Special Specification 7177
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 shall be of the sizes, materials and dimensions shown on the plans and shall 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 shall 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 shall 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 Fittings.

2.1.1. Fittings for Ductile-Iron Pipe, PVC C-900, or PVC C-905

This section covers ductile-iron fittings 3 inches through 48 inches 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 Standard C-110 for Gray-Iron and Ductile-Iron Fittings, 3-inch through 48-inch for Water and Other Liquids" and AWWA Standard C-153 for Ductile-Iron Compact Fittings, is to govern the design, manufacture, and testing of all fittings under this specification.

For 3 through 24-inch 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-inch 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 shall be provided with a petroleum asphaltic coating in accordance with the latest revision of AWWA Standard C110. The interior of flanged fittings supplied under this specification shall be either cement-mortar lined in accordance with the latest revision of AWWA Standard 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 shall be cement-mortar lined in accordance with the latest revision of AWWA Standard C104.

Fittings for 2-inch size are to be manufacturer's standard design, designed in accordance with applicable design standard of AWWA Standard C-110.

2.2. Bends and Fittings for PVC Pipe 4-inch through 36-inch.

All bends and fittings shall conform to the same requirements Section 2.1.1 Fittings for Ductile-Iron Pipe, PVC C-900, or PVC C-905.

2.2.1. Joint Restraint System

This section covers pipe joint restraint systems to be used on domestic water mains for PVC C-900 pipe sizes 4-inch through 12-inch diameter and PVC C-905 pipe sizes 16-inch through 24-inch diameter, and for Ductile Iron pipe sizes from 4-inch through 24-inch 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.

2.2.1.1. 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 shall meet or exceed A.S.T.M. Standard 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 shall meet or exceed U.L. Standard 194

Non-metallic restrained joint pipe and couplings shall be utilized specifically for C-900 PVC pipe and fittings in sizes 4-inch-12-inch.

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

2.2.1.2. Specific Requirements.

2.2.1.2.1. Restrainer for PVC C-900/C-905 & Ductile Iron Push-on Type Connections:

Pipe restraints shall be utilized 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 2 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 shall be restrained by a split retainer band. The band shall be cast ductile iron, meeting or exceeding ASTM A-536-80, Grade 65-45-12. The inside face or contact surface of the band shall be of sufficient width to incorporate cast or machined non-directionally sensitive serration to grip the outside circumference of the pipe. The serration shall provide full (360 °) contact and maintain pipe roundness and

avoid any localized points of stress. The split band casting shall 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 shall comply with ANSI B-18.2/18.2.2, SAE Grade 5. Tee-bolts, nuts and restraining rods shall be fabricated from high-strength, low-alloy steel per AWWA C-111-90.

The split ring type non-directionally sensitive restrainer system shall be capable of a test pressure twice the maximum sustained working pressure listed in Table 1 below, and be for both D.I. and/or PVC C-900.

Restraint systems sizes 6 through 12-inch shall be capable of use for both ductile iron and/or PVC C-900.

The restraint system may consist of 2 types: the two split retainer rings and for new construction use only the 1 split and 1 solid cast backup ring.

2.2.1.2.2. Compression Ring Fitting Restrainer for Ductile Iron Pipe & PVC C-900.

Compression ring with follower gland type of restrainer may be utilized in conjunction with Mechanical Joint (MJ) bell end ductile iron pipe fittings for restraining PVC C-900 and ductile iron pipe.

The system shall utilize 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 shall 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 shall be virgin SBR meeting ASTM D-2000 3 BA 715 or 3 BA 515.

The restraint system shall be capable of a test pressure twice the maximum sustained working pressure listed in Table 1 below.

2.2.1.2.3. Non-metallic restrained joint pipe and couplings for PVC C-900 Type Connections:

Gasketed restrained coupling connections shall join two sections of factory grooved PVC (C-900) pipe. The restrainer coupling or must not be directionally sensitive.

The coupling shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F-477 and shall be DR-14 Class 200 C-900 PVC 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 shall be of sufficient 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 shall provide full (360 °) contact and maintain pipe roundness and avoid and localized points of stress. The coupling shall be designed with an internal stop to align the precision-machined grooves in the coupling and pipe prior to 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 shall 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 shall be capable of a test pressure twice the maximum sustained working pressure listed in Table 1 below, and be for PVC (C-900) pipe sizes 4 through 12-inch.

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

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

2.2.1.2.4. Fitting Restraint for Ductile Iron Pipe (only):

Radial bolt type restrainer systems shall be limited to ductile iron pipe in conjunction with Mechanical Joint (MJ) bell end pipe of fittings. The system shall utilize a standard MJ gasket with a ductile iron replacement gland conforming to ASTM A-536-80. The gland dimensions shall conform to Standard MJ bolt circle criteria.

Individual wedge restrainers shall be ductile iron heat treated to a minimum hardness of 370 BHN. The wedge screws shall 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 shall be high strength steel conforming to AWWA C111/A21.11 and C153/A21.53-88.

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

2.2.1.2.5. Maximum Sustained Working Pressure Requirement. Restrainer system shall conform to the following maximum sustained working pressure requirement.(Table 1)

Table 1

Maximum Sustained Working Pressure Requirement

Nominal Diameter	PVC C-900 / C-905	Ductile Iron
4 & 6 in.	200 p.s.i.	350 p.s.i.
8 in.	200 p.s.i.	250 p.s.i.
10 & 12 in.	200 p.s.i.	200 p.s.i.
14 & 16 in.	200 p.s.i. (C-900)/ 235 p.s.i. (C-905)	200 p.s.i.
20 & 24 in.	200 p.s.i. (C-900) / 235 p.s.i. (C-905)	200 p.s.i.

2.2.1.3. 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.

2.3. 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 shall 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.

2.3.1. 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 in paragraph 4, providing such casing spacers conform to the provisions contained herein.

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

Casing spacers shall have a minimum 14-gauge steel band and 10 gauge steel riser when required. The band, risers and connecting studs shall 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 shall be between 10-16 mils thickness. The PVC coating shall provide good resistance to acids and alkalize and excellent resistance under ASTM B117 salt spray tests. The coating shall have a minimum 1380volts/mil per ASTM D149-61 short time 0.010" test and a Durometer-shore A@ (10 sec) of 80 per ASTM D1706-61T. Epoxy coatings are not an acceptable alternative.

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

The runners shall 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 shall 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 shall be shaped to resist hanging or sticking inside casing during installation of the carrier pipe. Polyethylene runners are not acceptable.

Runners shall be a minimum of 1.0 inch in width and a minimum of 7 inches long for carrier pipes up to 16", and a minimum of 2.0 inches in width and 11 inches long for larger carrier pipes. Bolts on runners are not acceptable. The runners shall be attached to the band or riser by 3/8 the wearing surface on the runner. The recess shall be filled with a corrosion inhibiting filler. There shall be four runners per casing spacer for carrier pipes up to 12" diameter, six runners for 14" through 36" and eight or more runners for carrier pipes over 36" diameter. Number of bottom runners shall be multiples of two. Number of top runners shall be multiples of two.

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

Casing spacers shall have ample riser height to limit vertical movement of the carrier pipe in the casing. A minimum of 1" to 2" clearance shall 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 shall be used in applications where continuous operating temperatures exceed 150°F.

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

2.3.2. Quality Assurance

All casing spacers are to be manufactured in accordance to NACE International Recommend Practice RP 0286-97 (Isolation Spacers.) Each casing spacer shall 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 paragraph 4 approved manufacturers.

If on receipt of casing spacers they are found to be non-compliant, the manufacturer shall 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," prior to March 2005) shall be provided with material submittal.

2.4. Copper Tubing and Brass Fittings for Copper Service Lines.

2.4.1. Copper Tubing.

This section covers copper tubing in nominal sizes of 3/4", 1", 1-1/2" and 2".

2.4.1.1. General Requirements

Copper service tubing shall be annealed seamless Type "K" and meet ASTM B-88 bearing NSF Standard 61 approval and be rated at 150 psi working pressure..

3/4" and 1" copper tubing shall be furnished in sixty-foot coils or one hundred- foot coil as specified; 1-1/2" shall be furnished in twenty-foot lengths, forty-foot coils or sixty-foot coils as specified, and 2" shall be furnished in twenty-foot lengths or forty foot coils as specified.

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

2.4.2. Brass Fittings.

This section covers waterworks brass goods, such as, corporation stops, curb stops, couplings, connectors, nipples, etc.

2.4.2.1. General Requirements

The brass composition shall conform to ASTM Specifications B-62, or latest revision thereof, fittings shall 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 shall be made from CDA/UNS C83600.

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

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

All brass fittings and valves shall have the manufacturers name and/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”; shall also be cast or stamped into the fitting or valve.

Painting, printing, sticker, or decals attesting to the components “no-lead” certification shall not be permitted.

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

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

2.4.2.2. Design Criteria for Ball Type Curb Stops/Angle Valves

All Curb Stop, Corporation and Angle valves shall 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 ftp 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 shall have a lifetime guarantee against lead leachate from the casting.

The reduced port design not will be acceptable.

Pack Joints will not be accepted.

2.5. Valve Boxes

This section covers cast-iron valve box assemblies.

2.5.1. General Requirements:

Each valve box assembly shall be of cast-iron and shall consist of a base, top section, and lid as shown on the plans on San Antonio Water System Standard Drawing No.DA-56-00.

Valve boxes shall be of a single size with a nominal diameter of 6 inches.

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

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

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

2.6. Meter Boxes

This section covers meter boxes for 5/8”, ¾”, 1”, 1-1/2”, and 2” meters.

2.6.1. General Requirements

For non-traffic bearing locations, the meter box assembly for 5/8" through 1" meters shall be made from 100% high-quality recycling plastic. The meter box and lid shall 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 shall 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 shall withstand 20,500 lbs loading in a non-deliberate and incidental traffic.

For traffic bearing locations, the meter box assembly for 5/8" through 2" meters shall consist of a cast-iron rectangular box and a steel checkered plate rectangular cover with raised lug pattern as shown on the plans in San Antonio Water System Standard Drawing No. DA-11-01 (Meter size: 5/8” thru 2”).

2.6.2. Specific Requirements

2.6.2.1. Plastic Lid is to have the following:

“Water Meter” and “SAWS” molded into the lid

Seat securely and evenly inside the meter box and shall 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 ½” rebar secured in lid. See detail.

2.6.2.2. Plastic body is to 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.

2.6.2.3. Cast Iron Rectangular box for Traffic Bearing Locations shall have the following:

Ultimate tensile strength of 25,000 psi and shall 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 degrees and the metal shall be at a temperature of 300 degrees prior to dipping. The casting shall be dipped and cured independently and the coating shall have ceased to be "tacky" within 72 hours after dipping.

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

2.6.3. Quality Assurance:

If on receipt of meter box(s) or lid(s) they are found to be non-compliant, the manufacturer shall 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.

2.7. 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 shall conform to the American National Standards Institute and American Water Works Association C502-05 Standard (ANSI/AWWA C502-05) or latest revision thereof and shall be UL approved.

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 shall 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.

2.7.1. 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 Table 2, provided such fire hydrants conform to the provision contained herein.

TABLE 2

APPROVED MANUFACTURERS

The manufacturers listed below are approved by the San Antonio Water System	
Manufacturer	Model
a. American Darling	B84B 5-1/4" (w / metal weather cap)
b. Clow Valve Company	Medallion
c. Kennedy Valve Company	Guardian
d. M & H Valve Company	Reliant Model 929
e. Mueller Company	Super Centurion 250
f. United States Pipe and Foundry, Inc.	Sentinel 250
g. Waterous	Pacer 100
h. American AVK Company	Model 2780 Dry
i. East Jordan Iron Works	5CD250

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

All parts of the hydrant shall 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 shall not be less than 5 and shall be based on the foot-pounds of torque required for the closing and opening of the hydrant at a working pressure of 200 psig. Hydrants shall 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-foot bury or less.

The length of bury shall be as specified but not less than 4 feet.

The fire hydrant shall have 2 hose nozzles and 1 pumper nozzle.

The nominal inside diameter of the hose nozzle shall be 2 ½ inches.

The nominal inside diameter for the pumper nozzle shall be 4 inches.

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 shall be 5 ¼ inches.

The hydrant shoe shall be provided with a 6 inches mechanical joint connection to fit the connecting pipe.

The fire hydrant shall open right (clockwise).

The color of the finish paint above the ground line shall be aluminum; however, fire hydrants for private use shall be painted red.

The fire hydrant shall have a non-rising stem.

No more than one 6" stem extension shall be provided if required to make the base of the fire hydrant grade level.

The bonnet section shall be designed so all bearing surfaces and stem threads are sealed in a lubricant reservoir. If oil is used as a lubricant, the reservoir shall 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 shall 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 shall be required and shall 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 shall be lubricated with a non-toxic food grade lubricant that does not pose a health hazard to the public if consumed.

2.7.2. Workmanship

All foundry and machine work shall 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 shall be well fitted and shall operate smoothly. The body and shaft shall be watertight.

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

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

2.7.3. Paint

The exterior surface of the hydrant shall be coated with a coating that shall 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 to 20 inches below the center line 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, shall be coated with a coating that shall 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 shall be coated with a fusion-bonded epoxy having a nominal dry film thickness of 8 mils, conforming to ANSI/AWWA C-550-05, and certified to NSF 61.

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

2.7.4. Testing and Inspection

Each assembled hydrant shall be subjected to two shop tests under a hydrostatic pressure of 400 psig or twice the rated working pressure, whichever is greater. One test shall 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 shall 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 shall not exceed 5 fl oz/min. Other leakage or other imperfections found in either test shall be corrected or the hydrant retested. The tests shall be conducted for a sufficient time to allow a check of all points of possible leakage and for a minimum of 30 seconds after all air has been exhausted.

Each assembled hydrant shall be operated through a full open-close cycle when not under pressure. The torque required for performing this operation shall not exceed 200 lbf-ft.

All fire hydrant tests and inspections shall 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 shall provide an Affidavit of Compliance conforming to Section 1.7 Affidavit of Compliance of ANSI/AWWA C-502-05 or latest revision thereof.

2.7.5. Quality Assurance

Manufacturers shall 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 Table 2 of this specification. If on receipt of fire hydrants they are found to be noncompliant the manufacturer shall 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 shall 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 shall 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 shall 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.

2.7.6. References

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

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

2.8. 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.

2.8.1. General Requirements

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

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

Gaskets shall 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 shall be imprinted/molded on the gasket in permanent ink (Minimum.)

Bolts and Nuts shall be of high-strength, low-alloy steel, with nominal coarse thread, and hex nuts with black finish. Dimensions and minimum stress values shall 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 shall be of the same manufacturer and compatible for the specific use intended.

Quality control procedures shall be employed to insure that the sleeve, follower flanges and gaskets are properly fabricated and free of any visible defects. Each coupling shall have a working-pressure rating not less than shown in Table 3.

Table 3

Minimum Working Pressure Rating (PSI)

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

2.8.2. **Straight Coupling Ranges & Wide Range Coupling**

Table 4

Straight Coupling Ranges

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

Table 5
Wide Range Coupling

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.

2.8.3. Approved Manufacturers

The manufacturers listed in Table 6 are approved by the Department

Table 6
Approved Manufacturers and Models for Straight Couplings

Manufacturer	Model
JCM Industries	210
Romac Industries	501
Smith-Blair, Inc.	441
The Ford Meter Box Co., Inc.	FC1
Powerseal Pipeline Products Corp.	3501
Cascade Waterworks Mfg. Co.	CDC & CTC
Dresser	253
Approved Manufacturers and Models for Wide Range Couplings	
PowerSeal Pipeline Products Corp	3506
The Ford Meter Box Company, Inc.	FC2W

2.9. 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.

2.9.1. General Requirements

Valves furnished under this specification shall conform to ANSI/NSF Standard 60 for direct additives and ANSI/NSF Standard 61 for indirect additives. Cast Iron Valve Body and cover shall be in accordance with ASTM A48-35 or ASTM A126 class B. Non-Metallic Valve Body shall be fabricated from fiberglass reinforced nylon. Inlet sizes through 2 inches shall be screwed (NPT). Pipe sizes 3” and above shall have flanged inlets (125# ASNSI B 16.1). A protective hood or cowl shall be installed on the outlet of flange-bodied valves.

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

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

Valves requiring Internal seats or orifice buttons shall be Buna-N rubber compounded for water service. For valves requiring cover gaskets, the cover gasket shall 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 shall be on NSF 61 certified rubber. Cover bolts shall be alloy steel. Rolling seals shall be furnished for non-metallic valves 2" and below.

Valve body shall 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.

2.9.2. General Operation Requirements

The air release valve shall be designed to vent accumulated air automatically. The outlet orifice shall be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve shall 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 shall be designed with the inlet and outlet of equal cross-sectional area where applicable. The valve shall be capable or automatically allowing large quantities of air to be exhausted during the filling cycle an 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 shall 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 shall 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 shall be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sized (4 inch and larger) may be furnished in a dual housing. When dual casings are used a bronze manual isolation valve shall 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.

2.9.3. 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.

2.9.4. Quality Assurance

The manufacturers shall 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.

2.10. Backfill

2.10.1. 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 shall be composed or well graded crushed stone or gravel conforming to the following requirements unless modified by the Engineer.

Modified Grade 5 gravel:

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 3.3.1 of this specification.

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

Well graded gravels or crushed stone shall meet the requirements of Modified Grade 5 gravel.

2.10.2. Secondary Backfill for Water Mains

Secondary backfill is defined as backfill from 1 foot above the top of the pipe to the top of the trench or bottom of pavement section. Secondary backfill shall be constructed in accordance with details shown in the construction documents.

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

2.11. Asphalt.

All asphaltic concrete used in the replacement of pavement over the trench line is to conform to 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.

2.12. Concrete.

All concrete used as the trench cap and in sidewalks and blocking mains is to conform to 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.

2.13. Reinforcing Steel.

All bar reinforcement is to be Grade 60, conforming to the requirements of Item 440, "Reinforcement for Concrete".

2.14. 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.

3. CONSTRUCTION METHODS

3.1. Excavation

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

3.1.1. Trenches

Trench walls shall 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 and/or Inspector’s direction. In special cases, where trench flaring is required, the trench walls shall remain vertical to a depth of at least 1foot above the top of the pipe.

The trench bottom shall be square or slightly curved to the shape of the trenching machine cutters. The trench shall 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 shall be dug after the trench bottom has been graded and bedding installed. The pipe shall rest upon the new bedding material for its full length

Where over-excavation occurs, the under-cut trench shall 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, shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width shall 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 shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24 inches. A trench wider than the outside diameter plus 24 inches may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry additional trench load. Such modifications shall 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 expense, shall 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 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 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 shall 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 the a depth no less than 6-inches below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3-in. prior to 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 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 in order 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.

In the event that 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 such time as 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 having 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 through the use of 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 utilized after all fill requirements have been met, shall become the responsibility of the Contractor. The Contractor shall 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 shall be restored to match the previous existing conditions. This shall 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.) shall be restored by grading and compacting to 98% or higher with a minimum of 4 inches of flex base materials for the entire width of the alley. Asphaltic materials shall have a compaction density of 95%. Alleys not actively used by vehicles shall 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 shall be covered with a temporary all weather surface to allow for vehicular traffic until the final asphalt/concrete paving is complete. This surface shall be a minimum of 4 inches 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 prior to final asphalting.

All street work shall be done in accordance with the latest TXDOT 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 prior to 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 shall 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 shall 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 shall order immediate shutdown, and remedial measures will be responsibility of the Contractor.

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

The Contractor shall maintain ground water table at least 12 inches below the finished excavation subgrade.

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

No direct payment shall be made for costs associated with dewatering. All costs in connection therewith shall 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. 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. 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. 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) 353-3333. Any damage to other utilities shall be reported to their proper governing entity.

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 shall be located at least two feet above the existing wastewater main or lateral, measured vertically, and at least four feet away, measured horizontally, from the existing wastewater main or lateral. Every effort shall 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 shall be replaced with at least 150 psi pressure-rated pipe. The new potable waterline shall be located at least two feet above the new wastewater line, measured vertically, and at least four feet 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 shall be constructed of at least 150 psi pressure-rated pipe. The new potable waterline shall be located at least two feet above the wastewater main or lateral, measured vertically, and at least four feet 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 shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral.

The potable waterline shall be at least two feet above the wastewater main or lateral. Whenever possible, the crossing shall 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 shall be replaced for at least nine feet in both directions (18 feet 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 shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral.

The potable waterline shall be at least six inches above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral shows signs of leaking, it shall be replaced for at least nine feet in both directions (18 feet 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 feet, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. The potable waterline shall be at least two feet above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. The wastewater pipe shall have a minimum pipe stiffness of 115 psi at 5.0% deflection. The wastewater main or lateral shall be embedded in cement stabilized sand for the total length of one pipe segment plus 12 inches 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 feet in length, the potable water pipe segment shall be centered over the wastewater line. The materials and method of installation shall conform with one of the following options:

- Within nine feet horizontally of either side of the waterline, the wastewater pipe and joints shall be constructed with pipe material having a minimum pressure-rating of at least 150 psi. An absolute minimum vertical separation distance of two feet shall be provided. The wastewater main or lateral shall be located below the waterline.
- All sections of wastewater main or lateral within nine feet horizontally of the waterline shall be encased in an 18-foot (or longer) section of pipe. Flexible encasing pipe shall have a minimum pipe stiffness of 115 psi at 5.0% deflection. The encasing pipe shall be centered on the waterline and shall be at least two nominal pipe diameters larger than the wastewater main or lateral. The space around the carrier pipe shall be supported at five-foot (or less) intervals with spacers or be filled to the springline with washed sand. Each end of the casing shall be sealed with watertight non-shrink cement grout or a manufactured watertight seal. An absolute minimum separation distance of six inches between the encasement pipe and the waterline shall be provided. The wastewater line shall be located below the waterline.

3.2.5. Pipe Grade

Water mains 16" or smaller shall have a minimum of 60 inches of cover from the proposed final finish ground/street elevation and 60 inches 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" and above shall have a minimum of 60 inches 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 shall be borne by the Contractor. Care is to be taken to insure 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 prior to backfill. Bedding material is to be placed under the coupling and compacted by hand prior to 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

Prior to placing pipe in a trench, the trench is to have been excavated to the proper depth as required in Subarticle 3.1, “Excavation”. Approved imported materials or Engineer-approved materials selected from suitable fines derived from the excavation shall 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 is unstable or unsuitable, and conditions are such that the existing material cannot be reworked to make it stable then the trench subgrade shall 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 shall 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 prior to 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

Every precaution is to be taken to prevent foreign material from entering the pipe while it is being placed in the line. Under adverse trench conditions, extended period of time and/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 shall be installed in a continuous bedding envelope which shall extend the full trench width to a depth of at least 6 inches below the pipe and to a depth at least 12 inch above water pipe. The pipe is to be

secured in place with approved bedding placed in lifts not exceeding 8 inches 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 sufficient 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 the open end of pipe in the trench is to be closed 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 is to provide plug & caps of various sizes required.

3.2.9.1. 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 prior to 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 shall, 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 prior to 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 construction inspector.

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 7, “Maximum Deflections of Ductile-Iron Pipe”, for ductile-iron pipe, and Table 8, “Maximum Defections of Concrete-Steel Cylinder Pipe”, for concrete pipe to be exceeded.

Table 7

Maximum Deflections of Ductile-Iron Pipe

Norm Pipe Dia.	Max Joint Open	Max Defl. Angle	Max Deflection in Inches with Pipe Length of:		Approx. Rad of Curve in Ft Produced by Succession of Joints with Pipe Length of:	
(Inch)	(Inch)	Deg/Min	18ft	20ft	18ft	20ft
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

Table 8

Maximum Deflections of Concrete-Steel Cylinder Pipe

Normal Pipe Diameter (Inches)	Maximum Deflection Angle Deg/Min	Maximum Deflection (Inches)		Approx Radius of Curve (Feet)	
		16' Lay Length	20' Lay Length	16' Lay Length	20' Lay Length
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	-	1100
42	0/54	-	3.8	-	1300
48	0/47	2.6	-	1170	-
54	0/44	2.5	-	1237	-
60	0/54	3.0	-	1024	-

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 shall 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 be found in the project General Notes in the Plans.

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 Uni-Bell recommendations.

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

3.2.14. Coating and Wrapping Underground Pipe.

3.2.14.1. Ductile-Iron Pipe.

3.2.14.1.1. 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 2 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 insure that tape extends beyond corporation and onto service line pipe 1 foot.

Prior to 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 shall 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 feet of the service shall be

wrapped and taped to achieve a complete seal. In addition, a sand envelope shall extend over and around the connection to a depth of eight inches above the main.

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 is to be considered subsidiary to the installation and 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, shall 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.

Mechanical Couplings: The installation of mechanical couplings is to be assembled and installed according to the standards recommended by the manufacturer. Prior to 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 prior to coating and wrapping the joint. Table 9, 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.

Table 9
Torque for Mechanical Couplings

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”x7” 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: 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 shall be installed with the thrust blocking or joint restraint shown in standard drawing DD-839 series. 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 shall 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 prior to 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 2.9.1. Bedding/Initial Backfilling.

Prepare the trench in accordance with applicable provisions of Section 3.1.1. 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 inches in every direction

3.2.19. Abandonment of Valves

Abandoned Valves: Valves abandoned in the execution of the work shall have the valve box and extension packed with sand to within 8 inches of the street surface. The remaining 8 inches shall 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 shall be salvaged and returned to the Owner.

New/Existing Valves: At no time during the project work shall 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.

3.2.20. Pipe Joint Restraint System

Pipe joint restraints shall be utilized 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 shall 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 shall be applied directly to the top of the pipe. For metal pipes and fittings the warning tape shall be applied to the top of the polyethylene film wrap.

3.2.21. 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 in Concrete Cradles, of this Section. The cradle shall be constructed in accordance with details and sections shown on the plans. Strap/Tie Downs shall 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.

3.2.22. Fire Hydrants and Miscellaneous Appurtenances

3.2.22.1. Fire Hydrants.

Hydrants are to be connected to the main as shown on the plans or as directed by the Engineer. They are to be installed in a manner which will provide complete accessibility and in a sage 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 inches nor 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 restrain will not be accepted. Restrained joints shall be furnished for pipe at all changes in direction at indicated on plans, details, or as directed. Restrained mechanical joints shall be locked mechanical joints. Joints shall 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. 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 18-20 inches below center line 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.

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 shall be connected to the mains as shown in the contract documents or as directed by the Engineer. Hydrants shall 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.

3.2.22.2. Gate Valves, Valve Boxes, Adjustments

Gate valve installation shall include valve, reaction blocking, cast iron boot, valve box extension (having ductile iron riser pipe), valve box, concrete collar (where subjected to vehicular traffic), and valve box lid. Gate valves constructed in the terrace shall be constructed with No. 3 bars all around.

The valve box shall be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6 feet and deeper shall 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 feet and 13 feet. Adjustable valve box and valve key extension systems shall 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 Engineer. Valve boxes located in streets or other area subject to vehicular traffic shall be provided with concrete collars as shown in these standard drawings.

Collars around such valve boxes shall be formed and finished off neatly and in a sound workmanlike manner. Valve pits shall be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box shall be set flush with the finished pavement surface or at other finish elevations as may be specified. Pits shall 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 inches and larger shall be supported on a concrete pad in accordance with details shown in 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.

Valve boxes installed as part of a new valve and mainline construction project are considered "new valves." Adjustments to "new valves" are incidental to the installation of the valve. No separate pay will be given to adjust "new valves" to finished grade.

3.2.22.3. 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 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 utilized 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 shall be in accordance with SAWS Standard Drawings DD-839 Series as shown on the plans. In all cases, the design of thrust blocking shall be of sufficient size to withstand a soil pressure of 3000 psf, unless specified otherwise in the job plans or specifications. The maximum soil pressure value that will be allowed for the design of thrust blocking shall be 5000 psf. When soil pressure bearing values of 4000 psf or 5000 psf are recorded for design of thrust blocks, copies of soil tests made for determining the bearing value of the soil is question shall 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.

3.3. Backfill

3.3.1. Initial Backfill.

Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the bedding to a point 1 foot above the top of pipe. The first lift of initial backfill is to be inspected and approved prior to 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 one foot 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 inches and larger, simultaneously spread initial backfill material alongside, under the lower quadrant of pipe and over the pipe in 12 inch lifts to a point sufficient to a minimum of 1 foot 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 shall be inserted every 3 feet on each side of pipe.

3.3.2. Secondary Backfill.

Secondary backfill is defined as backfill from 1 foot 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 shall be placed in maximum 12 inch 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 considered subsidiary to 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 and/or at locations directed. The flowable backfill material and operation is to be in accordance with Item 401, “Flowable Backfill”.

3.3.6. Operation of Valves

No valve in the distribution system is to be operated by the Contractor without prior permission of the Inspector. The Contractor shall notify the Inspector when a valve is to be operated and shall only operate the valve in the presence of the Inspector.

3.3.7. 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 shall 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 shall 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 shall be made watertight by the Contractor. When repairs are required, the hydrostatic field test shall be repeated until the pipe installation conforms to the specified requirements and is acceptable to the Engineer or Inspector. The Contractor shall insure that the Engineer or Inspector be present for the duration of the pressure test.

3.3.8. Test Procedures

After the new main has been laid and backfilled as specified, but prior to 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 10 or 11, 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 prior to beginning the test, and the Water System Company's Inspector is to be present during the pressure test.

PVC pipe leakage allowances shall conform to DI leakage allowances listed on Tables 10 and 11, Hydrostatic Test Leakage Allowances.

Table 10

Hydrostatic Test Leakage Allowance (Maximum) @ 150 psi

Pipe	100LF	200LF	300LF	400LF	500LF	600LF	700LF	800LF	900LF	1000LF	2000LF	3000LF	4000LF	5000LF
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 shall 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 and/or by the combination of various tabular data.

Table 11

Hydrostatic Test Leakage Allowances (Maximum) @ 200 psi

Nom	Allowable Leakage in Gallons Per Hour (GPH) **									
Dia-Ty	Pipe Length in Feet									
Pipe	100LF	200LF	300LF	400LF	500LF	600LF	700LF	800LF	900LF	1000LF
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	2.3	2.55
16"DI*	0.34	0.68	1.02	1.36	1.7	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	0.4	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	0.5	0.66	0.83	1.00	1.16	1.33	1.49	1.66
48"DI*	1.02	2.04	3.06	4.08	5.1	6.11	7.13	8.15	9.17	10.19
48"CSC	0.19	0.38	0.7	0.76	0.95	1.13	1.32	1.51	1.7	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 shall 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 and/or by the combination of various tabular data.

3.5. Service Supply Lines

Service supply lines and fittings, meter boxes and appurtenances shall conform to material specifications and shall 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.

3.5.1. 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 Customers lot or property is designated as “Customer’s yard piping”. Services 2” and smaller are designated “small services”; services 4” 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 shall 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 shall 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 shall be as specified for main and service line trench excavation.

For service lines and tap holes, payment for bedding, initial backfill and secondary backfill shall 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 shall be installed as described herein, and in plans. Unless otherwise indicated, existing meter and meter box relocation shall be included in the service line installation.

All service line installation shall 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 shall 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 shall be 8 inches, while the minimum trench width for large service Lines shall be the nominal pipe diameter plus 16 inches, except when specified otherwise by the Engineer. For ¾" to 2" Service lines, minimum bury depth shall be 3 feet. For services greater than 2", minimum depth of bury shall be 4 feet.

All service lines shall be installed in accordance with plans, and specifications, except that two strap service saddle clamps shall 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 shall 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 shall be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, corporation and the first three feet of the service, shall be wrapped and taped to achieve a complete seal. In addition, a sand envelope shall extend over and around the connection to a depth of 8 inches above the main.

Small service lines shall 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 shall 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.

Abandonment of Service Lines: The Contractor shall 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 shall be removed, and the tap at the main shall be plugged with an appropriately sized brass plug. For a non-ferrous main, the corporation stop shall not be removed from the main. Instead, the corporation stop shall be closed and the flared nut shall 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 shall salvage copper service line tubing, brass fittings, and other materials as directed by the Inspector and return them to the Owner.

Small Service Lines: Copper tubing shall be used for ¾" through 2" service lines. Brass fittings for ¾" and 1" service lines shall be of the flared or compression type for the use with Type 'K' soft annealed copper tubing. Brass fittings for 1½" and 2" lines shall be of the flared or compression type for use with type 'K' soft annealed copper tubing, except as modified by this specification.

Copper tubing shall 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 shall be used to remove the inside rolled lip from the tubing. Flared ends shall be expanded by the use of a flaring tool using care to avoid splitting, crimping, or overstressing the metal. Pipe adjacent to the fittings shall be straight for at least 10 inches. Bending of tubing shall 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 shall be cut out and replaced. When compression fittings are used, the copper tubing shall be cut squarely prior to insertion into the fitting Final assembly shall be in accordance with the manufacturers recommendations.

Small Service Lines on New Mains: Installation of new copper service lines shall 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 shall be exposed. The old main shall 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 shall 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 a sufficient 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 shall "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 shall then immediately open the stop and restore water service to the Customer. Where it is not possible to obtain sufficient length in the existing service to tie directly to the new main, at the direction of the Engineer, the Contractor shall 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 shall be as specified in this specification.

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 shall be exposed opposite location stakes placed on site at the direction of the Engineer. The existing or new main shall; 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 shall be reset and the meter box and base shall be installed at its staked location and perpendicular to the corporation stop in the water main. The meter box location shall not vary more than 24 inches in any direction from its staked location. The service line shall be installed with sufficient slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line shall 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 shall 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 shall consist of a 1" copper service line reducing to two ¾" copper service lines at a tee which shall be set in line with the front edge of meter boxes for ⅝" and ¾" meters. A single service line with dual meters shall be installed in those new residential developments where new ⅝" and ¾" meters are required and in main replacement work where it is necessary to change the location of existing ⅝" and ¾" meters. Single service line - dual meter materials and installation requirements shall 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 shall 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" shall 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 shall 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 shall 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.

3.5.2. 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 shall 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) shall be installed within the meter box between the meter and the customer's yard piping.

Round and oval meter boxes with round covers shall be salvaged and returned to the Owner by the Contractor. The Contractor shall 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 shall 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 shall install a number one meter box (2 pieces) as shown in the Specification and 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. In lieu of the new meter, the Contractor shall furnish and install a meter template in accordance with plans .

Meter and meter box configuration, shall have the meter set horizontal, approximately 6 inches 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 shall be flush with the existing ground surface. All excess soil above the meter coupling, meter flange and meter nuts inside the meter box shall be removed so that the meter register is clearly visible. The Contractor shall exercise special precautions during excavation at the existing meter location in order to minimize the disturbance of the customer's yard piping. However, if the existing meter elevation is low, the Contractor shall 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 shall be installed by the customer in accordance with the Uniform Plumbing Code and shall be placed beyond the outlet side of the meter, but not within the Owner's meter

box. The pressure reducing valve shall be the property of the water user who will be responsible for its installation, maintenance, and replacement as required.

The meter box adjustment shall not exceed 10 linear feet from the existing box.

Water Service for Fire Lines

Start of Work: Three working days notice will be given to the assigned Inspector prior to start of a project after permit has been issued. The Contractor shall start his work at a tie-in or point designated by the Engineer. Pipe shall 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 shall be installed to the required lines and grades with fittings, valves, and hydrants placed at the required locations. Spigots shall be centered in bells or collars, all valves and hydrant stems shall be set plumb, and fire hydrant nozzles shall face as shown on the plans or as directed by the Engineer. No valve or other control on the existing system shall 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 shall have a minimum of 48 inches of cover over the top of the pipe unless otherwise waived or modified by the Engineer. Excavation around other utilities shall be done by hand for at least 12 inches all around. Any damage to other utilities shall be reported to the governing entity/owner of said utility as well as the Inspector.

Pipe Grade:

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

Modified Grade 5 Materials:

Prior to placing pipe in a trench, the trench shall have been excavated to the proper depth as required of these specifications. Approved imported materials or Engineer approved materials selected from suitable fines derived from the excavation shall 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 shall 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 shall 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 prior to beginning work.

Lowering Materials into Trench:

Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient completion of work. All pipe, fittings, valves, and hydrants shall 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 shall water service materials, pipes, fittings, etc., be dropped or dumped into the trench. Extreme care shall be taken to avoid damaging polywrap films. No chains or slings shall be allowed unless the entire sling is wrapped with a protective nylon web sock.

Laying of Pipe:

Every precaution shall be taken to prevent foreign material from entering the pipe during its installation. Under adverse trench conditions or otherwise required by the Engineer, a heavy, tightly woven canvas bag of suitably sized shall be placed over each of the pipe.

The Canvas bag shall be left in place until a connection is made to the adjacent pipe. The interior of each pipe shall be inspected for defects, and the pipe shall be rejected if any defects are found.

After placing a length of pipe in the trench, the jointed end shall be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with the requirements of these Specifications. The pipe shall 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 shall be rejected and shall be replaced with pipe and fittings of proper dimensions. Precautions shall 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 shall be closed by a watertight plug or other means approved by the Engineer. Pipe in the trench which cannot temporarily be joined shall be capped or plugged at each end to make it watertight. This provision shall apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal shall remain in place until the trench is pumped completely dry. The Contractor shall 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 shall 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 shall be accomplished by the use of appropriate bends unless such requirement is specifically waived by the Construction Inspector.

Whenever it is necessary to deflect pipe from a straight line, the deflection shall be as directed by the Construction Inspector and as described herein. In no case shall the amounts exceed those shown in Table 12 "Maximum Deflections of Ductile-Iron Pipe" for ductile-iron pipe

Table 12

Maximum Deflections of Ductile-Iron Pipe

Norminal Pipe Diameter	Maximum Deflection Angle	Maximum Deflection In Inches		Approximate Radius of Curve In Inches	
		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	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	540	600
	1°35'	6	6.7	648	720

Cutting Pipe:

The cutting of pipe for inserting valves, fittings, or closure pieces shall 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 shall be strictly followed by the Contractor. Only qualified and experienced workmen shall be used and, under no circumstances, shall a workman not equipped with proper safety goggles, helmet and all other required safety attire be permitted to engage in this work.

Joint Assembly:

- Rubber Ring Joints: The installation of pipe and the assembly of rubber ring joints for Ductile-Iron pipe shall conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as "stabbing" shall 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 shall 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.

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

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

3.6. 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 subsection applies solely to the construction of high pressure water systems and shall govern when in conflict with of subsections of this specification.

High Pressure Systems

Each water distribution system that furnishes water in Pressure Zone 9 through Pressure Zone 16 shall be designated as a high pressure system. The static water pressure in each in each Service Level shall 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 13, 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.

Table 13
High Pressure Levels

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	1125	1000	870	780	720
10	1290	1160	1040	940	880
11	1400	1270	1150	1050	1000
12	1520	1390	1270	1170	1120
14	1630	1500	1380	1280	1230
15	1860	1730	1600	1510	1460
16	1990	1860	1740	1640	1590

4. MEASUREMENT

4.1. "Adjust Valve Box" will be measured as each assembly adjusted to correspond to finish grade.

4.2. "Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars" for pipe will be measured by the cubic yard as dimensioned on the plans, 6' in depth measured from the outside pipe diameter (0.0) or as directed. Reinforcing if required will not be measured for payment.

4.3. "Relocate Fire Hydrant" will be measured as each fire hydrant relocated.

4.4. "Relocate Air Release & Vent Pipe Assembly" will be measured as each assembly regardless of size adjusted.

4.5. "Trench Excavation Protection" and "Joint Trench Excavation Protection" will be measured by the linear foot along the centerline of trench where the depth of trench exceeds 5-ft.

4.6. "Relocate Existing Meter and Existing Meter Box" will be measured as each assembly relocated and customer's service reconnected.

4.7. "Relocate Existing Meter and New Meter Box will be measured as each assembly relocated and customer's service reconnected

4.8. "Excavation" will not be measured for payment, but is to be considered subsidiary to the pipe installation.

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

4.10. "Flowable Backfill". Will be measured by the cubic yard in accordance with Item 401, "Flowable Backfill", but not to exceed the minimum trench width specified in Section 3.1.2 , "Width of Trench" or as shown on the plans.

5. PAYMENT

5.1. The work performed and materials furnished in accordance with this 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.

5.2. Payment for "Adjust Valve Box" will be made at the unit price bid which shall be full compensation for each valve box adjusted to finish grade including all labor, materials, and incidentals to complete the work.

5.3. Payment for "Relocate Fire Hydrant" will be made at the unit prices bid which shall be full compensation for each such assemblies installed.

5.4. These payments are to include 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.

5.5. Payment for "Relocate Air Release & Vent Pipe Assembly" will be made at the unit price bid which shall be full compensation for each such assembly adjusted in accordance with the details shown on the plans. This price shall 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 regardless of sizes and types of meter boxes.

5.6. Payment for "Trench Excavation Protection" and "Joint Trench Excavation Protection" is to be made on the basis of the unit price bid which shall be full compensation for each linear foot of "Trench Excavation Protection" in place. Payment is to include all components of the trench 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.

5.7. Payment for "Relocate Existing Meter and Existing Meter Box" will be made at the unit price bid for each assembly relocated. This price shall 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 new meter box, and the existing yard piping.

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

5.8. Payment for “New Meter Box will be made at unit price bid which shall be full compensation for all labor, equipment, materials, and tools required to set the new meter box.

5.9. Payment for “Relocate Existing Meter and New Meter Box” will be made at the unit price bid for each assembly relocated. This price shall 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 new meter box, and the existing yard piping.

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

5.10. Payment for “Relocate Existing Air Release Assembly” will be made at the unit price bid for each assembly relocated. This price shall be full compensation for all labor, equipment, materials, tools, sand backfill, regardless of sizes and types.

5.11. Payment for “Flowable Fill” will be made at the unit price bid which shall be full compensation for each cubic yard of flowable fill placed, but not to exceed the minimum trench width specified in Section 3.1.2. “Width of Trench”.

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 shall 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 shall 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.