types of new unmetered service lines installed.
- 4.27. "Reconnect Short Service" will be measured as each of the various sizes of service lines reconnected.
- 4.28. "Reconnect Long Service" will be measured as each of the various sizes of service lines reconnected.

- 4.29. "Relay Short Service" will be measured as each of the various sizes of service lines re-laid.
- 4.30. "Relay Long Service" will be measured as each of the various sizes of service lines re-laid.
- 4.31. "Relocate Short Service" will be measured as each of the various sizes of service lines relocated.
- 4.32. "Relocate Long Service" will be measured as each of the various sizes of service lines relocated.
- 4.33. "Relocate Existing Meter and Existing Meter Box" will be measured as each assembly relocated and customer's service reconnected.
- 4.34. "Relocate Existing Meter and New Meter Box" will be measured as each assembly relocated and customer's service reconnected.
- 4.35. "Cut and Replace Concrete Sidewalk, Driveway, Etc." will be measured by the square yard of surface area of the concrete sidewalk and driveway cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.
- 4.36. "Cut and Replace Concrete Sidewalk (Asphalt)" will be measured by the square yard of surface area of concrete sidewalk to be cut and replaced with temporary asphalt (4-in. depth, Type C) pavement, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on the plans.
- 4.37. "Cut and Replace Asphalt Pavement" will be measured by the square yard of surface area of the asphalt pavement cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.
- 4.38. "Concrete Curb" will be measured by the foot of the concrete curb cut and replaced, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.
- 4.39. "Cut and Replace Asphalt Pavement with 6-in. Asphalt Treated Base" will be measured by the square yard of surface area of the asphalt pavement cut and replaced with 6-in. of asphalt treated base, but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on plans.
- 4.40. "Hydrostatic Pressure Test" will be measured as each successful test conducted.
- 4.41. "Flowable Fill Backfill". Will be measured by the cubic yard in accordance with Department Item 401, "Flowable Backfill", but not to exceed the maximum trench width specified in Section 3.1.2, "Width of Trench" or as shown on the plans.
- 4.42. "Water Service Line Breaks Leak Repair" will be measured by the unit of each such assembly of all types and sizes of service lines, repair and tap clamps required to repair the service line break and or leak.
- 4.43. "Water Main Breaks Leak Repair" will be measured by the unit of each such assembly of the various types and sizes of water mains, services, repair and tap clamps required to repair the water main break or leak.
- 4.44. "Ductile Iron and Gray Iron Fittings" will be measured by the weight to the nearest 1/100 of a ton of the various sizes of fittings installed.
- 4.45. "Reinforced Concrete Vault" will be measured by the each of the various sizes.
- 4.46. "Grout Abandonment Water Main" will be measured by the unit foot of main grout abandoned of the various sizes to the limits shown on the plans.
- "Removal Transport and Disposal of AC" will be measured by the unit foot of AC water main removed regardless of size, to the limits shown on the plans. The measurement shown on the plans is for

Contractor's information only and the work will be performed by a third party contractor as per Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

- 4.47. "New Meter Box" will be measured for payment as each new meter box is placed.

5. PAYMENT

The work performed and materials furnished in accordance with each item and measured as provided under "Measurement" will be paid for at the unit prices bid for the items of work hereinafter described. These prices are to be full compensation for furnishing and hauling all materials; for placing or installing the materials; for inspection and testing; and for all other items of material, labor, equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications.

- 5.1. Payment for "Pipe Water Main (DI)", "Pipe Water Main (PVC)", "Pipe Water Main (CSC)", "Pipe Water Main (PVC Casing) (Open Cut)", and "Pipe Water Main (Steel Casing) (Open Cut)" will be made at the unit price bid per foot of pipe of the various sizes installed by the open cut method. This price will be full compensation for all labor, equipment, materials, tools, selected bedding, excavation, backfill materials, polyethylene sleeve, and hauling and disposition of surplus excavated materials.
- 5.2. Payment for "Fire Lines" installed will be made at the unit price bid for pipe of various sizes installed by the open cut method. This price will be full compensation for all labor, equipment, materials, tools, excavating selected embedment material, backfill, compaction of trench backfill, testing of compaction, tie-in, polyethylene sleeve where required, hauling, disposing of surplus excavated material, and restoration of the surface, including asphalt, concrete, curbing, sidewalks, sod grass, landscaping, and any other surface type encountered. All replacement mains will include tie-in costs for existing fire lines.
- 5.3. Payment for "Water (Jacking, Boring or Tunneling)", will be paid for at the contract unit price bid per foot of jacking, boring or tunneling, which price will be full compensation for furnishing all materials (except carrier pipe, casings or liners), casing spacers, grout, labor, tools, equipment and incidentals necessary to complete the work, including excavation, grouting, backfilling, restoration to original ground conditions, end caps, and disposal of surplus materials.
- 5.4. Carrier pipe used in bores or tunnels will be paid for at the contract unit price bid for "Carrier Pipe (in Casing)" per foot which will be full compensation of pipe installed and measured as prescribed above.
- 5.5. Carrier pipe installed in open cut trenches will be paid for at the contract unit price bid for "Carrier Pipe for Open Cut Trench" per foot which will be full compensation of pipe installed and measured as prescribed above.
- 5.6. Casings or liners used in bores or tunnels will be paid for at the contract unit price bid for "Casing (Bore)" per foot which will be full compensation of casing or liner installed and measured as prescribed above.
- 5.7. Casings installed in open cut trenches will be paid for at the contract unit price bid for "Casing (Open Cut)" per foot which will be full compensation of casing installed and measured as prescribed above.
- 5.8. Payment for "Butterfly Valve and Box (Complete)", will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required. Such payment is also to include mechanical or transition couplings, and coated and wrapped steel pipe nipples required to complete the connection.
- 5.9. Payment for "Gate Valve and Box (Complete)" will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment, concrete collar at the valve box where subjected

to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required.

- 5.10. Payment for "Tapping Sleeve and Valve" will be made at the unit price bid for each such assembly of the various sizes installed. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment when specified, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required.
- 5.11. Payment for "Cut-in Tee (Complete)" will be made at the unit price bid for each assembly of the various types and sizes of tees to be installed. This price will be full compensation for all labor, equipment, materials, tools, necessary tie-ins, protective coating for bolts, nuts, ferrous surfaces, selected embedment material, anti-corrosion embedment when specified, backfill, fittings, polyethylene sleeve when required, site restoration, and any necessary hauling and disposition of surplus excavated materials.
- 5.12. Payment for "Adjust Valve Box" will be made at the unit price bid which will be full compensation for each valve box adjusted to finish grade including all labor, materials, and incidentals to complete the work.
- 5.13. Payment for "Removal Transport and Disposal of AC" will be paid to a third party contractor through force account for safely removing, transporting, and disposing of AC pipe.
- 5.14. Payment will be made at the unit price bid for "Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars" by the cubic yard of concrete placed, which price will be full compensation for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work. Reinforcing, if required, will not be measured separately for payment.
- 5.15. Payment for "Fire Hydrant Assembly" will be made at the unit prices bid which will be full compensation for each such assemblies, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal of existing fire hydrant as specified.
- 5.16. Payment for "Tapped Fire Hydrant" will be made at the unit prices bid which will be full compensation for each such assemblies installed, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal of existing fire hydrant as specified. Payment for "Fire Hydrant with Tapping Sleeve, 6-in. Valve and Box" will include tapping sleeve specified on plans and 6-in. valve and box.
- 5.17. Payment for "Relocate Fire Hydrant" will be made at the unit prices bid which will be full compensation for each such assemblies installed, including excavation, backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve, hauling and disposition of excavated surplus material where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites, and removal and relocation of existing fire hydrant as specified.
- 5.18. Payment for "Permanent Blow-off (Complete)" will be made at the unit price bid which will be full compensation for each such assembly installed in accordance with the details shown on the plans. Payment for the eccentric reducer will be made at the unit price bid for each ton of fittings of all types and sizes installed. Payment for the pipe nipple with reaction stop ring will be made at the unit price bid for each foot of pipe of the various sizes installed by the open cut method. These payments are also to include excavation,

anti-corrosion when specified, the housing and disposition surplus excavated materials and approved selected backfill.

- 5.19. Payment for "Temporary Blow-off (Complete)" will be made at the unit price bid which will be full compensation for each such assembly installed in accordance with the details shown on the plans. Payment for the eccentric reducer will be made at the unit price bid for each ton of fittings of all types and sizes installed. Payment for the pipe nipple with reaction stop ring will be made at the unit price bid for each foot of pipe of the various sizes installed by the open cut method. These payments are also to include excavation, anti-corrosion when specified, the housing and disposition surplus excavated materials and approved selected backfill.
- 5.20. Payment for "Air Release Valve (Complete)" will be made at the unit price bid for each assembly of the various sizes installed in accordance with the details shown on the plans. This price will be full compensation for all labor, equipment, materials, tools, selected embedment material, anti-corrosion embedment when specified, excavation and hauling and disposition of surplus excavated materials, blocking and various sizes and types of meter boxes.
- 5.21. Payment for "Trench Excavation Protection" is to be made on the basis of the unit price bid which will be full compensation for each foot of "Trench Excavation Protection" in place. Payment is to include all components of the trench excavation safety protection system which can include, but not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage. Payment is also to include the additional excavation and backfill required, any jacking, jack removal and removal of the trench support after completion and be full compensation for all other labor, materials, tools, equipment and incidentals necessary to complete the work.
- 5.22. Payment for "Tie-In (Complete)" will be made at the unit price bid for each tie-in of the various sizes and types completed. This price will be full compensation for all labor, equipment, materials, tools, shutdown and isolation of the existing main to which the tie is to be made, cutting pipe for connection, de-watering the excavation, and customer notification of service interruption where required. Connections between new and existing mains which are made with tapping sleeves and valves by cutting-in tees will be as a no-separate pay item.
- 5.23. Payment for "New Short Service" will be made at the unit price bid for each new service line of the various sizes and types installed. This payment is to include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and Customer valve. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type fittings of the various sizes used in the service line relay and copper tubing or ductile iron pipe (4-in. and larger).
- 5.24. Payment for "New Long Service" will be made at the unit price bid for each new service line of the various sizes and types installed. This payment is to include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and Customer valve. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type fittings of the various sizes used in the service line relay and copper tubing or ductile iron pipe (4-in. and larger).
- 5.25. Payment for "New Unmetered Short Service" will be made at the unit price bid for each new un-metered service line of the various sizes and types installed. This price will be full compensation for all labor, equipment, materials, tools, excavated materials, trench excavation protection, sand backfill, cutting in pavement and surface structures of whatever type encountered and replacement with whatever type specified, a new meter box where required, copper tubing or ductile iron pipe (4-in. and larger), valve and valve box assembly, and fittings of the various sizes used in the installation of new service lines.
- 5.26. Payment for "New Unmetered Long Service" will be made at the unit price bid for each new un-metered service line of the various sizes and types installed. This price will be full compensation for all labor, equipment, materials, tools, excavated materials, trench excavation protection, sand backfill, cutting in

pavement and surface structures of whatever type encountered and replacement with whatever type specified, a new meter box where required, copper tubing or ductile iron pipe (4-in. and larger), valve and valve box assembly, and fittings of the various sizes used in the installation of new service lines.

- 5.27. Payment for "Reconnect Short Service" will be made at the unit price bid for each service line of the various sizes and types reconnected. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation where required, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, copper tubing or ductile iron pipe (4-in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line reconnection.
- 5.28. Payment for "Reconnect Long Service" will be made at the unit price bid for each service line of the various sizes and types reconnected. This price will be full compensation for all labor, equipment, materials, tools, excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation where required, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, copper tubing or ductile iron pipe (4-in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line reconnection.
- 5.29. Payment for "Relay Short Service" will be made at the unit price bid for each service line of the various sizes and types re-laid. This price will be full compensation for all labor, equipment, materials, tools, reconnection of new service to existing meter, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4-in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line relay.
- 5.30. Payment for "Relay Long Service" will be made at the unit price bid for each service line of the various sizes and types re-laid. This price will be full compensation for all labor, equipment, materials, tools, reconnection of new service to existing meter, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4-in. and larger), valve and valve box assembly, and fittings of the various sizes used in the service line relay.
- 5.31. Payment for "Relocate Short Service" will be made at the unit price bid for each service line of the various sizes relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4-in. and larger) when required, valve and valve box assembly when required, and fittings of the various sizes used in the service line relocation.
- 5.32. Payment for "Relocate Long Service" will be made at the unit price bid for each service line of the various sizes relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, meter box relocation where required, copper tubing or ductile iron pipe (4-in. and larger) when required, valve and valve box assembly when required, and fittings of the various sizes used in the service line relocation.
- 5.33. Payment for "Relocate Existing Meter and Existing Meter Box" will be made at the unit price bid for each assembly relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, removal and replacement of yard piping with piping of the various sizes and types and in the quantities necessary to complete the connection between the relocated existing meter and the existing yard piping.
- Payment for the number one meter box installation in sidewalks and driveways will be paid in the amount difference between the standard meter box and the number one meter box.
- 5.34. Payment for "Relocate Existing Meter and New Meter Box" will be made at the unit price bid for each assembly relocated. This price will be full compensation for all labor, equipment, materials, tools, sand backfill, removal and replacement of yard piping with piping of the various sizes and types and in the quantities necessary to complete the connection between the new meter box and the existing yard piping.

Payment for the number one meter box installation in sidewalks and driveways will be paid in the amount difference between the standard meter box and the number one meter box.

- 5.35. Payment for "Cut and Replace Concrete Sidewalk, Driveway, Etc." will be made at the unit price bid which will be full compensation of concrete sidewalk, driveways, etc. to be removed and replaced.
- 5.36. Payment for "Cut and Replace Concrete Sidewalk (Asphalt)" will be made at the unit price bid which will be full compensation of concrete sidewalk removed and replaced with asphalt.
- 5.37. Payment for "Cut and Replace Asphalt Pavement" will be made at the unit price bid which will be full compensation of asphalt pavement removed and placed.
- 5.38. Payment for "Concrete Curb" will be made at the unit price bid which will be full compensation for concrete curb placed.
- 5.39. Payment for "Cut and Replace Asphalt Pavement with 6-in. Asphalt Treated Base" will be made at the unit price bid which will be full compensation of asphalt and asphalt treated base removed and placed.
- 5.40. Payment for "Hydrostatic Pressure Test" will be made at the unit price bid which will be full compensation for each successful test. Such payment includes all materials and equipment required to conduct test.
- 5.41. Payment for "Flowable Fill Backfill" will be made at the unit price bid, which will be full compensation for each cubic yard of flowable fill placed, but not to exceed the maximum trench width specified in Section 3.1.2. "Width of Trench".
- 5.42. Payment for "Water Service Line Breaks Leak Repair" will be made for if during construction, certain water service lines break or if leaks occur within or immediately adjacent to the Contractor's specified area of construction operations, the Inspector may authorize the replacement or repair to be performed. However, the Contractor is cautioned that no payment will be made by SAWS when particular breaks or leaks are direct results of the Contractor's construction operations. Where encountered, payment to the Contractor for cutting and replacing pavements (any type), curbs, trench protection, sidewalks, and sodding must be considered subsidiary to this item and no direct payment will be made. Such payment must include any necessary hauling and disposition of surplus excavated material, and pumping of water.
- 5.43. Payment for "Water Main Breaks Leak Repair" will be made if during construction, certain water main breaks or if leaks occur within, or immediately adjacent to, the Contractor's specified area of construction operations, the Inspector may authorize the replacement or repair to be performed by the Contractor. The work involved must consist of excavation, hauling of disposition material, dewatering, shut-down and isolation of the existing main if required, installation of the necessary repair clamps and or new water main (length to be determined by the Inspector) to include all necessary tie-ins, fittings, approved reaction blocking required, backfilling the excavation with approved materials; customer notification or service interruption where required. Cutting and replacing pavements (any type), curbs, sidewalks, trench protection, and sodding will be considered subsidiary to the work. However, the Contractor is cautioned that no payment will be made by SAWS when particular breaks or leaks are direct results of the Contractor's construction operations. Where encountered, payment to the Contractor for cutting and replacing pavements (any type), curbs, trench protection, sidewalks, and sodding must be considered subsidiary to this item and no direct payment will be made. Such payment must include any necessary hauling and disposition of surplus excavated material, and pumping of water.
- 5.44. Payment for "Gray Iron Fittings" and "Ductile Iron Fittings" will be made at the unit price bid for each ton of fittings of all sizes and types installed and will be based upon the weights of fittings shown in Table 20, "Weights of Ductile-Iron and Gray Cast-Iron Fittings". This price will be full compensation for all labor, equipment, materials, tools, excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking. If compact fittings

are not manufactured and other fittings are installed, Contractor will provide quantities and unit weights with pay request.

Weigh tables are estimated quantities and can be verified by vender information. Payments will be made by the lesser of the two (weights versus supplier) at the inspector's discretion.

5.45. Payment for "Reinforced Concrete Vault" will be made at the unit price for each size vault installed.

5.46. Payment for "Grout Abandonment Water Main" will be made for all types of pipe abandonment with grout, including asbestos-concrete pipe, and will be paid for at the contract bid price per foot for each size diameter of pipe, irrespective of the depth of the main, which will include the cost of removing content within the pipe, cleaning, grouting, plugging, capping and abandoning all pipe, pipe bend section and all other appurtenances, and for dewatering, trenching, excavation and backfill, removal, transportation and disposal and all material or work necessary to properly abandon the pipe. Payment for abandoning water lines will be made on the contract unit price per foot per each size diameter of pipe complete in place at locations shown on the plans. Said price will be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.

Payment for "Removal Transport and Disposal of AC" will be paid to a third party Contractor through force account for safely removing, transporting, and disposing of AC pipe.

5.47. Payment for "New Meter Box will be made at unit price bid which will be full compensation for all labor, equipment, materials, and tools required to set the new meter box.

No direct payment will be made for concrete blocking of water mains; coating and wrapping pipe joints; trench excavation below specified limits; excavation and removal of unsuitable material at bottom of trench grade and restoration with approved material; supporting pipe or conduits of public utilities; abandonment of water mains and valves; resetting existing meters and meter boxes in proper configuration; salvaging fire hydrants, valve boxes and meter boxes; flushing water mains; and disinfection of water mains. This work is to be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the nonmetallic pipe detection system. This work and materials are to be considered subsidiary to the various pay items. In addition, the Contractor is to ensure that the detection system is complete and operational to the satisfaction of the Engineer.

No direct payment will be made for furnishing and installing the pipe joint restraint system. This work and materials will be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the Joint Restraint System for PVC C-905. This work and materials will be considered subsidiary to the various pay items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the various unit prices. These prices are full compensation for furnishing materials and for equipment, labor, tools, and incidentals.

Table 20 - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)							
BENDS							
Size (In.)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (In.)	MJ Compact (C153)	MJ (C110)	FLG SB
1/4 Bend (90°)				1/8 Bend (45°)			
4	25	55	44	4	21	51	36
6	43	86	67	6	35	75	57
8	61	125	115	8	50	110	105
12	119	258	236	12	96	216	196
16	264	454	478	16	200	345	315
20	447	716	878	20	337	555	485
24	602	1,105	1,085	24	441	777	730
30	979	1,740	1,755	30	775	1,393	1,355
36	1,501	2,507	2,135	36	1,140	2,163	1,755
42	2,277	3,410	3,055	42	1,652	2,955	2,600
48	3,016	4,595	4,095	48	2,157	4,080	3,580
BENDS							
Size (In.)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (In.)	MJ Compact (C153)	MJ (C110)	FLG SB
1/16 Bend (22-1/2°)				1/32 Bend (11-1/4°)			
4	18	50	35	4	17	50	40
6	32	75	64	6	30	73	56
8	46	110	90	8	42	109	90
12	85	220	194	12	74	220	193
16	175	354	315	16	153	354	315
20	314	550	505	20	265	553	505
24	414	809	528	24	339	815	760
30	668	1,500	1,385	30	603	1,410	1,395
36	963	2,182	1,790	36	830	2,195	1,805
42	1,354	3,020	2,665	42	1,210	3,035	2,680
48	1,790	4,170	3,665	48	1,523	4,190	3,695

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
TEES				
Size (In.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	26	56	53
4	3	31	76	54
	4	33	80	60
6	4	49	114	90
	6	60	124	98
8	4	65	163	155
	6	76	175	148
	8	89	188	179
12	4	99	316	322
	6	115	325	297
	8	127	339	346
	12	162	407	369
16	6	226	563	573
	8	240	565	555
	12	283	615	590
	16	326	676	635
20	6	344	750	773
	8	371	766	720
	12	427	799	816
	16	503	975	950
	20	566	1,068	1,005

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
TEES				
Size (In.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	466	1,035	1,089
	8	487	1,047	1,060
	12	539	1,075	1,125
	16	625	1,109	1,070
	20	729	1,504	1,510
	24	785	1,617	1,685
30	8	739	1,808	-
	12	800	1,842	1,801
	16	959	1,885	-
	20	1,026	1,941	-
	24	1,228	2,496	2,475
	30	1,373	2,531	2,615
36	24	1,548	2,710	2,255
	30	1,901	3,545	3,000
	36	2,012	3,686	3,160
42	24	2,272	3,690	3,245
	30	2,512	4,650	4,125
	36	3,048	5,119	5,360
	42	3,225	6,320	5,580
48	24	2,934	4,995	4,385
	30	3,147	5,140	4,455
	36	4,046	6,280	5,555
	42	4,249	8,130	7,195
	48	4,469	8,420	7,385

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
CROSSES				
Size (In.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	34	70	-
4	3	42	90	-
	4	46	105	-
6	4	63	140	-
	6	74	160	160
8	4	88	185	185
	6	97	205	205
	8	105	239	234
12	4	114	340	-
	6	135	360	360
	8	151	382	385
	12	199	493	495
16	6	250	590	575
	8	270	619	605
	12	332	685	-
	16	409	811	790
20	6	358	760	-
	8	379	822	790
	12	413	883	860
	16	550	1,117	1,085
	20	598	1,274	1,230

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
CROSSES				
Size (In.)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	566	1,025	-
	8	578	1,085	1,045
	12	610	1,153	1,110
	16	663	1,256	1,200
	20	975	1,733	1,675
	24	907	1,906	1,835
30	8	650	1,795	-
	12	870	1,925	1,865
	16	900	1,950	-
	20	1,220	2,060	-
	24	1,497	2,776	2,675
	30	1,808	3,188	3,075
36	24	1,853	2,928	2,980
	30	2,580	3,965	-
	36	2,698	4,370	4,370
42	24	2,415	3,910	-
	30	2,920	5,040	-
	36	3,788	5,835	-
	42	3,908	6,493	7,145
48	24	3,435	5,210	-
	30	4,145	5,495	-
	36	4,873	6,790	-
	42	5,465	8,815	-
	48	5,588	9,380	-

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
CAPS			PLUGS	
Size (In.)	MJ Compact (C153)	MJ (C110)	MJ Compact (C153)	MJ (C110)
4	10	17	12	16
6	16	29	19	28
8	24	45	30	46
12	45	82	54	85
16	95	160	97	146
20	141	235	146	218
24	193	346	197	350
30	362	644	381	626
36	627	912	688	884
42	893	1,322	1,200	1,222
48	1,076	1,737	1,550	1,597

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
SOLID SLEEVES				
Size (In.)	Weight			
	MJ Short Compact (C153)	MJ Long Compact (C153)	MJ Short (C110)	MJ Long (C110)
4	17	21	35	46
6	28	35	45	65
8	38	48	65	86
12	57	77	113	143
16	127	172	192	257
20	201	258	258	359
24	264	337	340	474
30	500	651	690	1,005
36	725	960	947	1,374
42	877	1,209	1,187	1,628
48	1,406	1,516	1,472	2,033

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)			
CONCENTRIC REDUCERS			
Size (In.)			Weight
Large End	Small End	MJ Compact (C153)	MJ (C110)
6	4	27	59
8	4	38	81
8	6	41	95
12	4	70	136
12	6	69	150
12	8	70	167
16	6	134	234
16	8	136	258
16	12	126	310
20	12	213	427
20	16	221	492
24	12	304	562
24	16	315	633
24	20	315	727
30	16	596	1,027
30	20	599	1,085
30	24	492	1,204
36	20	1042	1,459
36	24	785	1,580
36	30	655	1,868
42	24	1,356	2,060
42	30	1,112	2,370
42	36	1,116	2,695
48	30	1,722	3,005
48	36	1,650	3,370
48	42	1,429	3,750

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)		
2" Tapped Tees and Crosses		
Size (In.)	Weight	
	MJ Compact (C153)	MJ (C110)
4	24	47
6	36	71
8	54	97
10	69	130
12	87	169
20	-	259
24	-	320

TABLE 20 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)		
OFFSETS		
Size (In.)	Weight	
	MJ Compact (C153)	MJ (C110)
4 x 6	35	75
4 x 12	55	83
6 x 6	35	110
6 x 12	67	138
6 x 24	96	189
8 x 6	82	164
8 x 12	98	209
8 x 24	141	280
12 x 6	121	320
12 x 12	178	420
12 x 24	240	645
20 x 12	-	1,025
20 x 24	-	1,245