

Special Specification 7172

Water and Sanitary Sewer Systems



1. DESCRIPTION

This Item will govern for furnishing new materials and installing water and sanitary sewer systems shown on the plans.

2. WATER MAINS

2.1. **Description.** Furnish all labor, materials, equipment and incidentals required to install water mains as shown on the plans and as specified and in compliance with McAllen Public Utility material specifications. All materials used in this project are to be new and unused unless otherwise specified on the plans, specifications or the proposal. Submit descriptive information and evidence that the materials and equipment proposed for incorporation into the Work are of the kind and quality that meet the material requirements listed herein.

2.2. **Materials.**

2.2.1. **Polyvinyl Chloride (PVC) Pressure Pipe.** The following specifications cover the requirements for polyvinyl chloride (PVC) pressure plastic pipe materials and installation for potable water use and apply to PVC pipe, sizes 4 in. through 16 in. diameters.

2.2.1.1. **Quality Assurance.** Color-code PVC pipe in blue to provide positive identification and prevent accidental damage to or interruption of the water facilities. Pipe will conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water System Components - Health Effects" and be certified by and organization accredited by ANSI. Provide compliance affidavit from the manufacturer or vendor. If the pipe does not conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

Only pipe manufactured in the United States of America will be accepted.

Pipe must be suitable for use in the conveyance of water for human consumption. Mark each piece of pipe with two seals of the testing agency that certified the pipe material as being suitable for potable water use.

2.2.1.2. **Submittals.** Furnish all necessary shop drawings, certificates, etc. for review and acceptance. A certification from the manufacturer must be furnished attesting compliance with appropriate ASTM Standards and ANSI/NSF Standard 61. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. Failure to provide this information may result in rejection of pipeline material. Include documentation on pipe products, fittings, and related materials as may be required by the plans or the Engineer. Review all submittals prior to submission. Submit it in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the product complies with appropriate ASTM standards

2.2.1.3. **Standards.** Comply with the applicable requirements of the following items listed below. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Section will prevail.

- ANSI/NSF 61 Drinking Water System Components - Health Effects
- ASTM F-477 Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

- ASTM D-1784 Specifications for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
- ASTM D-2241 Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)
- ASTM D-2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
- ASTM D-2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
- ASTM D-3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- AWWA C-651 Standard for Disinfecting Water Mains
- AWWA C-900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution
- AWWA C-905 Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 in. through 36 in.
- AWWA M-23 Manual: PVC Pipe - Design and Installation
- UNI-BELL-3 Polyvinyl Chloride (PVC) Pressure Pipe (Complying with AWWA Standard C-900)
- UNI-BELL-11 Polyvinyl Chloride (PVC) Water Transmission Pipe Nominal Diameters 14 in. through 36 in.
- Texas Commission on Environmental Quality, Chapter 290 - Public Drinking Water

2.2.1.4. **Delivery and Storage.** Pipe, fittings, and accessories will be inspected upon delivery and during progress of the work. Any material found defective will be rejected and must be promptly removed from the site.

Unload at point of delivery all pipe, fittings, and other accessories, unless otherwise directed, haul to and distribute at the work site. In loading and unloading, lift materials by hoists or roll on skidways to avoid shock or damage. Do not incorporate materials that have been dropped. Do not skid or roll pipe handled on skidways against pipe already on the ground.

Do not store PVC pipe outside exposed to prolonged periods of sunlight. Any discoloration of pipe due to such exposure is an indication of reduced pipe impact strength, and will be sufficient cause for rejection of the pipe. Remove rejected all pipe from the job site.

2.2.1.5. **Pipe Materials.** Meet the requirements of AWWA C-900 for 4 in. through 12 in. sizes, and AWWA C-905 for 14 in. through 36 in. pipe. Provide pipe that is Underwriters Laboratories (UL) approved. Furnish all PVC pressure pipe in cast iron pipe equivalent outside diameters and a standard laying length of 20 ft. Provide a minimum pressure class of 235 psi (DR 18) for 4 in. through 12 in. diameters and 200 psi (DR 21) for 14 in. through 16 in. pipe.

2.2.1.6. **Joints.** Furnish push-on flexible, elastomeric gasketed pipe joints. The pipe length must contain one bell-end or couple with a synthetic elastomeric gasket.

Gaskets must meet the requirements of ASTM F-477. The bell will be an integral part of the pipe length, and have the same strength and DR as the pipe. The spigot pipe end will be beveled.

All push-on joint PVC pipe must have dual insertion marks on the spigot indicating proper penetration when the joint is assembled and only one mark remains visible. The sockets and spigot configurations for the fittings and couplings should be compatible to the pipe. Socket configuration must prevent improper installation of gasket and will ensure that the gasket remains in place during joining operations.

Cartridge-style restrained joint PVC pipe will be joined using a non-metallic coupling to form an integral system. Coupling will be designed for use at or above the pressure class of the pipe with which they are utilized and will incorporate twin elastomeric sealing gaskets meeting ASTM F-477. High strength, flexible thermoplastic splines will be inserted mating, machined grooves in the pipe and coupling to provide full 360° restraint.

Restrained joint pipe systems must have a restrained joint that in and of itself prevents over bellng of the pipe during assembly of the joint and every joint already assembled in that string of pipe. Restrained joint system will allow the installer to both push and pull the pipe during installation without the risk of over bellng of any of the pipe joints in the string. Joint will not require electrical power or other additional equipment (other than hand tools) to assemble.

2.2.1.7. **Fittings.** Provide DIP, cement lined pipe fittings in accordance with AWWA C-110 and Article 7, "Valves and Fittings." Provide mechanical joint (MJ) pipe fittings unless otherwise specified.

2.2.1.8. **Provisions for Thrust.** For 12-in. diameter water mains and smaller, concrete thrust blocks or other approved thrust restraint method will be installed at all fittings and valves per design plans and in accordance with these Specifications. If approved, thrust restraint devices may be installed in lieu of thrust blocks as per manufacturer's specifications.

For 16-in. diameter water mains and larger, thrust restraint devices must be installed at all fittings and valves per manufacturer's specifications and as shown on design plans. Concrete thrust blocks are not allowed unless approved by the Engineer.

Acceptable thrust restraint devices include EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new water line to existing main, both concrete thrust blocking in accordance with this Specification and thrust restraint devices must be used, regardless of main size.

Thrust restraint devices must be used for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the test pressure of the pipe. For the purposes of thrust restraint, test pressure will be 1.5 times the design working pressure indicated. Length of pipe with restrained joints to resist thrust forces will be determined by pipe manufacturer.

2.2.1.9. **Pipe Trenching, Installation and Backfill.** Except as noted, Pipe Trenching, Installation and Backfill for PVC Pressure Pipe will be in accordance with AWWA M-23, C-900, C-905, and conforming to "Excavation and Backfill for Structures" Item 400 and details shown on construction plans.

2.2.1.9.1. **Trench Width.** Provide a minimum trench clear width of 1 ft. greater than the outside diameter of the pipe and a maximum clear width at a point 1 ft. above the top of the pipe equal to the pipe outside diameter plus 2 ft. If the maximum recommended trench width is exceeded or if the pipe is installed in a compacted embankment, compact pipe embedment to a minimum width of 2 1/2 times the proposed pipe diameter from the side of the pipe or to the trench walls.

2.2.1.9.2. **Pipe Zone Embedment.** Unless otherwise specified, embed PVC pressure pipe in Class II material as defined in Item 400, "Excavation and Backfill for Structures." Native material or imported material meeting or exceeding Class II requirements may be used. Class I material is acceptable at the Engineer's discretion.

2.2.1.9.3. **Installation.** Install plastic pressure pipe in accordance with AWWA M 23 and C-900/C-905 or manufacturer's printed recommendations, whichever is applicable. Where a conflict arises, this Specification controls.

Exercise care to insert the pipe spigot to the correct reference mark per manufacturer's recommendation to prevent buckling or separation of the pipe joint. The second insertion mark must be visible after installation and not be further than 3/4-in. from the leading edge of the pipe bell. Verify that the manufacturer's reference marks are correct per manufacturer's literature.

Do not drop pipe or accessories into the trench. When pipe laying is not in progress, close the open ends of installed pipe to prevent entrance of trench water, dirt, and foreign matter into the line.

2.2.1.9.4. **Marking Tape.** Mark PVC pressure water pipe by installing the appropriate marking tape for detection purposes concurrently. Provide a high visibility blue detectable tape consisting of a 5.0 mil inert polyethylene

plastic material with the standard warning and identification for potable water imprinted on the tape. Provide a minimum width of 6 in. for all potable water lines and bury tape to a depth of 36 in., measured from finished grade. Use detecting tape manufactured by Empire, Lineguard, or approved equal.

- 2.2.1.9.5. **Deflection.** Maximum ring deflection (cross-sectional deflection) of installed PVC pressure pipe is 5%. Joint deflection (horizontal deflection) will not exceed manufacturer's recommendations for the particular pipe size.
- 2.2.1.9.6. **Corrosion Protection.** As a precaution against corrosion, coat all flanges, bolts, nuts, and other exposed metal surfaces underground with Texaco, Koppers, or approved equal rustproof compound.
- 2.2.1.10. **Testing.** Disinfect and test the piping system as detailed in AWWA C-651 and in accordance with Article 10, "Cleaning, Disinfection, and Testing of Water System."
- 2.2.2. **Ductile Iron Pipe.** The following specifications cover the requirements for ductile iron pipe (DIP) materials.
- 2.2.2.1. **Quality Assurance.** Manufacturer must have a minimum of 10 yr. successful experience in designing and manufacturing DIP, pipe joints of similar design, pipe diameter, and pressure class of the type specified. The entire pipeline will be the product of one manufacturer. Pipe must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water System Components - Health Effects" and be certified by and organization accredited by ANSI. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.
- 2.2.2.2. **Submittals.** Submit documentation on pipe products, fittings, and related materials as required by the plans or Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the DIP complies with appropriate AWWA Standards and ANSI/NSF Standard 61. Provide by an affidavit from the manufacturer or vendor as evidence of compliance. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. If requested, provide copies of results of factory hydrostatic tests.
- 2.2.2.3. **Standards.** Comply with applicable requirements of the following items listed below. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Section will prevail:
- ANSI/NSF 61 Drinking Water System Components - Health Effects
 - ASTM A-536 Specification for Ductile Iron Castings
 - AWWA C-104 Standard for Cement Mortar Lining for Ductile Iron Pipe and Fittings
 - AWWA C-105 Standard for Polyethylene Encasement for Ductile Iron Piping
 - AWWA C-110 Standard for Ductile Iron and Gray Iron Fittings
 - AWWA C-111 Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings
 - AWWA C-150 Standard for Thickness Design of Ductile Iron Pipe
 - AWWA C-151 Standard for Ductile Iron Pipe
 - AWWA C-214 Tape Coating Systems for the Exterior of Steel Water Pipelines
 - AWWA C-600 Standard for Installation of Ductile Iron Water Mains & Appurtenances
 - AWWA C-651 Disinfecting Water Mains
 - Texas Commission on Environmental Quality, Chapter 290 - Public Drinking Water
- 2.2.2.4. **Pipe Materials.** Manufacture DIP in accordance with AWWA C-151 and conform to ASTM Specification A-536 with physical properties of Grade 60-40-18 with a minimum pressure class rating of 350 psi, unless otherwise specified. Design pipe for 5 ft. of cover or for the depths shown on the plans, whichever is greater. Provide a standard joint length of 18 or 20 ft. and an industry standard inside diameter. Replace any material found to be damaged or defective in manufacture at Contractor's expense.

- 2.2.2.5. **Joints.** Provide push-on standard joints for DIP manufactured in accordance with AWWA C-111, AWWA C-151. Where indicated on the plans, joints will be mechanical or flanged. Flanged joints will have pressure ratings equal to or greater than adjacent pipe. Flange pattern will match pattern of valve, fitting, or appurtenance to be attached.
- 2.2.2.6. **Marking.** Each ductile iron pipe joint and fitting will be marked as required by the applicable AWWA specification including the following:
- Manufacturer's identification,
 - Country where cast,
 - Year of Casting,
 - "DUCTILE" OR "DI,"
 - Barrels of flanged pipe will show thickness class; others will show pressure class,
 - The flanges of pipe sections will be stamped with the fabricators identification,
 - Fittings will show pressure rating and the nominal diameter of openings and the number of degrees for bends, and
 - Painted markings are not acceptable.
- 2.2.2.7. **Fittings.** Provide DIP in accordance with AWWA C-110 and Article 7 of this Specification. Fittings will be rated for a minimum working pressure of 250 psi, unless otherwise specified. Factory welded outlets, minimum pressure rating 250 psi, may be used in lieu of tee fittings for 18 in. and larger tee fittings. Do not use factory welded outlets near sources of vibration, such as pump stations or roads, unless specifically noted on the plans.
- 2.2.2.8. **Exterior Coating.** Provide a standard asphaltic coating in accordance with AWWA C-151, unless otherwise specified. The finished coating will be continuous, and smooth and strongly adherent to the pipe.
- For DIP sizes 30 in. and smaller, use a 30 mils minimum thickness polyethylene wrap applied wrap in accordance with AWWA C-105/A21.5.
- Tape coat DIP 36 in. and larger. The exterior of the pipe must have a prefabricated cold-applied tape coating system conforming to the requirements of ANSI/AWWA C-214, except as noted herein. Blast clean the surface to achieve a surface preparation at least equal to that specified in SSPC SP6. The blast profile must have an anchor pattern as specified by the tape manufacturer. Hold the coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the type of joint used. Taper the tape wrap cut back. Provide a nominal thickness of 80 mils.
- 2.2.2.9. **Interior Lining.** DIP Pipe and fittings will have a cement mortar lining in accordance with AWWA C-104 and bituminous seal coat. Cement Type for lining will be appropriate for pipe application. Provide lining thickness as specified in AWWA C-104.
- 2.2.2.10. **Interior Lining.** Pipe and fittings for wastewater pipelines must be coated to a minimum 40 mils dry film thickness with an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Coating must be "Protecto 401" ceramic epoxy, as manufactured by Induron Protective Coatings.
- 2.2.2.11. **Provisions for Thrust.** Where indicated and where required for thrust restraint, joints must be restrained. Restrained joints will be mechanically interlocking joints. Provide restrained joints such as U.S. Pipe "TR Flex," American Cast Iron Pipe "Flex Ring," or Clow Corporation "Super-Lock" that are capable of sustaining the specified design pressure. If thrust cannot be accommodated using restrained joints, such as bends adjacent to casing pipe, use approved thrust restraint devices.

Thrust at bends, tees, plugs, or other fittings must be resisted using thrust restraint devices. Concrete thrust blocks are not allowed unless approved by the Engineer. Acceptable thrust restraint devices are as manufactured by EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new water line to existing main, both concrete thrust blocking (per Article II of these Specifications) and thrust restraint devices must be used.

Restrained joints and thrust restraint devices must be used for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, design pressure is 1.5 times the design working pressure class indicated. Length of pipe with restrained joints and restraint devices will be determined by pipe manufacturer and in accordance with the Handbook of Ductile Iron Pipe.

The following parameters will be used: laying condition equal to AWWA C-600 Type 5 soil, safety factor of 1.8, a unit bearing resistance equal to zero, an a factor for polyethylene encasement as recommended by DIPRA (Ductile Iron Pipe Research Association), if required.

- 2.2.2.12. **Pipe Trenching, Installation, and Backfill.** Except as noted, perform pipe trenching, Installation, and Backfill for DIP in accordance with AWWA C-600 and Article 6 of this Specification.
- 2.2.2.12.1. **General.** Repair any damage to polyethylene wrap according to AWWA C-105. Keep pipe clean during installation. Provide two coats of Koppers Bitumastic No. 50, or approved equal to exposed ferrous metal that cannot be protected with field-applied tape coating. Install pipe and fittings to line and grade indicated. In areas where the line and grades indicated cannot be achieved using standard manufactured bends and fittings, make slight adjustments by deflecting joints according to the limitations of AWWA C-600.
- 2.2.2.12.2. **Pipe Zone Embedment.** Unless otherwise specified, embed DIP in Class II material as defined in Article 6. Native material or imported material meeting or exceeding Class II requirements may be used.
- 2.2.2.12.3. **Marking Tape.** Mark DIP by installing the appropriate marking tape for detection purposes concurrently. Provide a high visibility blue detectable tape consisting of a 5.0 mil inert polyethylene plastic material with the standard warning and identification for potable water imprinted on the tape. Provide a minimum width of 6 in. for all potable water lines and bury tape to a depth of 36 in., measured from finished grade. Use detecting tape manufactured by Empire, Lineguard, or approved equal.
- 2.2.2.12.4. **Pipe Cutting.** When required, machine cut DIP leaving a smooth cut at right angles to the axis of the pipe. Bevel ends of cut pipe to be used with a push-on joint bell to comply with manufactured spigot end. Do not damage cement lining.
- 2.2.2.12.5. **Corrosion Protection.** As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or equal rustproof compound.
- 2.2.2.13. **Testing.** Disinfect and test the piping system in accordance with Article 10 of this Specification and as detailed in AWWA C-651.
- 2.2.3. **Steel Main Pressure Pipe (STEEL).** The following specifications cover the requirements for steel main pressure pipe (STEEL) materials and for proper and function of the pipe.
- 2.2.3.1. **Quality Assurance.** Conform to applicable standards of ASTM and AWWA and ANSI/NSF Standard 61 "Drinking Water System Components – Health Effects."

Manufacturer must have a minimum of 5 yr. successful experience in manufacturing pipe of the particular type and size indicated. The entire pipeline will be the product of one manufacturer and pipe manufacturing operations (pipe, fittings, lining, and coating) must be performed at one location. Clearly mark one end of each pipe joint and fitting with the class for which it is designed, the date of manufacturer and the identification number.

The quality of materials, the process of manufacture and finished pipe will be subject to inspection and approval. Inspections may be made at the place of manufacture, on the jobsite or both places. Pipe may be subject to inspection by an independent testing laboratory selected and retained by the McAllen Public Utility

(MPU). Pipe manufacturer must provide proper facilities for access and inspection and allow laboratory representatives or Engineer to inspect whenever work is in preparation or progress. Notify MPU, through Engineer in writing, at least two weeks prior to pipe fabrication so that the manufacturer is advised of the decision regarding independent laboratory tests to be performed. Material, fabricated parts, and pipe, discovered to be defective, or do not conform to the requirements of this specification are subject to rejection at any time prior to final acceptance of the product. Promptly remove rejected materials from the jobsite.

The inspection and testing by the independent testing laboratory anticipates that production of pipe be done over a normal period of time and without "slowdowns" or other abnormal delays. In the event that an abnormal production time is required, and MPU is required to pay excessive costs for inspection, reimburse MPU for such laboratory costs over and above those incurred under a normal schedule of production as determined by the Engineer.

Welders must be certified as qualified in accordance with Chapter 9 of the ASME Boiler and Pressure Vessel Code and AWWA C-206. Welds will be tested for conformance with ASTM E-165. Submit welded test specimens upon request.

- 2.2.3.2. **Submittals.** Provide record drawings from the pipe manufacturer for pipe and fittings prior to fabrication that a schematic location-profile and a tabulated layout schedule, both of which are appropriately referenced to the stationing of the proposed pipeline as shown on the plan-profile sheets. Base record drawings on the plans and specifications and incorporate changes necessary to avoid conflicts with existing details of reinforcement, lining, and dimensions for pipe and fittings. Include details for the design and fabrication of all fittings, specials and provisions for thrust restraint. Where welded joints are required, include proposed welding requirements and provisions for thermal stress control. Record drawings are for record purposes only and will not be reviewed or approved.

Provide an affidavit stating that the pipe to be furnished complies with AWWA C-200, AWWA C-205, AWWA C-214, and these specifications.

Furnish the procedure, specifications and qualification records of welding procedures for all pipe welding to be performed for review and approval. Submit a list of the welders and the type of welding for which each has been qualified. All qualification and requalification tests costs are at Contractor's expense.

- 2.2.3.3. **Standards.** Comply with the following applicable requirements:
- ASTM A-307 Low Carbon Steel Externally Threaded Standard Fasteners
 - AWWA C-200 Standard for Steel Water Pipe 6-in. and Larger
 - AWWA C-205 Standard for Cement Mortar Protective Lining and Coating for Steel Water Pipe – 4 in. and Larger
 - AWWA C-206 Standard for Field Welding of Steel Water Pipe
 - AWWA C-207 Standard for Steel Pipe Flanges Waterworks Service – Sizes 4 in. - 144 in.
 - AWWA C-208 Standard for Dimensions for Steel Water Pipe Fittings
 - AWWAC-209 Standard for Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings
 - AWWA C-214 Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines
 - AWWA M-11 Manual Steel Pipe – A Guide for Design and Installation

- 2.2.3.4. **Delivery and Storage.** Deliver, handle, and store pipe in accordance with the Manufacturer's recommendations to protect coating systems. Prepare pipe for shipment to afford maximum protection from normal hazards of transportation and allow pipe to reach project site in an undamaged condition. Do not deliver pipe damaged in shipment to the project site unless such damaged pipe is properly repaired.

Band plastic end covers to pipe ends and maintain until pipe is placed in the trench. Maintain moisture inside the pipe by periodic application of water, as necessary.

Support pipes carefully during shipment and storage. Internally support and brace each end of each length of pipe, fitting, or special and the middle of each pipe joint with stulls to maintain a true circular shape. Provide internal supports consisting of timber or steel stulls firmly wedged and secured so that the stulls remain in place during handling. Rotate pipe so that one of the stulls is vertical during storage, shipment and installation. Do not remove stulls from pipe until backfill operations are complete. Separate pipe, fittings, and specials so that they do not bear against each other, and securely fasten the entire load to prevent movement in transit. Ship pipe on padded bunks with tie-down straps approximately over stulling. Store pipe on padded skids, sand or dirt berm, tires, or other suitable means to protect the pipe from damage.

- 2.2.3.5. **Pipe Materials.** Steel pipe manufactured under AWWA C-200 must be fabricated from sheet or coil conforming to the requirements of ASTM A-570, Grades 30, 33, 36, or 40. It can also be fabricated from plate in coil form conforming to the requirements of ASTM A-36, A-283, Grades C or D, or A 572, Grade 42, or coil conforming to the requirements of ASTM A-139, Grades B or C. Butt weld all longitudinal and girth seams, whether straight or spiral using an approved electric-fusion weld process. Standard laying length is 45 ft.
- 2.2.3.5.1. **Wall Thickness.** Determined wall thickness by performance requirements as follows: Minimum pipe wall thickness is 0.188in. or pipe O.D./230, whichever is greater for pipe and fittings with no minus tolerance. Maximum fiber stress for minimum wall thickness must not exceed 21,000 psi at design working pressure and not exceed 50% of the minimum yield strength of the steel used at the specified maximum working pressure for each class of pipe. In addition, the fiber stress must not exceed 75% of the maximum yield strength at the working pressure plus transient pressure. Minimum wall thickness for pipe placed in casing or tunnel liner is O.D./144 or 0.25in. whichever is greater.
- 2.2.3.5.2. **Exterior Tape Coating.** Coat and wrap pipe outside with the pre-fabricated multi-layer cold-applied polyethylene tape coating in accordance with AWWA C-214. Provide machine-applied tape coating system in accordance with AWWA C-214 and is 80 mils consisting of a primer, 20 mil inner layer, and two 30 mil outer layers. Hold coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the specified joint type. Taper tape wrap cut back. Hand wrap specials and fittings that cannot be machine wrapped. The application must conform to AWWA C-209 and consist of three layers, a primer layer and two 35 mm tape layers. Allow the fitting coating system to overlap the machine-applied coating system a minimum of 6-in. and bond together. Use the same manufacturer for hand wrap tape and machine wrap tape. Tape coating manufacturer will recommend the procedure and tape product required to smooth sharp or abrupt changes at bell, spigot, or flanged joints.
- 2.2.3.5.3. **Cement Mortar Lining.** Shop-applied cement linings must conform to the requirements of AWWA C-205. Use ASTM C-150 Type I or II cement and silica sand. Field applied cement mortar-lining must conform to the requirements of ASTM C-602. Linings on fittings and specials, such as miters, angles, bends and reducers, may be hand troweled. Thoroughly cleaned the pipe interior a method acceptable to the Engineer.
- 2.2.3.5.4. **Mortar for Interior Joints.** Furnish mortar that is one part cement to two parts sand using ASTM C-150 Type I or II cement and silica base sand is plaster and meets ASTM C-35 requirements. Dry mix cement and sand adding sufficient water added to permit packing and troweling without crumbling.
- 2.2.3.6. **Pipe Design.** Design, manufacture, and test steel pipe in accordance with AWWA C-200, AWWA Manual M-11, and with the criteria specified herein for sizes and pressure classes (working pressure) shown. For the purpose of pipe design, the total design internal pressure (transient pressure plus working pressure) will be 1.5 times the working pressure class specified. Design fittings, specials, and connections for the same pressure as the adjacent pipe. Base pipe design on trench conditions and the design pressure in accordance with AWWA Manual M-11. The trench depth is as shown on the plans. Provide the Unit Weight of Fill (W) of 130 pcf, and use live load for AASHTO HS-20 truck load (unless otherwise specified). Use a deflection lag factor 1.1, a bedding constant of 0.1, the modulus of Soil Reaction (E') for design purposes of 700 and the maximum allowable horizontal or vertical deflection of 2% after backfill. Submit design calculations for approval prior to the fabrication of the pipe. Standard laying length is 45 ft. with special lengths, field trim pieces and closure pieces as required by plan and profile for location of elbows, tees, reducers, and other in-line fittings.

- 2.2.3.7. **Joints.** The standard field joint for steel pipe is either a single welded lap joint or a rubber gasket joint. Mechanically coupled or flanged joints are required where shown. Use butt strap joints where shown. Furnish joints that have the same or higher pressure rating as the abutting pipe.
- 2.2.3.7.1. **Lap Welded Slip Joint.** Provide lap welded slip joint at all locations where pipe is to be installed in casing or tunnels and where specified. Do not exceed a clearance of 1/8 in. at any point around the periphery between the surfaces of lap joints. In addition to the provisions of AWWA C-200 for a minimum lap of 1-1/2in., the depth of bell must provide a minimum distance of 1 in. between the weld and the nearest tangent of the bell radius when welds are to be located on the inside of the pipe. Weld joints from the outside for pipe diameters 30 in. or smaller and on the inside for pipe diameters larger than 30 in. If specified on the plans, weld joints on the inside and outside.
- 2.2.3.7.2. **Bell and Spigot with Rubber Gasket.** The standard joint is bell and spigot with rubber gasket at locations where other joint types are not specified and for working pressures not exceeding 250 psi. Joints must conform to AWWA Standards C-200 and AWWA M-11. Form and size the spigot and groove designed to retain the O-ring rubber gasket and size by rolling on male-female dies to match the bell. The differences in diameter between the I.D. of bell and the O.D. of spigot shoulder, at point of full engagement with allowable deflection, is 0.00in. to 0.04in. as measured on the circumference with a diameter tape. Provide gasket with sufficient volume to approximately fill the area of the groove in conformance to AWWA C-200 and AWWA M-11. Ensure that the joint is suitable for a safe pressure equal to the pressure class of the pipe and operates satisfactorily with a deflection tangent not to exceed 0.75D where D is the outside diameter of the pipe in in. or with a pull-out of 3/4 in.
- 2.2.3.7.3. **Flanged Joints.** Provide flanged joints on pipe, fittings and specials on welded steel piping exposed in vaults, on buried pipe system to connect valves and appurtenances or where otherwise indicated that conform to the requirements of AWWA C-207 and AWWA C-206. Ends to be fitted with slip-on flanges must have the longitudinal or spiral welds ground flush to accommodate the type of flanges provided. Rate pipe flange pressure equal to or greater than the adjacent pipe class and match the fittings or appurtenances that are to be attached.
- 2.2.3.7.4. **Butt Strap Closure Joints.** Provide butt strap closure joints in accordance with AWWA C-206 and applicable provisions of this specification where necessary to provide closure to previously laid pipe.
- 2.2.3.7.5. **Flexible Couplings.** Provide flexible couplings where specified. Prepare ends to be joined by flexible couplings as stipulated in AWWA C-200 with plain end type. Ground flush welds on ends to be joined by couplings to permit slipping the coupling in at least one direction to clear pipe joint. Provide harness bolts and lugs that comply with AWWA Manual M-11.
- 2.2.3.8. **Fittings and Specials.** Employ special shop fabricated fittings fabricated in accordance with AWWA C-200 and M-11 where abrupt changes in grade and direction occur. Provide fittings in conformance to the dimensions specified in AWWA C-208. Provide elbows with a minimum radius of 2.5 times the pipe O.D. Provide welded fittings of the sizes and types indicated on the plans. Provide steel plate thickness for fittings equal to or greater than nominal thickness of steel pipe. Reinforce all tees, laterals, and outlets in accordance with M-11. Do not field cut the ends of the steel pipe to accomplish angular changes in grade or direction of the line.
- 2.2.3.9. **Provisions for Thrust.** Use restrained joints to resist thrust at bends, tees, or other. If thrust cannot be resisted using restrained joints, such as bends adjacent to casing pipe, use thrust blocking or concrete anchors. Restrained joints consist of welded joints and will be used a sufficient distance from each side of the bend, tee, plug, or other fitting to resist thrust which develops at the design pressure of the pipe. For the purposes of thrust restraint, use a design pressure of 1.5 times the working pressure class. The length of pipe with restrained joints to resist thrust forces will be determined by the pipe manufacturer in accordance with AWWA Manual M-11. Apply the following criteria for unsaturated soil conditions: calculate the earth weight as the weight of the projected soil prism above the pipe, soil density = 110 pcf (maximum value to be used) and the coefficient of friction = 0.25 (maximum value to be used). In locations where groundwater is encountered, reduce the soil density to its buoyant weight for all backfill below the water table and reduce the coefficient of friction to 0.20.

- 2.2.3.10. **Pipe Trenching, Installation, and Backfill.** Except as noted, Pipe Trenching, Installation, and Backfill for DIP will be in accordance with AWWA C-600 and Article 6 of this Specification.
- 2.2.3.10.1. **General.** Inspect and "jeep" each joint for holidays just before it is lowered into the ditch. Repair all holidays before the pipe is lowered into the trench. Place and consolidate embedment and backfill prior to removing pipe stulls.
- 2.2.3.10.2. **Trench Width.** The minimum clear width of the trench is the outer diameter plus 36 in.
- 2.2.3.10.3. **Pipe Embedment.** Unless otherwise specified or shown on the plans, embed steel pipe in Native material as defined in Article 6. If Native material is not suitable, use Class II material as defined in Article 6.2.4.2
- 2.2.3.10.4. **Installation-Welded Joints.** Weld joints in accordance with the AWWA C-206. Provide full circle fillet welds. Remove the pipe from the line if the ends of the pipe are laminated, split, or damaged to the extent of satisfactory welding contact cannot be obtained.

Welders are required to identify their work with a code marking. Furnish a listing of the welder's names with corresponding code marks. Any welder making defective welds will not be allowed to continue to weld. If a disagreement arises with the Engineer's interpretation of welding tests, test sections may be cut from the joint for physical testing. Repair joint, regardless of the results of physical testing, at no additional cost to the Department. Submit repair procedure for approval before proceeding.

Provide adequate provisions for reducing temperature stresses.

Shim or tack the spigot and bell essentially concentric to obtain clearance tolerance around the periphery of the joint after the pipes have been joined and properly aligned and prior to the start of the welding procedure. Clearance tolerances are not permitted to accumulate.

Before welding, thoroughly clean pipe ends. Weld pipe by machine or by the manual shielded electric arc process. Perform welding in a manner that does not damage lining or coating. Cover the tape coating as necessary to protect from welding.

Furnish labor, equipment, tools and supplies, including shielded type welding rod. Protect welding rod from any deterioration prior to its use. If any portion of a box or carton is damaged, reject entire box or carton.

Deposit metal in successive layers so that there will be at least two passes or beads in the completed welds. Deposit no more than 1/4 in. of metal on each pass. Thoroughly clean each pass, including the final pass, by wire brushing and hammering to remove dirt, slag, or flux.

In all hand welding, deposit metal in successive layers so that there are at least as many passes or beads in the completed weld as indicated in Table 1.

Table 1
Hand Welding Requirements

Plate Thickness	Fillet Weld, Minimum
In.	Number of Passes
3/16	1
1/4	2
5/16	2
3/8	3
13/32	3
7/16	3
15/32	4
1/2	4
More than 1/2	1 for each 1/8 in. and any remaining fraction thereof

Do not deposit more than 1/8in. of metal in each pass for hand welds. Thoroughly bob or peen each pass except the final one, whether in butt or fillet welds, to relieve shrinkage stresses and to remove dirt, slag, or flux before the succeeding bead is applied. Thoroughly fuse each pass into the plates at each side of the welding groove or fillet and do not permit to pile up in the center of the weld. Undercutting along the side is not permitted.

Construct welds free from pin holes, non-metallic inclusions, air pockets, undercutting and any other defects.

- 2.2.3.10.5. **Installation – Rubber Gasket Joints.** Join rubber gasket joints in accordance with the manufacturer's recommendations. Clean bell and spigot of foreign materials. Lubricate gaskets and relieve gasket tension around the perimeter of the pipe. Engage spigot as far as possible in bell, allowing for a 3/8 in. to 1 in. gap for inside joint grouting after any joint deflection.
- 2.2.3.10.6. **Interior Joint Grouting for Pipe with Plant-Applied Mortar Lining.** Upon completion of backfill, fill the inside joint recess with a stiff cement mortar as indicated. Prior to the placing of mortar, clean out dirt or trash that has collected in the joint, and moisten the mortar surfaces of the joint space by spraying or brushing with a wet brush. Ram or pack the stiff mortar into the joint and take extreme care to ensure that no voids remain in the joint space. After the joint has been filled, level the surface of the joint with the interior surfaces of the pipe by steel troweling. Carefully inspect every joint to ensure a smooth continuous interior surface. Thoroughly clean the interior of the pipe and remove any obstructions that may reduce its carrying capacity. Butter with mortar the bottom of the bell on the interior joints of pipe smaller than 21 in. in diameter prior to inserting the spigots, such that when the spigot is pushed into position it extrudes surplus mortar from the joint. Strike off the surplus mortar flush by pulling a filled burlap bag or inflated ball through the pipe.
- 2.2.3.10.7. **Field-Applied Outside Joint Coating.** Clean the surface of foreign materials. Remove weld slag, splatter, and scale. Remove by grinding or filing the sharp edges or burrs that could puncture or cut the tape. Clean the surface using a solvent wash and wire brushing, dry, and prime the surface prior to tape coating. Wrap joints with a tape coating system conforming to AWWA C-209, consisting of three layers, a primer layer and two (2) 35 mm tape layers. Overlap the factory-applied coating system with the field-applied coating system a minimum of 6 in. and bond together.
- 2.2.3.10.8. **Protection of Exposed Metal.** Coat exposed ferrous metal such as bolts and flanges that cannot be protected with field-applied tape coatings with a coat of Koppers Bitumastic No. 50 or approved equal.
- 2.2.3.10.9. **Patch of Coating.** When visual inspection shows a portion of the tape system has sustained physical damage, the area in question may be subjected to an electrical holiday test to 6,000 volts. When the area is tested and there are no holidays or tearing of the material (only wrinkling or bruising), no patching is required. When the damaged area has a tearing of material, remove the damaged layers of outer-wrap by carefully cutting with a sharp razor type utility knife. Wipe the area clean and dry with a rag. Apply the repair tape using a "cigarette wrap" in accordance with the tape manufacturer's recommendation of sufficient size to completely cover the damaged areas, plus a minimum overlap of 6 in. tape in all directions. Apply a second patch of repair tape over the first patch. Overlap the first patch a minimum of 6 in. with the second patch.

- 2.2.3.10.10. **Patch of Lining.** Repair cracks larger than 1/16 in. and disbanded linings. Excessive patching of lining is not permitted. Field-patching of lining will be allowed where area to be repaired does not exceed 100 sq. in. and has no dimension greater than 12 in. Repair larger areas by gunite method and reinforce work. No more than one patch in the lining of any joint of pipe is allowed. Wherever necessary to patch the pipe, make the patch with the mortar indicated. Do not install patched pipe until the patch has been properly and adequately cured and unless approved for laying by the pipe manufacturer's technician and by the Engineer.
- 2.2.3.11. **Testing.** Disinfect the piping system in accordance with Article 10 of this Specification and as detailed in AWWA C-651. Test the field-applied joint coating for holidays after field-applied coating and prior to backfilling as per AWWA C-209. Where welds cannot be tested by hydrostatic tests, such as fittings adjacent to test valves, perform a dye penetrant test in accordance with ASTM E-165. Replace or repair welds that prove to be defective. Engineer must approve all patch work necessary during such tests.
- 2.2.4. **Polyethylene Pipe**
- 2.2.4.1. All polyethylene pipe will be made from HDPE material having a material designation code of PE3608 or higher. The material will meet the requirements of ASTM D3350 and will have a minimum cell classification of PE345464C. The pipe material will also meet NSF-61.
- The pipe and fittings will meet the requirements of AWWA C906.
- 2.2.4.2. **Standards.** Comply with the applicable requirements of the following items listed below. In case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Section will prevail.
- ANSI/AWWA C906-15 Polyethylene (PE) Pressure Pipe and Fittings, 4 in through 63 in for waterworks
 - AWWA M55 Manual of Water Supply Practices, PE Pipe Design and Installation
 - ASTM D2239 Standard Specification for Polyethylene (PE) Pressure Pipe
 - ASTM D3035 Standard Specification for Polyethylene (PE) Pressure Pipe
 - ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Pipe and Tubing
 - ASTM D3350 Standard Specification for Polyethylene Pipe and Fittings Materials
 - ASTM F905 Standard Specification for Qualification of Polyethylene Saddle-Fused Joints
 - ASTM F1055 Standard Specification for Electrofusion Type Polyethylene Fittings
 - ASTM F2164 Standard Practice for Field Leak Testing of Polyethylene (PE) systems using Hydrostatic Pressure
 - ASTM F2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)
 - ASTM F2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
- 2.2.4.3. The polyethylene pipe will be rated for use at a pressure of 200 psi. The outside diameter of the pipe will be based upon the DIPS (Ductile Iron Pipe Size) sizing system.
- 2.2.4.4. The high density polyethylene pipe manufacturer will provide either a certification that stress regression testing has been performed on the specific product, or a stress life curve per ASTM D2837. The stress regression testing will have been done in accordance with ASTM D2837, and the manufacturer will provide a product supplying a minimum Hydrostatic Design Basis (HDB), as determined in accordance with ASTM D2837.
- The manufacturer's certificate will state that the pipe was manufactured from one specific resin in compliance with these specifications. The certificate will state the specific resin use, its source, and list its compliance to these specifications.
- The pipe will be produced with the nominal physical properties outlined in this specification, and to the dimensions and tolerances specified in ASTM F714.

The pipe service identification color for the exterior will be blue for pipes used as potable water mains. The coloring agent used must be resistance to the effects sunlight and must allow the color to be stable for a period of at least six months in full sunlight.

2.2.4.5. **HDPE Pipe Joints**

Butt Fusion: Sections of high density polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method will be the butt fusion method and will be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400°F, alignment and 75 psi interfacial fusion pressure.

Saddle Fusion: Saddle fusion will be done in accordance with ASTM F2620 or PPI TR-41 or the manufacturer's recommendations and PPI TR-41. Saddle fusion joints will be made by qualified fusion technicians. Qualifications of the fusion technician will be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on this project.

Electrofusion: Electrofusion joining will be done in accordance with the manufacturer's recommended procedure. Other sources of electrofusion joining information are ASTM F1290 and PPI TN-34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician must be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

Weld Strength: Fusion joining will be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion and extrusion welding must not be used.

Trial Fusion: At the beginning of each day, a trial fusion will be performed to verify fusion procedure and equipment settings for the actual jobsite conditions. Allow trial fusions to cool completely before cutting straps and cutting by bending the straps until the ends touch. The test specimen dimensions will conform to ASTM D2657.

2.2.4.6. **HDPE Service Connections**

Service connections will be electrofusion saddles with stainless steel threaded outlet, sidewall fusion branch saddles, tapping tees, or mechanical saddles.

2.2.5. **Flowable Backfill.** Backfill trenches to the elevations shown with flowable backfill as per Item 401, "Flowable Backfill."

2.2.6. Acceptance Tests for Pressure Mains

2.2.6.1. Perform hydrostatic pressure and leakage test.

2.2.6.1.1. Conform to AWWA C600 procedures.

- As Modified herein.
- Will apply to all pipe materials specified.

2.2.6.1.2. Perform after backfilling.

2.2.6.1.2.1. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plug.

- Contractor to furnish and install test plugs, including all anchors, braces and other temporary or permanent devices to withstand hydrostatic pressure on plugs, at no additional cost to the owner.
- Contractor responsible for any damage to public or private property caused by failure of plugs.

2.2.6.1.2.2. Limit fill rate of line to available venting capacity. Fill rate will be regulated to limit velocity in lines when flowing full to not more than 1 fps.

2.2.6.1.2.3. Owner will make water for testing available to contractor at nearest source. Valves of existing water system will at all times be operated by City personnel only.

2.2.6.1.2.4. Pressure Test:

- Conduct at pressure at least 1.5 times the normal working pressure (not less than 150 psi test pressure).
- Maintain pressure for a minimum of 2 hr.
- Test pressure will not vary by more than +5 psi

2.2.6.1.2.5. Leakage Test:

- Conduct concurrently with the pressure test.
- Maintain pressure for a minimum of 2 hrs.
- Acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{N \cdot D \cdot P^{0.5}}{7400}$$

L = Maximum permissible leakage in gallons per hour.

N = Number of pipe joints in segment under test.

D = Nominal internal diameter of pipe being tested in inches.

P = Average actual leakage test pressure, psig.

2.2.6.1.2.6. Repeat leakage test as necessary.

- After location of leaks and repair or replacement of defective joints, pipe or fittings.
- Until satisfactory performance of test.
- At no increase in cost to the Owner.

2.2.6.1.2.7. Refit and replace all pipe not meeting the leakage or pressure requirements. The use of a repair clamp is not permitted.

2.2.6.1.2.8. Repair all visible leaks regardless of the amount of leakage.

2.2.6.1.2.9. Owner or Engineer will observe all tests.

2.2.7. Disinfection of Pipelines for Conveying Portable Water.

2.2.7.1. Contractor to provide all equipment and materials and perform in accordance with AWWA C601.

- As modified herein.
- Include chlorination and final flushing.

2.2.7.2. Add chlorine to attain an initial concentration of 50 mg/l chlorine with 10 mg/l remaining after 24 hr.

2.2.7.3. Flush main until concentration is 2 mg/l or less prior to placing man in service.

- 2.2.7.4. Obtain approval of materials and methods proposed for use.
- 2.2.7.5. May be conducted in conjunction with acceptance tests.
- 2.2.7.6. Dispose of flushing water without damage to public or private property.
- 2.2.7.7. Repeat disinfection procedure should initial treatment fail to yield satisfactory results.
- At no additional cost to the Owner.
 - Owner will provide water under terms specified for acceptance tests.
- 2.2.7.8. Do not exceed 500 gpm rate in flushing.
- 2.2.7.9. Provide safe bacterial sample results before placing main into service.
- 2.2.8. **Cutting and Restoring Pavement.** Where water facilities must be installed in streets or other paved areas beyond limits of the roadway improvements, the work includes saw-cutting of the pavement and base to neat lines and prompt replacement of these materials after water excavation and backfill are completed. The replacement materials, as to type and thickness, are shown on the plans.
- 2.3. **Measurement.**
- 2.3.1. **Water Main (PVC).** This Item will be measured in place by the foot of PVC along the centerline of pipe as installed.
- 2.3.2. **Water Main (DIP).** This Item will be measured in place by the foot of DI pipe along the centerline of pipe as installed.
- 2.3.3. **Water Main (STEEL).** This Item will be measured in place by the foot of STEEL pipe along the center line of pipe as installed.
- 2.3.4. **Abandon and Fill Existing Water Pipe.** This Item will be measured by the foot of existing water main pipe that is abandoned in place for the size indicated
- 2.3.5. **Remove Existing Water Pipe.** This Item will be measured by the foot of existing water main pipe that is removed as identified in the plans.
- 2.3.6. **Cutting and Restoring Pavement.** This Item will be measured by the square yard as shown under Item 400, "Excavation and Backfill for Structures."
- 2.3.7. **Flowable Backfill.** This Item will be measured by the cubic yard as shown under Item 401, "Flowable Backfill."
- 2.4. **Payment.**
- 2.4.1. **Water Main (PVC).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (PVC)" of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, valves, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: gate valves, stainless steel tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, bonnet boxes, valve/access manholes, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, thrust restraint devices and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including

coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures." Flowable fill will be paid for in accordance with Item 401, "Flowable Fill." Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection."

- 2.4.2. **Water Main (DIP).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (DIP)" of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, valves, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: gate valves, stainless steel tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, bonnet boxes, valve/access manholes, cathodic protection, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, polyethylene wrap, concrete thrust blocks, thrust restraint devices and all other items not indicated as being covered under the other specific bid items; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing;; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures." Flowable fill will be paid for in accordance with Item 401, "Flowable Fill." Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection."

- 2.4.3. **Water Main (STEEL).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (STEEL)" of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, valves, fittings and accessories; welded joint restraint systems; and all appurtenances defined herein to include, but not limited to the following items: gate valves, stainless steel tapping sleeves and valves, butterfly valves with manholes, air/vacuum release valves, blow-off valve assemblies, valve/access manholes, cathodic protection, bonnet boxes, concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, welded thrust restraint and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including testing, coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required; cutting, capping, and connection of new water main to existing water lines.

All fittings and appurtenances shown on the plans will not be paid for directly but will be subsidiary to the water pipe installation.

Cutting and restoring pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures." Flowable fill will be paid for in accordance with Item 401, "Flowable Fill." Trench excavation protection will be paid for in accordance with Item 402, "Trench Excavation Protection."

- 2.4.4. **Abandon and Fill Existing Water Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Abandon and Fill Existing Water Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation, complete draining (dewatering) of pipe, flowable backfill, cutting, capping, complete filling with approved flowable backfill of water mains to be abandoned, removal of bonnet boxes

from abandoned valves, and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal.

- 2.4.5. **Remove Existing Water Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Remove Exist Water Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation and backfill, complete draining (dewatering) of pipe, groundwater dewatering, flowable backfill, cutting, capping, removal of pipe, disposal of materials, and all other items not indicated as being covered under the other specific bid items.

3. CONCRETE

- 3.1. **Description.** Furnish all labor, materials, equipment and incidentals necessary to mix and place concrete, consisting of Portland cement, fine aggregate, coarse aggregate, admixtures, and water in the proper proportions as specified herein for use in Water and Sewer Mains.

- 3.2. **Materials.**

- 3.2.1. **Quality Assurance.** Proportion cement to give the necessary workability and strength and conform to the requirements shown on Table 3.

**Table 3
Cement Requirements**

CLASS	MINIMUM 28-DAY COMPRESSIVE STRENGTH	MINIMUM CEMENT	MAXIMUM SIZE COARSE AGGREGATE	SLUMP (inches)
A	3,000 psi	5.5 bag/cy	3/4in.	3 1/2in.
B	2,500 psi	4 bag/cy	1 1/2in.	4in.
C	4,000 psi	6 bag/cy	3/4in.	4in.

- 3.2.2. **Class Designations.** The class designations provided above are to be used as listed:
 - Class A Use for curb, gutter, and sidewalk replacement, unless otherwise directed.
 - Class B Use for thrust blocks, pipe encasement, ground anchors for piping and as noted in the plans.
 - Class C Use for cast in place sewer manhole bases and aprons, special structures or as required by manufacturer's specifications for pre-cast structures, unless otherwise indicated.

- 3.2.3. **Submittals.** Submit certified test reports regarding concrete mix design and reinforcing steel as may be required by the plans or the Engineer. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary.

- 3.2.4. **Standards.** Comply with the following applicable requirements for concrete and related products:
 - ASTM C-33 Specification for Concrete Aggregates,
 - ASTM C-150 Specification for Portland Cement,
 - ASTM C-260 Specification for Air-Entraining Admixtures for Concrete, and
 - ASTM C-494 Specification for Chemical Admixtures for Concrete.

- 3.2.5. **Portland Cement.** Conform to ASTM C-150 for the appropriate required Type.

Aggregates. Conform to ASTM C-33. Use fine aggregate consisting of natural, washed, and screened sand having clean, hard, strong, durable, un-coated grains complying with ASTM C-33. Use coarse aggregates that comply with ASTM C-33 Size 467, Size 57, or Size 67. Local aggregates of proven durability may be used with prior approval.

Use air-entraining admixture for concrete of 3,000 psi or greater and complies with ASTM C-260. The total average air content will be in accordance with ACI 211.1.

Use water reducing admixture when required by job conditions in conformance with ASTM C-494. Use only admixtures that have been tested and accepted in mix designs, unless otherwise acceptable. Use according to manufacturer's recommendations.

Use set retarding admixtures as approved, in conformance with ASTM C-494 and according to manufacturer's recommendations.

Use water that is clean and free from impurities. Drinking and ordinary household water is acceptable.

3.2.6. **Manufactured Products.** Provide forms of wood or metal of sufficient strength to support the concrete without bulging between supports and sufficiently water tight to hold the concrete mortar. Construct forms to the shape and dimensions of finished concrete shown on the plans. For exposed surfaces, provide form work material and construct to produce a smooth, even surface when the concrete is poured. Oil all forms before use. Remove wall forms after the concrete has been in place for 24 hr. Chamfer all exposed edges 3/4 in. chamfer. Repair any honeycombed sections immediately upon removal of the form as directed.

Embedded Items. Accurately set in place and maintained in position during concreting operations all bolts, pipe, pipe sleeves, inserts, or other fixtures, required by the plans or this specification to be embedded in the concrete.

Reinforcing Steel. Provide bar reinforcement that is round, deformed bars, Grade 60, conforming to either "Specification for Rail Steel Deformed and Plain Bars for Concrete Reinforcement" (ASTM A-616), or "Specifications for Axle Steel Deformed and Plain Bars for Concrete Reinforcement" (ASTM A-617).

- Rail Steel Bars will be permitted only where bending is not required.
- Permanently mark all reinforcement bars with grade identification marks or, on delivery, be accompanied by a manufacturer's guarantee of grade that will identify variation.
- Protect reinforcement stored on the site from accumulation of grease, mud or other foreign matter and from rust producing conditions.
- Ensure that bars are free from rust, scale, oil, mud, or structural defects when incorporated in the structures.
- Accurately place and securely hold in place reinforcement during concrete placement in accordance with the ACI Detailing Manual.

3.2.7. **Concrete Thrust Blocking.** Block with concrete all underground piping bearing solidly against undisturbed trench walls, at all changes in direction subsidiary to the installation of fittings, valves, and all other appurtenances requiring provisions for thrust restraint.

Place concrete blocking against undisturbed trench walls with a minimum 18 in. between trench wall and pipe extending a minimum of 0.75 times the pipe diameter shown on Table 4 and above the centerline of pipe. Do not extend beyond any joints. Place blockings in accordance with the recommendations of "A Guide for the Installation of Ductile Iron Pipe" published by Cast Iron Pipe Research Association. If requested, contain the ends of the thrust blocks in wood or metal forms. Reinforce concrete anchor where upward thrusts are to be resisted.

Use Class B concrete for Blocking. The minimum area of concrete bearing against undisturbed trench bank is shown on Table 4.

Table 4
Bearing Surface Per Bend

PIPE SIZE	TEE, DEAD END, 90° BEND	45 AND 22-1/2° BEND
6in.	4 sq. ft.	3 sq. ft.
8in.	6 sq. ft.	3 sq. ft.
12in.	13 sq. ft.	7 sq. ft.
16in.	23 sq. ft.	12 sq. ft.
20in.	37.02 sq. ft.	20.04 sq. ft.

- 3.3. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main bid items and related appurtenances items. This includes furnishing all required materials including concrete used for thrust blocking or anchoring fitting (bends, plugs, reducers, etc.), valves, fire hydrants, manholes, water services or water fire lines, and all other concrete items damaged by Contractor due to negligence during the course of the project; and all hauling, mixing, manipulation, tools, labor, equipment, forming and incidentals necessary to complete the work.

4. GROUT

- 4.1. **Description.** Provide all labor, materials, equipment, and incidentals for grout uses other than masonry.
- 4.2. **Materials.**
- 4.2.1. **Non-shrink, Epoxy Type.** Provide a non-metallic, 100% solids, high strength epoxy grout such as Epoxitite as manufactured by A.C. Horn Company, or Five Star Epoxy Grout by U.S. Grout Corporation, or approved equal.
- 4.2.2. **Non-shrink, Non-metallic Type.** Provide a premixed non-staining cementitious grout requiring only the addition of water at the job site. Provide Darex In-Pakt Grout Pre-mix by A.C. Horn Company, or Masterflow 713 by Master Builders Company, or approved equal.
- 4.2.3. **Ordinary Cement-Sand Grout.** Consisting of one part by weight of Portland cement complying with ASTM C-150, Type V, to three parts by weight of clean sand of suitable gradation and complying with ASTM C-33. Ordinary grout may be of masonry cement, 4 sacks per cu. yd. of clean sand, together with approved air-entraining agent and a minimum of clean water for placing. Where water repelling and shrinkage reducing requirements are shown or specified, use approved admixtures.
- 4.2.4. **Water.** Use clean, fresh, potable water free from injurious amounts of oils, acids, alkalies, or organic matter.
- 4.3. **Standards.** Comply with the following applicable requirements:
- ASTM C-33 Specification for Concrete Aggregates and
 - ASTM C-150 Specification for Portland Cement
- 4.4. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main bid items.

5. EXCAVATION, INSTALLATION, AND BACKFILL

- 5.1. **Description.** Excavation classification is defined as “unclassified” and involves removing unnecessary materials and excavating trenches to the alignment, width, and depth as indicated in the plans or as required for the proper installation of the pipe and appurtenances. Protect adjacent structures from damage by construction equipment. Pile all excavated material along the trench in a manner that will not endanger the work.

5.2. **Materials.**

5.2.1. **Standards.** Comply with the following applicable requirements for embedment materials:

- ASTM D-75 Methods for Sampling Aggregates,
- ASTM D-448 Specification for Standard Sizes of Coarse Aggregate for Highway Construction,
- ASTM D-2321 Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe, and
- ASTM D-2487 Classification of Soils for Engineering Purposes.

5.2.2. **Definitions.** For the purpose of this specification, “pipe zone” defines the area extending from the bottom of the trench bedding to 12 in. above the top of the pipe and to the undisturbed trench walls on either side of the pipe. “Embedment” is defined as those vertical stratas of backfill material in the pipe zone consisting of bedding, haunching, and initial backfill, as defined in ASTM D-2321.

5.2.3. **Submittals.** Include certified test reports for embedment material from an independent laboratory. Include sieve analysis and Atterberg’s limits on test reports. Submit a gradation of Class I material for approval prior to installation.

5.2.4. **Pipe Zone and Backfill.** Classify materials according to The Unified Soil Classification System as defined in ASTM D-2487.

Class I Material. Provide manufactured angular, well-graded, crushed stone per ASTM D-2321, 1/4 in. to 3/4 in. size material. Acceptable materials under this class designation are: ASTM D-448 - Stone Sizes 4, 67, 5, 56, 57, and 6. Pea Gravel and other uniformly graded material are not acceptable under this class.

Class II Material. Provide coarse sands and gravels per ASTM D-2487 with maximum particle size of 3/4 in., including variously graded sands and gravels, containing less than 5 percent fines (material passing the #200 sieve) generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class.

Class III Material. Provide fine sand and clayey (clay filled) gravels, per ASTM D-2487, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Class III includes soil Types GM, GC, SM and SC.

Do not use Class IV or V material, as defined in ASTM D-2487, for embedment of flexible pipe.

5.2.5. **Final Backfill.** Unless otherwise shown, material for backfilling above the pipe zone is defined as follows:

Native. The most granular material excavated from the trench comprising the spoil bank may be used, provided it is devoid of rocks larger than 3 in. in greatest dimension, organic material, and other unsuitable material. If initially saturated during the excavation, allow backfill to dry sufficiently, being manipulated if necessary, prior to placing back into trench, to achieve the specified compaction at plus or minus 2% of optimum moisture content.

Select. Select material is designated as Class II as described in 6.2.4.2. If material excavated from the trench is unsuitable as backfill material, or the required compaction is unattainable for the particular spoil backfill material, import select material to be mixed with or used in place of the spoil material.

Soil Cement. When shown on the plans, cement stabilized backfill will consist of a mixture of soil or sand and 2 sacks of Portland cement per cubic yard. Use a sandy material, free from lumps, clods or organic material. If excavated material is not suitable, use pit-run sand. Mix cement stabilized backfill in a concrete mixer or transit mixer.

5.3. **Construction.**

5.3.1. **Sources and Evaluation Testing.** Obtain materials to be used for embedment and for backfill in accordance with a sampling plan and ASTM D-75. Perform testing of materials to certify conformance with specification requirements by an approved independent testing laboratory. Perform tests and provide results upon change of source and at sufficient intervals to certify conformance of all material furnished.

5.3.2. **Trench Excavation and Preparation.** Construct trench walls in the “pipe zone” vertically.

Trench Width. See Tables 5 and 6 below for trench widths for flexible and rigid pipes.

**Table 5
Flexible Pipe Trench Width**

PIPE DIAMETER	TRENCH WIDTH = BARREL OUTER DIAMETER PLUS	
	Minimum	Maximum
Less than 24 in.	15 in.	18 in.
24 in. – 48 in.	18 in.	24 in.
Greater than 48 in.	24 in.	1/2in. Pipe O.D.

**Table 6
Rigid Pipe Trench Width**

Do not exceed the outside diameter of the pipe barrel plus the following allowance for RIGID PIPE trench width:	
PIPE DIAMETER	TRENCH WIDTH = BARREL OUTER DIAMETER PLUS
Less than 18 in.	16 in.
18 in. - 24 in.	19 in.
27 in. – 39 in.	22 in.
42 in. & Larger	1/2 in. Pipe O.D.

If maximum trench width specified above is exceeded at the top of the pipe, provide additional load-bearing capacity by means of improved bedding, concrete cradle, cap, or encasement, or other approved means

Lay back or bench the trench walls above the pipe zone, where space permits, as necessary to satisfy the requirements of OSHA and additional requirements for Trench Support as specified herein.

Wherever the prescribed maximum trench width is exceeded, remove all loose and sloughed-in material from the trench and replace with compacted granular material such that haunching and initial backfill is compacted to at least 2.5 pipe diameters from either side of the pipe or to the trench walls.

Unless otherwise agreed upon, no additional payment will be made for extra material and labor required to fill excessive trench widths caused by Contractor’s equipment or natural collapse of trench walls.

5.3.3. **Trench Bottom.** Excavate the trench to an even grade so that the full length of the pipe barrel is supported and joints may be properly assembled.

For 30 in. diameter and smaller pipe, “rough cut” the trench a minimum of 4 in. below the bottom of the pipe. For 33 in. and larger pipe, “rough cut” the trench a minimum of 6 in. below the bottom of the pipe. Increase the “rough cut” dimension as necessary to provide a minimum clearance of 2 in. from the bottom of the trench to the bottom of the bells, flanges, valves, fittings, etc.

The entire foundation area at the bottom of all excavations will be firm, stable material. Remove loose material leaving a clean, flat trench bottom. Do not disturb material below required subgrade except as described elsewhere in this specification.

If the subgrade is soft, spongy, disintegrated, or where the character of the foundation materials is such that a proper foundation cannot be achieved at the elevation specified, deepen the excavation, not less than 6 in. to a depth where a satisfactory foundation may be obtained. Bring back subgrade to the required grade with Class I coarse gravel compacted to 70% relative density per ASTM D-4254.

5.3.4. **Over Excavation.** If the trench is excavated to a faulty grade (at a lower elevation than indicated), correct the faulty grade at no additional cost as follows:

- In uniform, stable dry soils, correct the faulty grade with Class II granular embedment material thoroughly compacted to 90% Modified Proctor Density per ASTM D-1557.
- In soft spongy disintegrated soils, or where necessary to allow proper drainage, correct the faulty grade with Class I coarse gravel compacted to 70% of relative density.

5.3.5. **Rock Excavation.** When pipe is to be laid in rock cut, provide a clearance of at least 6 in. below parts of the pipe, valves or fittings. Provide adequate clearance at bell holes to permit proper jointing of pipe laid in rock trenches. Refill excavation to pipe grade with Class II granular embedment material compacted to 90% Modified Proctor Density. Blasting is not permitted unless specifically required and called for in the plans and with a permit issued by governing authorities.

5.3.6. **Bell Holes.** Dig, in trenches, bell holes of ample dimension at each joint of pipe to permit the jointing to be made properly, visually inspected, and so that the pipe will rest on the full length of the barrel.

5.3.7. **Dewatering.** Dewater excavations by physically installing/drilling dewatering wells, laying of discharge piping, other preparatory work and the maintenance of the operating system so that the work is performed in dry conditions.

Use coarse gravel and geo-synthetic material to maintain the integrity of pipe and embedment material. Geo-synthetic material must wrap completely around pipe and gravel.

Determine and record the elevation of the groundwater level prior to dewatering. Unless otherwise specified, the method of dewatering will maintain a phreatic water surface a minimum of 18 in. below pipe grades. Should over-excavation be necessary due to unsuitable foundation conditions, lower the ground water as necessary.

Direct water removed from trenches to natural drainage ways, drains, or storm sewers in such a manner as to prevent damage to adjacent property or to the public. Provide pumps of ample capacity and in duplicate to ensure that once an excavation is dried, the water level remains below the trench depth until that portion of the work is completed. Obtain approval for discharge from the appropriate governing agency. Do not discharge into the sanitary sewer systems.

Determine if any wells used for domestic purposes are affected by the dewatering and furnish potable water to any affected residents when dewatering may affect the production of private wells along the route. Prepare baseline water level analysis in area to confirm affect on private wells.

Dispose of the water from the dewatering operation according to the conditions of the discharge permit. Coordinate dewatering effort with City of McAllen Engineering Department, insofar as compliance with discharge permit is concerned, and where dewatering effluent will enter drainage ditches operated and maintained by Hidalgo County Drainage District #1.

Equip engines or engine generators used to run the dewatering pumps with residential grade silencers. Provide silencers that have an attenuation range of 25 to 30 dBA as required by McAllen Public Utility.

Submit a dewatering plan indicating proposed locations of dewatering wells, pumping facilities, collector and discharge pipe-lines, and discharge points (names of ditches, laterals, etc.). If discharging into City of McAllen drains, provide the plan for City comments and approval. To comply with the requirements of the Hidalgo County Drainage District #1 (HCDD#1) discharge permit, discharge monitoring points may be required. City of McAllen personnel will obtain samples for laboratory analysis to check water quality limitations imposed by the permit.

Record pumping rates at dewatering wells, pump times, and flows and become familiar with the methods of measurements as shown on Table 7.

**Table 7
Pumping Rates Schedule**

DATA RECORDED	METHOD OF MEASUREMENT	FREQUENCY OF MEASUREMENT
Pumping Rate At Each Dewatering Well or Discharge Point	"California-Pipe Method"	Daily If Changes Occur
Pumping Time	Hours	Daily
Total Dissolved Solids (TDS)	PSB Laboratory	Monthly
Total Discharge	Rate x Time	Continuous

Record obtained data on a standard data sheet and submit monthly. Comply with HCDD#1 requirements and allow HCDD#1 inspection of dewatering system at any time during project life.

Submit a Dewatering Plan, a Final Schedule for Dewatering, and an estimate of fees due HCDD#1 within 15 working days from the date of the Notice to Proceed. The Plan is a mandatory submittal and must include the estimated quantities of dewatering for each month and the points of discharge. The Engineer will review and approve the Dewatering Submittal and forward it, through the MPU, to the District. MPU must receive the approved plan at least two weeks in advance of the planned dewatering operations. Dewatering Fees due are estimated on the following basis:

- Non-refundable application fee of \$1,000,
- \$150 per acre-foot of estimated groundwater estimated that will be discharged into the HCDD#1's facilities during term of the agreement, and
- Payment due a minimum of seven (7) calendar days in advance of any discharge.

5.3.8.

Trench Support. Brace and sheet excavations to provide complete safety to persons working therein in conformance with applicable federal (OSHA), state and local laws and ordinances. Meet the requirements specified in the current OSHA Standard for all trenches exceeding 5 ft. in depth as measured from the ground surface at the highest side of the trench to the trench bottom.

Provide sufficient and adequate bracing for excavations with respect to work under construction and to adjacent utility lines and private property. Where soil conditions within trench area require support, use tight sheeting, skeleton sheeting, stay bracing, trench jacks, movable trench shield, or other approved methods to support the trench during pipe installation operations such as bedding preparation, pipe laying, and backfilling of haunches and initial zone.

Do not extend trench support below the pipe crown whenever possible. Where trench support must extend below the crown, such support should either be left in place or consist of approved steel sheets that can be retracted with minimal disturbance. Treat remaining voids with grout or granular embedment material.

When a movable trench shield is used, the trailing half of the shield should be notched to the height of the top of the pipe. This will allow the haunch area of the pipe to be compacted properly to the wall of the trench. Dragging of a trench shield at pipe grade may be done provided such practice does not disturb the bedding. Fill and compacted voids created by the shield properly.

5.3.9. **Trenching in Public Right-of-Way.** Except where otherwise specified, indicated on the plans, or approved in writing, do not exceed the maximum length of open trench shown on Table 8, where the construction is in any stage of completion. The definition of “open trench” for the purposes of this description includes excavation, pipe laying, backfilling, and pavement replacement. The descriptions under the area designations are general in nature and may be amended in writing by the Engineer due to particular or peculiar field conditions.

**Table 8
Maximum Open Trench Lengths**

TYPE OF AREA	MAX LENGTH (LF)	DESCRIPTION
Business District	300	Store front areas
Commercial	300	Industrial, shopping centers, churches, schools, hotels, motels, markets, gas stations, government and private office buildings, hospitals, fire and police stations, and nursing homes
Residential	One (1) block or 300 linear feet, whichever is the least.	Single and multi-family residences, apartments, and condominiums
Undeveloped	1,500	Parks, golf courses, farms, undeveloped subdivided land

Any excavated areas is considered “open trench” until all pavement replacement has been made or until all trenches outside of pavement replacement areas have been backfilled and compacted in accordance with the plans. Completely backfill trenches across streets with temporary or permanent pavement in place within 72 hr. after pipe laying. An open trench is not permitted overnight, unless approved and adequately barricaded.

Provide steel plates with adequate trench shoring and bracing, designed to support traffic loads where required to bridge across trenches at street and alley crossings, commercial driveways, and residential driveways where trench backfill and temporary patch have not been completed during regular working hours. Provide safe and convenient passage for pedestrians. Maintain access to fire stations, fire hydrants, and hospitals at all times.

5.3.10. **Pipe Installation.** Install pipes true to lines and grades as indicated on the plans. Inspect all pipe and fittings before placing in the trench. Clean all joint surfaces and soiled materials prior to connecting one another. As work progresses, maintain interior of pipes clean.

5.3.10.1. **Standard Cover.** Standard cover depends on the water main size and installation conditions and is generally

- 6 and 8 in. diameter Main: Minimum of 4-ft. cover from top of pipe to finished grade
- 12 in. & larger diameter Main: Minimum of 5-ft. cover from top of pipe to finished grade

5.3.10.2. **Potholing.** Existing utilities shown on plans are for informational purposes only. Prior to new pipe installation, pothole all existing utilities and structures to confirm their location, depth, and size. In the event of conflict or discrepancy that affects the project design, notify Engineer before proceeding with pipe installation in order to formulate a solution

5.3.10.3. **Pipe Zone Embedment.** Unless otherwise specified or shown on the plans, embed pipelines either Class I, II, or III material defined in this Article 6.2.4 and installed as described. Native or imported material for embedment may be used provided material conforms to this Specification.

Place embedment materials in lifts not exceeding 8 in. loose depth. Unless otherwise specified or directed in writing, provide homogenous material in the embedment zone

Place bedding to provide uniform and adequate longitudinal support under the pipe. Place the first lift of bedding material from the bottom of the trench to slightly above the bottom of the pipe grade. Unless

otherwise shown on the plans, provide a minimum bedding of 4 in. in depth for pipe sizes 30 in. and smaller, and 6 in. for pipe sizes greater than 30 in.

Install material true to line and grade with bell holes of ample dimension to permit pipe to rest on the full length of the barrel and to permit joint make-up and coating application at joints. Consolidate and compact the bedding material as described in Article 6, and lay pipe to indicated grade.

Place a second lift, and if required, subsequent lifts, of embedment material to the springline of pipe. This process is defined as Haunching. Slice material under the haunches of the pipe, carefully filling all voids, and using care to prevent movement of the pipe.

Place Initial Backfill using a third lift from the springline of the pipe to the pipe crown, and a fourth lift from the pipe crown to a point 12 in. above the pipe.

5.3.10.4. **Groundwater Installation.** In areas where the pipe is installed below existing or future ground water levels, use Class I material throughout the pipe zone and enclose with a layer of approved geotechnical filter fabric. Place fabric carefully along the bottom of the trench and up the side of the trench a sufficient distance to lap over the top of the completed pipe installation. Lap fabric a minimum of 3 ft. in the longitudinal at the end of one roll and beginning of the next, and lap 2 ft. in the transverse at the top of pipe, except that for trench widths greater than 3 ft. measured at the top of pipe, the top overlap will be 3ft.. Follow manufacturer's recommendations for installation. Provide fabric that is either Mirafi 140N, Dupont Tytar 3401, or approved equal.

5.3.10.5. **Embedment Class Schedule.** Unless otherwise shown on the plans, use the Utility Standard Embedment Class designations for the pipe material types listed in this Article to define each particular pipe's Embedment Condition allowed. Examine the detail drawings for additional information or other special bedding requirements.

5.3.10.6. **Consolidation Methods in Embedment Zone.** Compact embedment backfill by equipment that is suitable for the type of soil encountered, and is capable of producing the degree of compaction specified. Where applicable, provide backfill materials that is moisture conditioned to produce the required degree of compaction.

Do not use flooding or jetting methods for compaction of embedment material.

Use hand or mechanical tamping to compact Class II or III material used in bedding, haunching, and initial backfill, except that the use of mechanical tampers or vibratory compactors directly over the pipe in the embedment area is prohibited. Exercise caution in the use of mechanical compactors in the haunch and initial backfill to 12 in. above the pipe to avoid damaging or misaligning the pipe.

5.3.10.7. **Compaction and Testing of Pipe Embedment Zone.** Class I material used in the embedment zone may be placed by loose dumping with a minimum of compactive effort, exercising care to assure proper placement of material under the pipe haunches.

Class I material does not specifically require testing unless directed by the ENGINEER, in which case, such test will be measured by ASTM D-4254 by percent of relative density.

Compact Class II material used in the embedment zone to a density of not less than 90% of Standard Proctor Density defined by ASTM D-698.

Compact Class III material used in the embedment zone to a density of not less than 90% of Standard Proctor Density defined by ASTM D-698.

Do not exceed a moisture content of 3% over the optimum in Class II or III material to assure proper compaction.

Unless otherwise directed, one compaction test in the embedment zone for Class II or III material will be taken at 200 ft. intervals along the trench on either side of the pipe, or at any other intervals as may be judged warranted by questionable installation conditions. For pipe sizes 8 in. to 12 in. diameter, perform the first test on the side level with the top of pipe. For sizes 15 in. and larger, perform the first test at the springline of the pipe. For all sizes, perform the second test at the top of the embedment zone.

- 5.3.10.8. **Density Control and Laboratory Testing.** Unless otherwise specified, reference to “maximum dry density” means maximum density defined by ASTM D-1557 or D-698. Determination of density of backfill in-place, will be in accordance with the requirements of ASTM D-2922.

Unless otherwise specified, the Engineer selects a soils testing laboratory to perform initial density testing of in-place backfill and Contractor is responsible for all density testing of backfills, including tests found not to be within the minimum requirements of the specifications.

Provide laboratory materials testing, including but not limited to determination of Atterberg Limits, Proctor Curves, Grain Size Analysis, as well as laboratory certification of manufactured materials and as required by this Article

Notify the soils testing laboratory and Engineer 24 hr. in advance to obtain soil density tests to fulfill the compaction requirements.

- 5.3.11. **Final Backfill.**

- 5.3.11.1. **General.** Backfill trench, as soon as practicable after laying and jointing of the pipe, the completion of embedment and the completion of structures. Take the necessary precautions to protect the pipe during backfilling operations.

Remove sheeting and shoring as backfilling operations progress. Incorporate methods so that a good bond is achieved between the backfill material and the undisturbed trench walls. Where sheeting or trench protection is intact below the top of pipe and their removal cause obvious damage to the bedding and haunching, it may be necessary to leave portions of sheeting or bracing in place.

Exercise caution in the use of mechanical compactors in the haunch and initial backfill to 12 in. above the pipe avoid damaging or misaligning the pipe. Provide at least 3 ft. of compacted cover over the top of the pipe before the trench is wheel-loaded, and 4 ft. of cover before using pneumatic hammers during compaction. Avoid contact between pipe and compaction equipment at all times.

- 5.3.11.2. **Consolidation Methods.** Backfill above the pipe zone to surface subgrade with backfill material as indicated on the plans and described in this Article. Compact backfill above the pipe zone by mechanical means. Water consolidation (flooding) may be used if approved.

Mechanical Compaction. Place backfill material above the pipe zone in lifts not exceeding 8 in. loose depth, moisten or aerate to obtain optimum moisture, and compact to the required density as described in this Article.

Ponding Method. When permitted, place backfill material above the pipe zone in the trench not exceeding 3 ft. loose depth, and flood until free water is evident on the surface for at least 2 hr. Place approximately 1 ft. of water in the trench and start subsequent lifts by depositing backfill material in the water until a maximum 3 ft. lift is placed. Add additional water to the backfill material until free water is again evident as before. Repeat procedure until the entire trench is filled and thoroughly settled

Jetting Method of water tamping is not allowed.

- 5.3.11.3. **Cement Stabilized Backfill.** Stabilize backfill material with a minimum of two sacks per cu. yd. of Portland cement of material placed. Place stabilized soil as shown on the plans under roads, driveways, concrete slabs, and in the excavation zone for structures. Cement stabilized soil placed around all adjusted manholes

is subsidiary to the various manhole installation items. No compensation will be made for use of soil cement backfill at the Contractor's discretion, without prior approval, or for over-excavated trenches.

- 5.3.11.4. **Compaction and Testing Final Backfill.** This subsection may be superseded by the Department requirements, if stricter. Under existing or proposed paved streets, compact final backfill to the Modified Proctor Densities shown on Table 9 and as per ASTM D-1557 and to standard plan detail layouts, "Typical Trench Backfill Detail under Existing or Proposed Paved Streets."

Table 9
Paved Street Compaction Densities

ZONE	SOIL CONDITION	% OF PROCTOR
Top of Pipe Embedment to 18 in. Below Finished Subgrade	Native Material As Specified	90%
Top of Finished Subgrade to 18 in. Below Top of Subgrade	Cohesive Non-cohesive	90% 95%

Compaction tests are required on backfill under proposed or existing streets and easements as follows, unless otherwise directed and deemed necessary.

- Tests at 8 in. below subgrade at 200 ft. intervals and not less than two per street at this level and
- One test for every 2 ft. of vertical trench backfill between top of pipe bedding and 18 in. below subgrade at 200 ft. horizontal intervals and not less than two per street at each level.

Obtain density of not less than 85% ASTM D-1557 from top of pipe bedding to ground surface for all other areas not in existing or proposed paved streets.

Provisions for selection of the testing laboratory and responsibilities for density control as described in this Article also apply to this backfilling section.

5.4. **Measurement.**

- 5.4.1. **Excavation and Backfill.** This Item will not be measured individually and is subsidiary to the installation of the various water mains, sanitary sewer mains, and related appurtenances.

- 5.4.2. **Cement Stabilized Backfill .** Unless shown on the plans as a pay item, quantities shown are for informational purposes. When specified as a pay item, this Item will be measured by the cubic yard as shown under Item 401, "Flowable Backfill."

- 5.5. **Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various bid items for water main, sanitary sewer mains and manhole installations, including related appurtenances, such as all excavation, bedding, backfill for pipe zone (embedment), final backfill, compaction and compaction testing. Associated dewatering is subsidiary to the different materials and sizes of water mains, sanitary sewer mains, steel casings, valves, fittings and appurtenances, and service installation, including but not limited to excavation, embedment and final backfill for "Additional Fittings" as described in Article 7.

When Flowable Backfill is specified as a pay item, flowable backfill will be paid as provided in Item 401, "Flowable Backfill."

6. **VALVES AND FITTINGS**

- 6.1. **Description.** Furnish all valves and fittings as shown on the plans and as called for in this specification or as required for proper operation of the equipment in general. Unless otherwise indicated, conform to requirements as specified herein. Upon acceptance, provide and install valves similar and comparable to valves specified for similar and comparable duty in other parts of the project where proper operation and utilization of equipment and facilities require installation of valves not indicated or specified.

- 6.2. **Materials.** Conform to the pertinent material requirements of the items listed. Furnish complete shop drawings and specifications. If requested, submit a list of similar installations that have been in satisfactory operation for at least three years.

Furnish a complete set of installation, operation, and maintenance instructions, bound in a cover, for each type of valve furnished.

Quality Assurance. Conform to American National Standards Institute / National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water system Components - Health Effects" and be certified by an organization accredited by ANSI. Provide an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, submit information from the manufacturer regarding action being taken to comply with this standard. Include manufacturer's name or trademark permanently stamped or cast on all valves and fittings along with "No Lead" brass alloy, e.g. "NL." Design all valves installed in a given line to withstand the test pressure for that particular line and fabricate with ends to fit the piping.

- 6.2.1. **Valves.**

- 6.2.1.1. **Non-Rising Stem Double Disc Gate Valves (NRS).** Provide Non-Rising Stem Gate Valves that are iron-body, bronze mounted, parallel seat internal wedging type with non-rising stem and designed for a gauge working pressure of 200 psig. Comply with latest revisions of AWWA C-500 "Gate Valves for Water and Sewage Systems."

Provide 12 in. or smaller valves for horizontal installation with a minimum number of turns to open at least three times the valve diameter. Acceptable manufacturers and models are:

- American-Darling 52NRS (Flanged Ends), 55NRS (Mechanical Joint Ends),
- Clow F5065 (Mechanical Joint Ends), F5070 (Flanged Ends),
- Kennedy 561X (Flanged Ends), 571X (Mechanical Joint Ends),
- M&H Style 67NRS, and
- MuellerA-2380-6 (Flanged), A-2380-20 (Mechanical Joint Ends).

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500 (300 ft.-lbs.).

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint or flanged with drilling valve ends and size, as specified, in compliance with ANSI B16.1.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 in. of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 in. square base, a 1 15/16 in. square top and 1 3/4 in. high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges

6.2.1.2.

Outside Screw and Yoke (OS&Y) Gate Valves. Provide iron-body, bronze mounted, parallel seat internal wedging type with outside screw and yoke in conformance with AWWA C-500 "Gate Valves for Water and Sewage Systems." Provide OS&Y gate valves for the size specified. Acceptable manufacturers and models are listed:

- American Darling 52 OS&Y,
- Clow F5072,
- Kennedy 566,
- M&H STYLE 68, and
- Mueller A-2483-6.

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500 (300 ft.-lbs.). Provide records of all tests performed in accordance with Section 5.2 and 6.3 of AWWA Standard C-504.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide flanged ends with drilling in compliance with ANSI B16.1 or otherwise specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 in. of 10%. Brush the opening through the bonnet for the stem with grade A, B, C, D, or E bronze as defined in AWWA C-500.

Yoke. The yoke may be either integral or bolted on to bonnet such that a hand may not be jammed between the yoke and handwheel.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 in. square base, a 1 15/16 in. square top and 1 3/4 in. high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

6.2.1.3.

Tapping Valves. Provide iron-body, bronze mounted, parallel seat internal wedging type with non-rising stem tapping valves that conform to AWWA C-500 "Gate Valves for Water and Sewage Systems" except that tapping valves will have over-sized seat rings to accommodate full size cutters. Provide for the size specified. Acceptable manufacturers and models are listed:

- American Darling 565,
- Clow 2640 (Figure F-6114),
- Kennedy 8950 KEN-SEAL II,
- M&H STYLE 751, and
- Mueller H-667.

Minimum number of turns to open is three times the valve diameter.

Submittals. Provide submittals for approval. Provide manufacturer's Affidavit of Compliance in accordance with Section 6.3 of AWWA Standard C-500. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-500 that are representative test results per Section 5.1 of AWWA Standard C-500 along with an affidavit and certificate of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-500.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint outlet ends unless otherwise specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Gate. Manufacture in cast iron or Grade A bronze. Grade A gate rings must be rolled, peened, or pressed into grooves machined in the discs, or may be fastened by some other accepted method.

Body-Seat Ring. Construct of Grade A bronze, back-face threaded and machined screwed into the valve body.

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 in. of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 in. square base, a 1 15/16 in. square top and 1 3/4 in. high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

6.2.1.4.

Non-Rising Stem (NRS) Resilient-Seated Gate Valves. Provide NRS gate valves that are resilient seat, non-rising stem and have a minimum rated gauge working pressure of 200 psig that comply with AWWA C-509 "Resilient-Seated Gate Valves for Water and Sewage Systems" and AWWA C-550 "Standard for Protective Coatings for Valves and Hydrants." Valve designed with recesses, insets in the bottom of the waterway that would promote build-up or collection of residue and debris are not acceptable. Provide NRS Gate Valves the size specified. Acceptable manufacturers and models are listed:

- American Flow Control Series 500, Series 2500,
- Clow 2640 (Figure F-6100),
- Kennedy 8571 KS – FW,
- M&H 3067,
- US Pipe METROSEAL 250,
- Mueller A-2360, and
- J&S Series 6800, Series 6900.

Submittals. Provide submittals for approval. Provide manufacturer's approved certified test data or an affidavit stating that the valve complies with AWWA C-509 Section 5.1 and the following, in accordance with AWWA C-509 Section 6.3:

- Hydrostatic Test. Provide results of manufacturer's pressure test for one valve of each size and class with 400 psi applied to one side and zero to the other made in each direction across the closed gate.
- Torque Test. Provide results of manufacturer over-torque test on one valve of each size to demonstrate that no distortion of the valve stem occurs. Applied torque for a 4-in. valve is 250 ft.-lb. and 350 ft.-lb. for the larger valves in both the open and closed position.
- Leakage Test. Provide results of manufacturer's leakage test where manufacturer selects two valves of each size to be fully opened and closed for 500 complete cycles with a 200 psi differential pressure across the gate and the valve is drip tight upon completion of the test.
- Pressure Test. Test one valve of each size with the gate fully open to a pressure of 500 psi. No evidence of rupture or cracking of valve body, bonnet or seal plated should be detected

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide mechanical joint or flanged ends as specified.

Valve Body and Bonnet. Provide in cast iron conforming to ASTM A-126 Class B, or ductile iron conforming to ASTM A-395 or ASTM A-536.

Bolts. Provide all bonnet and seal plate bolts that are factory installed and made from stainless steel ASTM A-276 with either regular-square or hexagonal heads with dimensions conforming to ANSI B18.2.1.

Wedge. Provide cast iron or ductile iron fully encapsulated wedge with resilient rubber material bonded to the disc in conformance with ASTM D-429 as required by AWWA C-509.

Valve Stem. Construct of low zinc bronze CDA Copper Alloy No. C99500 with a minimum yield strength of 40,000 psi and minimum elongation in 2 in. of 10%.

Stem Seals. Provide two O-rings such that the seal above the stem collar can be replaced with the valve under pressure in the fully open position meeting the requirements of ASTM D-2000 and have physical properties suitable for the application.

Valve Operator. Provide a cast iron, ASTM A-126 Class B, wrench nut that has a 2 in. square base, a 1 15/16 in. square top and 1 3/4 in. high, opening counterclockwise (left). Paint wrench nut black with and cast an arrow indicating direction of opening in accordance with AWWA C-509.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and having a minimum dry film thickness of 8 mils. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

6.2.1.5.

Butterfly Valves. Provide butterfly valves that are tight-closing, rubber-seated type for Class 150B service and comply with the requirements of AWWA C-504, "Standard for Rubber-Seated Butterfly Valves." Provide valves for the size specified. Acceptable manufacturers and models are listed:

- Val-Matic Class 150B Flanged or Mechanical Joint,
- M&H 450, 4500, 1450,
- Kennedy 30A, 30C,
- Mueller Lineseal III, and
- Pratt Groundhog Flanged or Mechanical.

Submittals. Provide submittals for approval. Provide manufacturer's approved certified test data or an affidavit stating that the valve complies with the performance tests, leakage tests, hydrostatic test and proof-of-design tests as described in Sections 5.2 and 6.3 of AWWA C-504.

Valve Ends. Provide short body flanged, mechanical joint valve ends or as otherwise specified.

Valve Bodies. Construct valve bodies of cast iron ASTM A-126, Class B, or ASTM A-48, Class 40 or Ductile Iron, ASTM A-536, Grade 65/45/12.

Valve Discs. Construct valve discs of cast iron conforming to ASTM A-126, Class B or Ductile Iron conforming to ASTM A-536, Grade 65/45/12, and seat in a position of 90° to the pipe axis and rotates 90° between full open and tight closed position. Dimensions of clearance for valve discs are required.

Valve Shafts. Provide Type 304 or 316 Stainless Steel valve shafts, keys, dowel pins, or taper pins used for attaching valve shaft to the valve disc in conformance with ASTM A-276, or equivalent corrosion resistant material. All portions of shaft bearings must be stainless steel or bronze. Valve shafts may consist of a one-piece unit extending completely through the valve disc, or may be of the "stub shaft" type as defined in AWWA C-504. Provide butterfly valves with an extended bonnet, unless otherwise specified.

Shaft Seals. Provide a Split-V or O-ring type shaft seal that allows replacement without removing the valve shaft.

Valve Seats. Provide new natural or synthetic rubber resilient seats attached to either the disc or the body that provide tight shut off at the specified pressure. Seats must be clamped, mechanically secured, bonded or vulcanized to either the disc or body, be stainless steel and fastened by stainless steel cap screws.

Mating Seat Surface. Conform to ASTM A-276, stainless steel 18-8, Type 304, or have a 95% pure nickel overlay.

Valve Bearings. Manufacture bearings from corrosion resistant, and "self-lubricated" materials that will not damage natural or synthetic rubber and are sleeve type.

Valve Operators. Provide manual valve operations with a 2-in. square operating-nut and turn left (counterclockwise) to open. Totally enclose, pre-lubricate or grease pack all gearing. Provide operators of the worm gear or traveling nut and link type with field adjustable stops capable of withstanding 300 ft.-lb. input torque, as required by AWWA C-504.

Protective Coating. Except as otherwise specified, shop coat all interior steel or cast iron surfaces in accordance with the requirements of AWWA Standard C-504. Shop coat all external surfaces for buried valves with two coats of asphalt varnish according to AWWA C-504. When specified, apply a standard epoxy interior coating in accordance with AWWA Standard C-550, "Standard for Protective Interior Coatings for Valves and Hydrants."

6.2.1.6. **Air Release, Air/Vacuum, and Combination Air Valves.** Conform to AWWA C-512 requirements, testing requirements found in Section 5.1 of AWWA C-512 and the following specifications that apply to valve sizes 6in. and smaller.

Air Release Valves (AR). Design to automatically release accumulated air pockets within the pipeline while in operation and under pressure. .

Air/Vacuum Valves (AV). Design to allow large volumes of air to escape through the valve orifice when filling a pipeline and to close watertight once the air has been expelled. Permit large volumes of air to enter through the valve orifice when the pipeline is being drained to break the vacuum.

Combination Air Valves (CAV). Provide heavy-duty air and vacuum valves with air release designed to release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled and by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Also design CAV to permit large volumes of air to enter the pipeline during pipeline drainage. Provide H-TEC Model 992 or approved equal.

Submittals. Provide submittals for approval. Provide manufacturer's affidavit stating that the valve and all materials used in its construction conform to the applicable requirements of AWWA C-512 and these specifications. When required, the manufacturer must provide an affidavit stating that the valve has been tested and is in compliance with the requirements specified in Section 5.1 of AWWA C-512.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Body and Cover. Provide each air valve with a cast or ductile iron body and cover that complies with ASTM A-126 Class B, or ASTM A-48 Class 35. Ductile iron requirements in conformance with ASTM A-536, Grade 65-45-12. Meet or exceed the strength requirements of ASTM A-307 for bolting material. Provide all internal trim of stainless steel.

Float. Provide stainless steel float that is baffled to prevent air from blowing valve closed until air is exhausted. Design valve body, float, etc., for a working pressure equal to that of the system in which it is installed. Floats for valves with inlet sizes less than 4 in. must be capable of withstanding a collapse pressure of 1,000 psig. For larger inlet sizes, floats must be capable of withstanding a collapse pressure of 750 psig.

Valve Outlet. Fit outlet to attach discharge pipe as indicated. Provide N.P.T valve inlet. for 2 in. and smaller valves and ANSI flange for 3 in. and larger valves. Flange rating must equal or exceed the maximum working pressure of the system in which it is installed.

Installation. Install AR and AV valves within valve vaults, or manhole, in accordance with Utility Standard Details shown on plans.

Protective Coatings. Interior surface coatings are not required unless otherwise specified. Coat external surfaces with the manufacturer's standard primer.

6.2.1.7.

Swing Check Valves. Provide swing check valves 2 1/2 in. to 12 in. in diameter that withstand a working pressure of 175 psig, comply with the requirements of AWWA C-508 and are tight seating to prevent the backflow of the media during pump shut-off or power failure. Design the closure assembly to assume the closed position by gravity under no flow conditions in a horizontal position. Provide fully open swing check valves with a net flow area not less than the area of a circle with a diameter equal to the nominal pipe size. Check valves can be either Swing Type Spring and Lever or Swing Type Lever and Weight. Acceptable manufacturers are Kennedy Company, Mueller, or equal.

Provide internals that are replaceable in the field without removing the main valve from the pipeline.

Submittals. Comply with the requirements of Article 7.2.1.2 in accordance to the applicable requirements of AWWA C-508. When required, the manufacturer must provide an affidavit stating that the valve has been tested and is in compliance with the requirements specified in Section 5.2 of AWWA C-508.

Markings. Cast markings on the bonnet or body of each valve. Include the manufacturer's name or mark, the year the valve casting was made, the size of the valves, and the designated working pressure.

Valve Ends. Provide flanged valve ends unless otherwise specified.

Body. Provide heavy cast-iron body conforming to ASTM Standard A-126, Class B.

Disc. Provide cast-iron disc conforming to ASTM Standard A-126, Class B that is either Rubber-Faced, or Bronze-Faced conforming to ASTM B-584 "Specification for Copper Alloy Sand Castings for General Applications."

Disc Seat or Plate. Provide resilient Buna-N material or Bronze disc seat or plate conforming to ASTM Standard B-62 for drip tight shut-off and easily replaced in the field without the use of special tools.

Seat Ring. Provide Bronze seat ring conforming to ASTM Standard B-584 and is mechanically attached to machined surfaces in the body.

Hinge or Clapper Arm. Provide Bronze hinge or clapper arm conforming to ASTM Standard B-584.

Hinge Pins. Provide stainless steel hinge pins conforming to ASTM A-276 "Specification for Stainless and Heat Resisting Steel Bars and Shapes" in accordance with AWWA C-508.

Lever. For Swing-Type Lever and Weight, provide the lever with an adjustable counterweight to control opening and closing of clapper arm. For Swing-Type Spring and Lever, provide lever with an adjustable spring tension to control opening and closing of clapper. Install lever on either side of valve.

Protective Coating. Apply epoxy coating to all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. Do not apply coating to the gasket surfaces of the end flanges. Paint valve exterior with Red Oxide Phenolic Primer Paint as accepted by the FDA for use on materials in contact with potable water.

6.2.1.8.

Pressure Reducing Valves. Provide pressure reducing valves that maintain a constant downstream pressure regardless of varying inlet pressure and, unless otherwise specified, will be a direct acting, spring loaded, normally open globe pattern valve designed to permit flow when controlled pressure is less than the spring setting. Acceptable manufacturers and models are listed:

- Cla-Val Co. Model 90,

- Fisher Governor Co. Type 616, and
- Bailey Model 30A.

Two in. or smaller. Provide valves with a bronze body, nylon reinforced diaphragm, single seat, composition disc, Watt No. 223 or Masoneilan No. 227, or approved equal.

Larger than 2 in. Provide valves with a cast iron body conforming to ASTM B-61, bronze main valve trim conforming to ASTM B-61, a reinforce neoprene diaphragm, stainless steel stem and flanged ends.

Pressure Rating. Provide a pressure rating of 125 psi with an adjustment range of 30-300 psi.

Valve Components. Provide removable and repairable components while the valve body remains in the line.

Diaphragm Assembly. Provide a synthetic rubber assembly a stem fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. Do not use diaphragm as a seating surface.

Resilient Disc. Provide discs that form a sealed chamber against the disc seat when the valve is closed. Provide seat that is removable and has a smooth surface that will not induce seal cutting or wear.

Strainer. For valves 3 in. and smaller, provide a standard flow clean strainer mounted in the inlet supply port of the main valve. For valves 4 in. and larger, provide a standard y-strainer externally mounted for the protection of the control circuit.

Protective Coating. Apply an epoxy coating to all exterior and all stationary interior ferrous surfaces including all interior openings in the valves body in accordance with AWWA C-550 and the manufacturer's instructions. After the coating is completely cured, test coated surface for porosity, holidays, and pinholes using a holiday detector. Repair all holidays or irregularities and test the coating again. Do not apply coating to the gasket surfaces of the end flanges.

6.2.2.

Fittings. Provide ductile iron (DIP) fittings for use with ductile iron and polyvinyl chloride (PVC) for water pressure or transmission pipe that are smooth cement lined in accordance with AWWA C-104 and outside asphaltic coated per AWWA C-110. The size, body type, type of joint ends, and applicable reference standard are shown on plans or are specified.

Standards. Comply with the following applicable requirements:

- ANSI B16.1 Cast Iron Pipe Flanges and Fittings,
- AWWA C-104 American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water,
- AWWA C-105 Standard for Polyethylene Encasement for Ductile Iron Pipe and Fittings,
- AWWA C-110 American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids,
- AWWA C-111 Rubber-Gasket Joints,
- AWWA C-153 American National Standard for Ductile-Iron Compact Fittings, 3 in. through 16 in., for Water and Other Liquids, and
- Minimum Requirements. Apply minimum requirements of shown Table 10 and Table 11 to the specified fittings.

Table 10
Standard Short-Body Fittings per AWWA C-110

TYPE OF JOINT	DIAMETER	RATE WORKING PRESSURE	MATERIAL
Mechanical (Rubber Gasket/C-111)	4-24 in.	350 psi	DI
Flanged	4-24 in.	250 psi	DI
All Types	30-80 in.	250 psi	DI
Push-On (Rubber-Gasket/C-111)	4-24 in.	250 psi	DI

Table 11
Compact Short-Body Fittings per AWWA C-153

TYPE OF JOINT	DIAMETER	RATE WORKING PRESSURE	MATERIAL
Mechanical or Push-On (Rubber Gasket/C-111)	4-24 in.	350 psi	DI

Provide all joint accessories such as gaskets, glands, bolts, and nuts with mechanical joints, and gaskets and lubricant furnished with push-on joints in sufficient quantity for assembly of each joint.

Mark push-on joint fittings with the proprietary name or trademark of the joint marked on the outside with their applicable AWWA Standard and information specified in the standard.

Provide polyethylene wrapped fittings in accordance with AWWAC-105.

6.2.3. **Valve Vaults.** Provide pre-cast vaults with pre-cast or cast-in-place bases as shown on the plans.

Quality Assurance. Provide vaults that meet the requirements of ACI 318 and are designed for a minimum H-20 loading per AASHTO Specifications, plus a 30% impact factor, or greater if shown on the plans or specified. Mark date of manufacture and name or trademark of manufacturer on inside of each pre-cast vault section.

Submittals. Submit structural calculations sealed by a Structural Engineer registered in the State of Texas for approval along with shop drawings.

Materials. Provide concrete with a minimum 28 days compressive strength of 4,000 psi and reinforcing steel that meets the requirements of Article 4. Provide metal frames, covers, steps, toe pockets, and similar required items as shown. Each pipe entering and exiting the vault requires an approved flexible joint that provides a watertight installation. Submit jointing system or material for approval..

Installation. Cast-In-Place. Place cast-in-place bases on suitable foundations after the pipes are laid. Exercise special care when placing the concrete around the bottom of the pipes to obtain a waterproof structure. Cast an approved bell in the base to receive the pipe sections forming the barrel.

Pre-Cast. Set pre-cast bases on a concrete or crushed stone foundation as shown at the proper grade and carefully aligned. Set pre-cast vault sections vertical in true alignment. Install sections, joints, and gaskets in accordance with manufacturer's recommendations.

Seal lifting holes tight with a solid rubber plug driven into hole and the remaining void filled with cement-sand mortar.

6.3. **Provisions for Thrust.** Block all underground piping with concrete, bearing solidly against undisturbed trench walls, at all changes in direction, fittings, and valves subsidiary to the installation of fittings, valves, and all other appurtenances requiring provisions for thrust restraint.

Place concrete blocking against undisturbed trench walls with a minimum 18 in. between trench wall and pipe. Extend blocking a minimum of 0.75 times pipe diameter below and above the centerline of pipe and do not extend beyond any joints. Place blockings in accordance with the recommendations of "A Guide for the Installation of Ductile Iron Pipe" published by Cast Iron Pipe Research Association and according to details shown on the plans.

If directed, contain the ends of the thrust blocks in wood or metal forms as provided for under Item 420, "Concrete Structures." Where upward thrusts are to be resisted, reinforce concrete anchor with reinforcing conforming to the provisions of Item 440, "Reinforcing Steel."

Use Class B concrete used for Blocking in accordance Item 421, "Portland Cement Concrete" and Table 12 depicting the minimum area of concrete bearing against undisturbed trench bank.

Table 12
Bearing Surface Per Bend

PIPE SIZE	TEE, DEAD END, 90° BEND	45 AND 22-1/2° BEND
6 in.	4 sq. ft.	3 sq. ft.
8 in.	6 sq. ft.	3 sq. ft.
12 in.	13 sq. ft.	7 sq. ft.
16 in.	23 sq. ft.	12 sq. ft.
20 in.	37.02 sq. ft.	20.04 sq. ft.

Install mechanical joint restrainers as specified that are manufactured by EBAA Iron, Uni-Flange or approved equal.

6.4. **Construction.**

Valve Installation. Polyethylene-wrap valves in accordance with AWWA C-105, unless otherwise specified. Provide thrust blocking as specified. Carefully handle and install valves horizontally in such a manner as to prevent damage to any parts of the valves in accordance with manufacturer's instruction. Valves delivered closed to the site will be opened by Contractor prior to installation. Record number of turns required to open the valve and submit information on the standard valve report to MPU through Engineer.

Valve Testing. Upon completion of installation of the valves, conduct an acceptance test to verify the satisfactory operation of the valves. Check unit for operation and leakage. The valves must perform in a manner acceptable to the Engineer.

6.5. **Measurement.**

6.5.1. **Valves.** This Item will not be measured individually and is subsidiary to the installation of the various water mains and related appurtenances.

6.5.2. **Fittings.** This Item will not be measured individually and is subsidiary to the installation of the various water mains and related appurtenances.

6.5.3. **Additional Fittings.** This Item will be measured in place by the pound of additional fittings installed.

6.6. **Payment.**

6.6.1. **Valves.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water mains Items. All valves shown on the plans are subsidiary to the various water mains and services pay items and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all valves shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring,

polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking is not be considered for additional compensation.

- 6.6.2. **Fittings.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water mains pay items. All fittings shown on the plans are subsidiary to the different pay items for water mains and services and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all fittings shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking will not be considered for additional compensation.
- 6.6.3. **Additional Fittings.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Additional Fittings." This price is full compensation for furnishing all required materials based on the cost of material only. Include labor costs, all costs associated with coordination; excavation; backfill, compaction, compaction testing for utilities; disposal of excess material; equipment and materials required for cutting and removal of water mains, furnishing and installing additional valves, bends, tees, crosses, couplings, reducers, adaptors, flexible fittings, not originally shown on the plans or details, as deemed necessary, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection in the unit price for Water Main (PVC), Water Main (DIP) and Water Main (STEEL). Mechanical joint restrainers in lieu of or in conjunction with concrete thrust blocking are not considered for individual payment through the "Additional Fittings" provisions. The actual amount of additional fittings may be less than, but may not exceed the total quantities on the plans without approval.

7. WATER SERVICE CONNECTIONS

- 7.1. **Description.** Furnish labor, materials, equipment and incidentals necessary to construct and install pre-cast concrete meter boxes and vaults, water service connections and fire lines, complete for potable water supply including.
- 7.2. **Materials.**
- General.** Provide fittings and valves in contact with potable water in conformance to the latest revision of NSF/ANSI Standard 61 (Annex F) and the requirements of Article 7. Include certifications from manufacturers that the products comply with appropriate ASTM, AWWA and Utility Standards with required submittals. New water meters will be furnished by MPU when required unless otherwise specified.
- Quality Assurance.** Fittings and valves in contact with potable water must conform to the latest revision of NSF/ANSI Standard 61 (Annex F). Such compliance must be evidenced by an affidavit from the manufacturer or vendor.
- All fittings and valves must have the manufacturer's name or trademark permanently stamped or cast on it and "No Lead" brass allow, e.g. "NL" will be cast or stamped on the valves and fittings.
- 7.2.1.1. **Water Service Connections.**
- Castings and Washer Nuts.** Provide certified cast bronze composition castings and washer nuts, 85-5-5-5 percent per ASTM B-62, fully formed, tapped threads meeting requirements of AWWA C-800 for underground service.
- Gaskets.** Provide gaskets that are self-sealing, 100% neoprene or Buna-N rubber, formulated for water service.

Service Saddles. Provide two or three piece all-bronze, double strap with National Coarse Class 2 thread saddles suitable for Class 200 asbestos cement pipe, cast iron pipe and ductile iron pipe with double straps. Provide single strap saddles for C-900 or C-905 PVC pipe. Extend saddle body 180% around pipe. Acceptable manufacturers and models are listed:

- Ford Meter Box Co. Model S90,
- James Jones Co. J-996,
- A.Y. McDonald Mfg. Co. 3805, and
- Mueller H-1344X.

Straps. Provide silicon bronze straps, approximate tensile strength of 70,000 psi chamfered for easy nut starting and flattened to provide wide bearing surface.

Valves. Provide valves in accordance with Utility acceptable standards and requirements for Article 7.2.1.11, "Gate Valves."

Use bronze valves for copper pipes with minimum 85% copper content casting and cast iron valves for PVC pipe that conform to requirements for Article 7.2.1.11, "Gate Valves."

Provide corporation stops manufactured by Ford Meter Box Co., Mueller, or approved equal and conform to the requirements of AWWA C800.

Provide angle ball valves with padlock wings that are copper flared inlet and female iron pipe thread outlet such as James Jones Company Model J-1965W, McDonald MFG Model 74606B, or approved equal. Use outlet meter coupling nut for 3/4 in. and 1 in. meters. Use inlet female iron pipe by outlet oval flange ends valves for 1 1/2 in. and 2 in. meters.

Service Pipe. Provide copper Type "K" for service pipe sizes up to and including 2 in., meeting ASTM B-88 requirements with bronze fittings. For 3in. services, provide 4 in. PVC per AWWA C-900 with reducers at meters. For 4 in. services and larger, provide PVC pipe per AWWA C-900. Provide ductile iron fittings for PVC pipe.

7.2.1.2.

Meter Boxes. Meet the standards listed:

- ASTM A-27 Specification for Steel Castings, Carbon, for General Application,
- ASTM A-36 Specification for Structural Steel,
- ASTM A-48 Specification for Gray Iron Castings,
- ASTM C-33 Specification for Concrete Aggregates,
- ASTM C-150 Specification for Portland Cement,
- ASTM C-309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete, and
- ASTM C-615 Specification for Granite Building Stone.

Shop Drawings. Submit shop drawings on molds, meter boxes, and associated hardware for approval prior to fabrication. Provide manufacturer's certification that products comply with appropriate ASTM, AWWA, and Utility standard details

Testing. When requested, provide compressive tests results and allow Engineer to inspect of the manufacturing process at any time, perform tests on materials used and to extract cores from completed meter boxes for compressive strength testing and placement of reinforcement.

Cement. Use Portland cement conforming to ASTM C-150, Type I or Type III. Provide concrete with a minimum 28 day compressive strength of 4,500 psi, a water cement ratio of 0.5 or less by weight, and a maximum 5.5 gal. water per sack cement. Handle concrete from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until the operation is completed. Place concrete in layers not exceeding 2 ft. deep. Compact

each layer by mechanical internal or external vibrating equipment. Limit duration of the vibration cycle to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

Aggregates. Conform to specifications outlined by ASTM C-33 for aggregates other than lightweight aggregates. Provide aggregate that is free of deleterious substances and graded in a manner as to produce a homogeneous concrete mix. Accurately weigh all materials at a central batching facility for mixture.

Curing. For the purposes of early re-use of forms, concrete may be heated in the mold, after initial set has taken place. Do not exceed a temperature of 71.11°C (160°F) and raise temperature from normal ambient temperatures at a rate not to exceed 4.44°C (40°F) per hr. Do not remove the cured unit from the forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms further curing by means of water spraying or a membrane curing compound of a clear or white type, conforming to ASTM C-309 may be used.

Steel Reinforcing. Comply with ASTM A-615 Grade 60 steel, $F_y = 60,000$ psi. Minimum concrete cover on re-bar top slab is 1 1/4 in. and 1 1/2 in. on re-bar for walls. Comply latest ACI Standards for bar bending and placement. Provide all reinforcing steel, including welded wire mesh, of the size and place in location shown on the plans. Tie all reinforcing sufficiently to withstand displacement during the pouring operation. Design lifters to handle the imposed weights, and place as shown on the plans or manufacturer's requirements.

Steel Frames and Covers. Conform to ASTM A-27, Grade 70-36. For structural welded steel, conform to the requirements of ASTM A-36 with dimensions as specified on the plans.

Cast Iron Ring and Covers. Conform to the requirements of ASTM 48, Class 30. Provide all castings of uniform quality, free from blowholes, shrinkage, distortion or other defects, smoothed and well cleaned by shot-blasting. Manufacture true to pattern. Provide component parts that fit together in a satisfactory manner. Provide round frames and covers with continuously machined bearing surfaces to prevent rocking and rattling. Do not exceed tolerances of 1/16 in. per ft. and deviation in weight of 5%.

7.2.1.3. **Tapping Sleeves and Pipe Couplings.** Furnish labor, materials, equipment and incidentals necessary to install stainless steel tapping sleeves and pipe couplings as specified suitable for operation at pressures as specified for the pipelines in which they will be installed, including test pressures and surge allowances. Furnish shop drawings a required.

7.2.1.3.1. **Cast Tapping Sleeves.** Provide stainless steel tapping sleeves of suitable construction and reinforced to provide resistance to line pressures that are designed for the pipe size and material on which they will be used. Build tapping sleeves in halves for assembly around the main to be tapped. The branch outlet will have a flanged face for bolting to the tapping valve with the inside diameter of outlet branch larger than the nominal size to provide clearance for the full size cutters of the tapping machine. Acceptable manufactures are Mueller Company or approved equal.

Type 1. Cast tapping sleeve allows water to circulate between the sleeve and the outside surface of the pipe. Gaskets of suitable material, designed for use on potable water must form watertight joints along the entire length of the sleeve. Seal circumferential joints at the ends of the run of the sleeves by mechanical joints, conforming to AWWA C-111 as to dimensions, clearances, and materials, except that gaskets and glands from mechanical joints must be totally confined or compressed between ridges or grooves extending continuously for the full length of both halves of the sleeve casting. Locate bolts close to the outside of the gaskets and spaced so as to exert sufficient pressure to form a watertight joint and withstand stresses imposed by the intended use.

Type 2. Water is confined to the immediate area of the tap opening. Fit the outlet half of each sleeve with a continuous gasket of approximately circular cross section, permanently cemented into a groove surrounding the outlet opening and the back half of each sleeve fitted with elastomeric pads, a metal shoe, or other device for developing adequate pressure on the gasket to prevent leakage at any pressure within the design capacity of the pipe.

Protective Coating: Coat all surfaces exposed to flow in accordance with AWWA C-550.

7.2.1.3.2. **Fabricated Tapping Sleeves.** Fabricated tapping sleeves must be rated for a working pressure of 150 psi and meet the following requirements. Acceptable manufacturers and models are listed:

- Ford FTSC,
- JCM 412,
- Romac FTS 420, and
- Powerseal 3490.

Markings: Permanently mark each tapping sleeve to identify the outer diameter size range.

Test Plug: Provide a 3/4in. NPT with standard square head.

Nuts and Bolts: Provide high strength, corrosion resistant 18-8 Type 304 Stainless Steel.

Four in. to 12 in. Provide tapping sleeve body and flange 18-8 Type 304 Stainless Steel or AWWA C111 Carbon Steel with fusion epoxy coating. Provide body, lug, and gasket armor plate in compliance with ASTM A-240 having all metal surfaces passivated, in accordance with ASTM A-380, after fabrication.

- Provide gasket with a watertight sealing surface around the full circumference of the pipe formed of natural or synthetic rubber.
- Weld lugs to the shell and prevent alignment problems by allowing the bolts to pass through. Do not weld bolts to the sleeve.

Sixteen in. and Larger: Provide tapping sleeves that have a heavy welded steel body in compliance with ASTM A-36 or ASTM A-285, Grade C.

- Provide natural or synthetic rubber compounded gaskets for water use providing a watertight sealing surface.
- Construct flanges in accordance with AWWA C-207 Class D and properly recess for aligning the sleeve and tapping valves.
- Coat steel tapping sleeves with 8 mils minimum thickness epoxy

7.2.1.3.3. **Flexible Couplings.** Furnish and install couplings where shown on the plans, specified, or in locations as approved. Use ductile iron flexible couplings and Type 316 Stainless Steel nuts and bolts when installed underground. When flexible couplings are used as expansion joints, separate the pipe ends to allow for expansion. Where indicated on the plans or required by field conditions, flexible couplings must be suitable for connecting pipes having different outside diameters. Restrain flanged coupling adapters with tie rods.

Protective Coating. Coat entire coupling assembly with a 20 mil coating of T.C. Mastic as manufactured by Tape Coat Company, Bitumastic No. 50 as manufactured by Koppers Company, or approved equal.

Ductile Iron Pipe. Flexible Joint Couplings will be Dresser Style 38, Rockwell Style 411, or equal. Flanged coupling adapters for ductile iron pipe will be Dresser Type 127, Rockwell International 112, Baker Series 600, or equal.

Steel Pipe. Flexible couplings will be Dresser Style 38, Rockwell International 411, or equal, except where other styles are required for special conditions.

Provide neoprene rubber or equal gaskets.

7.2.1.3.4. **Installation.** Install tapping sleeves in accordance with the manufacturer's recommendations. Construct disc and seat ring in a manner that the inside diameter of the ring is at least 3/16 in. larger than nominal size of valve. Block tapping sleeve and valve assembly blocked as indicated.

7.3. **Construction.**

- 7.3.1. **General.** Furnish and install service taps for 3/4 in. to 2 in. services with service saddle. Direct taps, i.e. without the saddle, are not allowed. For 3 in. and 4 in. services, construct taps using 4 in. tapping sleeve and valve. Insulate copper service pipe attached to metallic water mains at the corporation stop with a dielectric insulator in accordance with Utility Standards for Excavating, Backfilling, and Compacting.

Do not install multiple tapping, two or more taps on a length of pipe, on a common line parallel to the longitudinal axis of the pipe and no closer than 18 in. on the longitudinal axis of the pipe.

Splices are not allowed in any portion of the service pipe run between the main line connection and the meter assembly. Connect all services to new main by means of wet-tapping. Dry or direct taps are not allowed.

Perform meter installations larger than 1-in. with a bypass meter connection as listed:

- 1 1/2 in. and 2 in. meters, 1 in. bypass,
- 3 in. and 4 in. meters, 2 in. bypass, and
- 6 in. and 8 in. meters, 3 in. bypass.

- 7.3.2. **Existing Services.** Where existing water services are indicated on the plans to be replaced, relocated, or reconnected to new water lines, make prior arrangements with each water customer as to the time and length of shutdown necessary. Notify the customer 24 hr. before any connections are made. A maximum shut-off time of 4 hr. will be allowed for making connections, after which time supply the customer with potable water from an approved source at no additional cost to Department.

- 7.3.3. **Metallic Tracer Tape.** For 3in. services and larger (i.e. PVC), provide a minimum width of 6 in. or twice the line diameter. Do not exceed a burial depth of 36 in. below final grade or be at an elevation of less than 12 in. above the utility line. Follow tape manufacturer's recommended burial depths.

- 7.3.4. **Meter Box Installation.** Install in accordance with these specifications and Utility Standard Details to grade matching top of curb.

Do not install under sidewalks, driveways, or proposed above-ground structures. Where no curbing exists, install boxes in accessible locations beyond limits of street surfacing, walks, and driveways.

Install standard meter boxes for their respective meter size according to Table 13.

Table 13
Standard Meter Boxes

METER SIZE	BOX TYPE	CONSTRUCTION	DIMENSIONS W x H
3/4 in.	Type A	Single Unit	19.25 in. O.D. x 17 in.
1 in.	Type B	Single Unit	26 in. O.D. x 17 in.
1 1/2 in. to 2 in.	Type C	Single Unit	50 in. sq. x 24 in.
3 in. and larger	Type D	Modular	7 ft.-8 in. sq. x 4 ft.-6 in.

Where it is necessary to install Type A or B boxes for 3/4 in. or 1 in. meters under roadways or traffic bearing surfaces, encase boxes in 12 in. concrete 3,000 psi minimum.

- 7.3.5. **Testing and Flushing Procedures.** Pressure test all services for leakage by opening the corporation or service valve at the main service connection point, maintaining the meter angle valve closed, and visually observing all connections and piping for leaks. If no leaks are observed, then flush service line as follows. The angle valve is opened to "full" and then the corporation valve is slowly opened to full capacity. Water is allowed to flow until piping has been thoroughly flushed. Then the angle valve is slowly closed to prevent water hammer or shock pressure, which might rupture the main or adjacent water service connections. If no customer piping is currently connected to the meter outlet connection, use a fitted plug at the end of this connection to prevent the entrance of dirt or muddy water.

- 7.4. **Measurement.**

- 7.4.1. **Water Service Replace and Reconnect.** This Item will be measured in place by each water service replaced and reconnected for the size and type indicated.
- 7.4.2. **New Water Service Installation.** This Item will be measured in place by each new service installed for the size and type indicated.
- 7.4.3. **Meter Boxes.** This Item to install/remove/replace/adjust will not be measured for individual payment and is subsidiary to the water connection items.
- 7.4.4. **Water Valve.** This Item to install/remove/replace/adjust will not be measured for individual payment and is subsidiary to the water connection items.
- 7.5. **Payment.**
- 7.5.1. **Water Service Replace and Re-connect.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Service Replace & Reconnect" of the size and type specified. This price is full compensation for furnishing all required materials, including all costs associated with: furnishing labor, new materials, equipment, and incidentals to replace and reconnect existing water services of the specific size and type (water service or fire line); complete restoration to its original condition, any disturbed areas associated with the replacement and reconnection of existing water services; coordination; and all appurtenances defined herein to include, but not limited to the following items: concrete meter boxes, all fittings and valves in accordance with MPU requirements and as indicated on the plans.
- 7.5.2. **New Water Service Installation.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "New Water Service Installation" of the size and type specified. This price is full compensation for furnishing all required materials, including all costs associated with: furnishing labor, new materials, equipment, and incidentals to install new water services of the specific size and type (water service or fire line); complete restoration to its original condition, any disturbed area associated with the installation of new water services; coordination; and all appurtenances defined herein to include, but not limited to the following items: concrete meter boxes and vaults, all fittings and valves in accordance with MPU requirements and as indicated on the plans.
- 7.5.3. **Meter Boxes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" are subsidiary to the "Water Service Replace & Reconnect" or "New Water Service Installation" bid items.

8. FIRE HYDRANTS

- 8.1. **Description.** Furnish labor, materials, equipment and incidentals to install fire hydrants as shown on the plans in accordance with Utility requirements and typical fire hydrant installation.
- 8.2. **Materials.**
- Submittals.** Submittals include certified drawing showing dimensions and construction details and certification from manufacturers that the products comply with appropriate AWWA Standards and this Specification. Submit catalog data illustrating equipment to be furnished and a schedule of parts and materials. Provide manufacturer guarantee that friction loss meet the requirements of AWWA C-502.
- Standards.** Comply with requirements of AWWA C-502, Dry-Barrel Fire Hydrants, and AWWA C-550, Protective Epoxy Interior Coatings for Valves and Hydrants.
- 8.2.1. **Manufactured Products.**

General. Provide dry-barrel compression type fire hydrants, with the main valve opening against the pressure, in accordance with AWWA C-502. Design hydrant for a minimum working pressure of 150 psi and tested at 300 psi hydrostatic pressure.

Provide hydrant with permanent markings identifying name of manufacturer, size of main valve opening and year of manufacture that are easily located and legible after the hydrant has been installed.

Construct hydrant so that the standpipe may be rotated to eight (8) different positions.

Provide center of the lowest nozzle a minimum ground clearance of 15 in. Supply with extension sections in multiples of 6 in. with rod and coupling as required to increase barrel length.

The fire hydrant manufacturer must provide local representation and support services, through an established vendor, within the City of McAllen. Acceptable manufacturers and models are listed:

- Muller
- American Darling, and
- Kennedy

Size. Provide a minimum inside barrel diameter of 7 in. with a minimum diameter of the main valve opening of 5 in.

8.2.2.

Traffic Type. Design the barrel and operating mechanism that the main valve will remain closed and reasonably tight against leakage in the event of an accident, damage, or breaking of the hydrant above or near the grade level.

Provide manufacturer guarantee that the hydrant valve stem will not be bent when the hydrant is damaged or broken at or near ground level. Provide a safety breaking flange or thimble. Make provisions in the design of the stem to disconnect the stem from the hydrant parts above the standpipe break point in the event of a traffic accident.

If breakable couplings are used, design the barrel safety flange and stem safety collar to break before any other hydrant part in the event of an accident. Design coupling so that no part of the coupling will drop into the hydrant barrel in the event of an accident.

Corrosion Resistant Valve. Include a Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV) designed to protect against accidental backflow and intentional contamination of drinking water via the hydrant. The DATV must be a stealth check valve located internal to the upper barrel of the hydrant and consisting of four main parts.

- A sleeve-insert valve seat, made of E-coated or fusion-bonded epoxy steel. Provide a machined slot to the top of the valve seat to accommodate an EPDM quad ring that will provide an impenetrable seal between the seat and the valve and separates the valve from the insert to prevent the chance of galvanic corrosion. The sleeve will have a plug in the drain hole located at the bottom of the sleeve.
- A valve made of brass with machined slots to accommodate a Viton O-ring between the valve and the upper stem.
- A 304 stainless steel machined upper stem to replace the original upper stem. Attach the brass valve to the upper stem in such a manner as to provide free vertical movement along the shaft and be sealed and separated from the stem by a Viton o-ring that prevents contact between dissimilar metals to eliminate the chance of galvanic corrosion.
- A 302 stainless steel spring that fits around the upper stem and is of adequate compression strength and length such that sufficient pressure is placed on the valve to provide an impenetrable seal when the hydrant is not in use and yet allows water to flow freely when the hydrant is flowed.

Provide a technician certified by the DATV manufacturer to install the DATV. The DATV manufacturer or authorized representative must provide both initial and ongoing refresher training, free of charge to

governmental entities utilizing their product. Install DATV in a manner that does not alter the standard warranty offered by the hydrant manufacturer, except that such warranty will not cover the DATV itself

The DATV must be shop-installed by the hydrant distributor and be delivered to the project site ready for installation. The hydrant distributor will order the hydrants without the hydrant parts that are to be replaced by the DATV. Provide DATV with a minimum 10 yr, warranty against defects in workmanship and materials that also guarantees that its installation inside the hydrant will not cause failure of any of the original fire hydrant parts while the hydrant is under warranty, provided that: (a) the hydrant and DATV are installed and maintained in accordance with the corresponding manufacturers' recommendations; (b) the installer of the DATV was certified for such installation by the DATV manufacturer; and (c) that analysis of the failure clearly establishes that installation of the DATV as the primary cause of the failure.

Ensure that the DATV does not interfere with the breakaway functionality of the fire hydrant.

Drain Outlet. Provide upper valve plate, seat ring and drain ring or shoe bushing in bronze, to form an all bronze drain way and drains the hydrant properly by opening as soon as the main valve is closed.

Inlet Connections. Provide mechanical joint, with accessories, gland, bolts, gaskets, and a 6 in. diameter inlet connection. Provide synthetic rubber main valve facing against seats. Equip top of the stem or bonnet with O-ring seal. Provide oil or grease lubricated hydrant.

Outlet and Pumper Nozzles. Provide two hose outlets with two 1/2 in. nozzles with National Standard hose coupling screw threads. Provide outlet nozzles of the caulked type or mechanically connected into the barrel with an O-ring seal and a non-corrosive locking pin to lock the nozzle to the barrel.

Provide pumper Nozzle with an inner diameter of 4 in. with threads conforming to the McAllen Public Utility Standards.

Provide nozzle caps with one, 1 in. square nut, gaskets and non-kinking chains. Provide operating nut and nozzle cap nuts that have one, 1 in. square at the base and tapered to 7/8 in. square at the end and not less than 1 in. deep. Provide nozzle caps with rubber gaskets.

Hydrant Operator. Provide operator that is 1 in. square at the base and tapered to 7/8 in. at the end and not less than 1 in. deep. Attachment of the operator nut must not, in any way, hinder operating the hydrant with the wrench and must open by turning left (counterclockwise). Design hydrants with O-ring seals to prevent water from damaging the operating threads.

Tamper Proof Cover. Equip hydrant with a tamper proof cover, minimum inside diameter of 2 1/4 in., with drainage holes, that deters unauthorized operation of the hydrant and provides adequate wrench clearance. The height of the cover ranges from 2 1/4 in. to 2 1/2 in., measured from the base at the bonnet to the top of the collar.

Painting. Prime coat barrels above ground with two coats of aluminum colored paint as approved by MPU.

Protective Coating. Epoxy coat all interior ferrous surfaces of shoe exposed to flow to a minimum dry thickness of 4 mils. Factory-apply epoxy coating by an electrostatic or thermosetting process in accordance with manufacturer's printed instructions. Epoxy materials must be 100% powder epoxy or liquid epoxy conforming to AWWA C-550 and to the current requirements of the Food and Drug Administration and the EPA for potable water.

8.3. **Construction.** Install hydrants at locations shown on the plans or in approved standard locations. Touch up paint damaged during installation. Disinfect hydrants with the connecting pipe in accordance with Article 10, "Cleaning, Disinfection and Testing of Water System" in this Specification. Ensure installed hydrants are left in good working order with control valve open.

8.4. **Measurement.**

- 8.4.1. **Fire Hydrant (Relocate & Reconnect).** This Item will be measured in place by each fire hydrant reconnected to the new or existing water main.
- 8.4.2. **Fire Hydrant (New).** This Item will be measured in place by each new fire hydrant connected to the new water main.
- 8.4.3. **Fire Hydrant (Remove and Salvage).** This Item will be measured in place by each fire hydrant removed and salvaged.
- 8.5. **Payment.**
- 8.5.1. **Fire Hydrant (Relocate & Reconnect).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (Reconnect Only)" as specified. This price is full compensation for furnishing all required materials, including new piping from the new or existing water main to the fire hydrant, new gate valve with bonnet box, concrete thrust blocking or mechanical joint restraints, Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV), new spool extensions as needed, new fittings and appurtenances for a complete installation as shown in plans.
- 8.5.2. **Fire Hydrant (New).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (New)" as specified. This price is full compensation for furnishing all required materials, installation of new fire hydrant, Davidson Anti-Terrorism Corrosion Resistant Valve Kit (DATV), spool extensions as needed, mechanical joint tee at the main, gate valve with bonnet box and lid, all PVC C900 pipe from the main to the fire hydrant, thrust blocking or mechanical joint restrainers and all fittings and appurtenances for a complete installation as shown in the plans.
- 8.5.3. **Fire Hydrant (Remove and Salvage).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fire Hydrant (Remove and Salvage)" as specified. This price is full compensation for furnishing all required labor, materials, equipment, and incidentals to remove and salvage existing fire hydrants as indicated on the plans in accordance with MPU's requirements.

9. CLEANING, DISINFECTION, AND TESTING OF WATER SYSTEM

- 9.1. **Description.** Perform disinfection and testing of all water mains and related appurtenances.
- 9.2. **Materials.**
- Standards.** Comply with applicable requirements of AWWA B-300 "Standard for Hypochlorites," AWWA B-301, "Standard for Liquid Chlorine" and AWWA C-651, "Standard for Disinfecting Water Mains."
- Water.** Provide water required for filling, flushing and testing the line at such points along the pipeline as water is available from the existing distribution or supply systems (See "Water for Construction" in Project General Notes). Do not waste water. Such action may require appropriate charges. Provide water, by tank truck or other means, to the points necessary to produce specified test pressure. Coordinate disposal of water with Engineer and McAllen Public Utility. Do not dispose water onto the streets as that will be considered "wasting of water," unless otherwise approved.
- Chlorinating Material.** Provide either liquid chlorine conforming to AWWA B-301 or hypochlorite conforming to AWWA B-300.
- 9.3. **Construction.**
- General.** After completion of all pipe line section, use the following procedure to clean, sterilize and pressure test the pipeline. Fill the pipeline and flush until all evidence of dirt or debris has been washed from the

pipeline, then refill line, if necessary, introducing the chlorinating material. Perform pressure and leakage test at each valved section. After all sections have been approved, clean all valves and leave line full of sterilizing water.

Quality Assurance. Exercise special care to keep the interior of the pipe clean during storing, handling, and laying operations in order to reduce the need for flushing to an absolute minimum. In addition, tightly cover all open ends whenever unattended to prevent small animals and dirt from entering the pipeline after it is in place.

9.3.1.1. **Sterilization.** Before acceptance for operation, sterilize each unit of completed water system as specified below or as prescribed by AWWA Standard C-651. (As per C-651, collect two consecutive sets of acceptable samples taken at least 24 hr. apart from the new main.)

- Thoroughly flush with water the unit to be sterilized until all entrained dirt and mud have been removed before introducing the chlorinating material.
- Provide all chlorination material for sterilization and introduce the chlorinating material into the water line in an approved manner at a dosage of not less than 50 ppm.
- Retain treated water in the pipe at least 25 hr. to destroy all nonspore-forming bacteria except where a shorter period is approved. Retention time should produce not less than 10 ppm of chlorine at the extreme end of the line at the end of the retention period.
- Open and close all valves on the lines being sterilized several times during the contact period.

9.3.1.2. **Hydrostatic Pressure and Leakage Testing.** Furnish meter, pressure gauges, pump, small piping and hose connections, and all labor necessary for conducting hydrostatic pressure and leakage tests. Check all valves and hydrants for proper operation and pressure. Subject the pipe system to a hydrostatic pressure and leakage test after completion of each valved section and following the filling and disinfection of the section.

After the section of pipeline has been filled, pump water into the section and raise the pressure to 150 psi. Maintain this test pressure for a period of at least two (2) hr. Deliver water required to maintain this pressure through the meter. The amount of water through the meter during the 2 hr. test period will be the total leakage. Should this leakage exceed the allowable amount, make repairs as may be required until the actual leakage, as determined by succeeding tests, is no greater than the allowable as determined by the following formula:

$$L = S \times D \times (P^{1/2}) / 133,200 \quad \text{except that } L = 0 \text{ in above ground systems and otherwise}$$

L = Allowable Leakage in gallons/hour

S = Length of pipe tested in feet

D = Nominal diameter of pipe in inches

P = Average test pressure during the test, in pounds per square inch, gage; determined by computing the weighted average of actual pressures on various portions of the section

After all sections of the pipeline have been tested, as described above, close all valves and leave line filled with the water used for disinfection and testing.

9.4. **Measurement and Payment.** The work performed and the materials furnished in accordance with this Article will not be measured or paid for individually as it is considered subsidiary to the various water main and related appurtenances bid items.

10. SANITARY SEWER FACILITIES

10.1. **Description.** Furnish all labor, materials, equipment and incidentals required and install sanitary sewer systems and adjustments as shown on the plans and as specified.

Verification of Utilities. The data furnished in the plans regarding the size and location of utility lines has been obtained from field surveys and the various utility companies. Verify the location of all utilities prior to commencing sewer construction. Perform all work within public right-of-way. Do not extend into or encroach upon private property including basements, residences, and places of business.

Coordination with McAllen Public Utility (MPU). Coordination with McAllen Public Utility is required for sewer line tie-ins and bypassing, where indicated in the specifications and on the plans, and for CCTV video-inspection of new sewer lines. McAllen Public Utility will perform video-inspection of all new sewer lines to determine acceptance. Notify McAllen Public Utility through Engineer, a minimum of 48 hr. in advance of any scheduled inspection; and provide a staging area that is free and accessible for TV camera activities.

Water Main Crossing. Where gravity or force main sewers are constructed in the vicinity of water mains, ensure that the most current requirements of the Texas Commission on Environmental Quality (TCEQ) are met.

10.2. **Materials.**

10.2.1. **Polyvinyl Chloride (PVC) Flexible Pipe.** These standard specifications designate the requirements for furnishing and installing PVC gravity pipe for sanitary sewage, with a standard dimension ratio (SDR) as shown in the plans and specified herein. Furnish all materials, equipment, tools, labor, superintendence, and incidentals required for the complete construction of the work designated.

Quality Assurance. Code all PVC pipe to provide positive identification and prevent accidental damage to or interruption of the sanitary sewer facilities. Only provide pipe manufactured in the United States of America. Provide new materials including all pipe, fittings, and accessories. Perform manufacturer's physical and chemical tests according to the ASTM standard applicable to the respective PVC pipe type and diameter herein specified, in order to demonstrate pipe quality.

Submittals. Submit documentation on pipe products, fittings, and related materials as may be required by the contract documents or the Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the product complies with appropriate ASTM standards.

Standards. Comply with applicable following requirements:

- ASTM D-1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds,
- ASTM D-2321 Specification for Underground Installation of Flexible Thermoplastic Sewer Pipe,
- ASTM D-3034 Specification for Type PSM Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings,
- ASTM D-3212 Joints for Drain and Sewer Pipes Using Flexible Elastomeric Seals,
- ASTM F-477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe,
- ASTM F-679 Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings,
- ASTM F-789 Specification for Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings,
- ASTM F-794 Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter,
- ASTM D3753 Standard Specification for Glass Fiber Reinforced Polyester Manholes,
- ASTM C-923 Standard Specification for Resilient Manhole Connectors,
- ASTM C-1244 Specification for Standard Test Method for concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test,
- AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe 4-in. through 12-in. for water distribution,

- AWWA C900 Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameter 14-in. through 36 in., and
- ASTM 2241 Polyvinyl chloride (PVC) Pressure- Rated Pipe (SDR PR Series).

Delivery and Storage. Inspect pipe, fittings, and accessories upon delivery and during progress of the work. Any material found defective will be rejected. Remove rejected material promptly from site.

Replace, at no additional cost to Department, any material found to be defective in manufacture or damaged.

Unload at point of delivery all pipe, fittings, and other accessories, haul to and distribute at the work site. In loading and unloading, lift materials by hoists or rolled on skidways so as to avoid shock or damage. Do not incorporate materials that have been dropped into the work. Do not skid or roll pipe handled on skidways against pipe already on the ground.

Do not store PVC pipe outside exposed to prolonged periods of sunlight. Any discoloration of pipe due to such exposure is an indication of reduced pipe impact strength, and will be sufficient cause for rejection of the pipe. Remove rejected all pipe from the job site.

Pipe Schedule. PVC pipe will be designated as gravity sewer conduit and must meet the requirements shown on Table 14.

Table 14
Gravity Sewer Conduit Dimensions

Pipe Size	ASTM Standard	Material	Wall Type	Minimum Stiffness	Standard Length
8 in.	D-3034	PVC	Solid SDR-35	46 psi	20 ft.
12 in. 15 in.	F-789	PVC	Solid T1-Wall	46 psi	20 ft.
18 in.	F-679	PVC	Solid T1-Wall	46 psi	20 ft.
	F-789	PVC	Solid T1-Wall	46 psi	20 ft.
	F-794	Large Dia PVC	Profile Open	46 psi	13 ft.
21 in.- 27 in.	F-679	PVC	Solid T1-Wall	46 psi	20 ft.
	F-794	Large Dia PVC	Profile Open or Closed	46 psi	13 ft.
30 in.- 36 in.	F-794	Large Dia PVC	Profile Open or Closed	46 psi	13 ft.
39 in. - 60 in.	F-794	Large Dia PVC	Profile Closed	46 psi	13 ft.

Joints. Provide push-on, bell and spigot type joints with elastomeric seals that conform to the requirements of ASTM D-3212. Provide factory installed gaskets that are chemically bonded to the bell end of the pipe with gasket material that conforms to the requirements of ASTM F-477.

Pipe Materials. Provide pipe and fittings made from polyvinyl chloride compounds that comply with the requirements for minimum cell classification defined by ASTM D-1784. Provide PVC fittings, service risers, and laterals with a SDR 35 rating.

Pipe Trenching, Installation and Backfill. Except as noted, Pipe Trenching, Installation and Backfill of PVC gravity sewer pipe will be in accordance with ASTM D-2321 and Article 6 of this specification.

- Refer to Article 6.3.2.1 for Flexible Pipe.
- Following the preparation of the trench bottom and trench bracing installed where required, proceed up grade with spigot ends pointing down grade. Lay pipe true to lines and grades as shown on plans. Grade may be established by laser beam, or batter boards (not exceeding 50 ft. intervals), and string line may be used with each pipe set to grade, from the string line, with a grade rod equipped with a "shoe" designed to fit into the flow line of the pipe.

Testing. Inspect PVC and test for leakage and deflection in accordance with Article 11.3.3.

10.2.2. **Polyvinyl Chloride Plastic Pipe (PVC).**

10.2.2.1. Unless otherwise required for trenchless installation or for water line crossing, provide pipe and fitting complying with ASTM D3034 or ASTM F679, manufactured using material conforming to ASTM D1784, and having wall thickness equivalent to SDR 26. Joints will be single elastomeric gasket push-on type complying with ASTM F477 and D3212.

10.2.2.2. Where PVC gravity sewers cross water lines and where indicated on the plans, sewer that conforms to the following standards and have a minimum pressure rating for 150 psi for pipe joints, and fittings:

- AWWA C900 (DR 18),
- AWWA C905 (DR 25), and
- ASTM 2241 (SDR 26).

10.2.2.3. Where PVC gravity sewer is installed using non-encased, trenchless methods, pipe may be one of the following having minimum wall thickness corresponding to SDR 18:

- **Jointless PVC.** Pipe will conform to the requirements of AWWA C900/C905 and PPI TR2. The pipe will be extruded with plain ends square to the pipe and free of any bevel or chamfer. Pipe must be Fusible C900 OR Fusible C905 as manufactured by Underground Solutions, Sarver, PA.
- **Restrained Joint PVC.** Couplings will be non-metallic and incorporate high-strength, flexible thermoplastic splines which will be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360 restraint with evenly distributed loading. Coupling will be designed for use at or above the pressure class/rating of the pipe with which they are installed and will incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F 477. Joints will be designed to meet the zero leakage test requirements of ASTM D3139. Pipe must be C900/RJ or C905/RJ as manufactured by Certain Teed Corporation, Valley Forge, PA.

10.2.2.4. All PVC pipe for sewer service will be green in color.

10.2.2.5. Lubricant for jointed pipe to be in accordance with the requirements of ASTM D3212. Lubricant to be suitable for lubricating the parts of the joints in the assembly. The lubricant will not have any deteriorating effects on the gasket and pipe materials.

10.2.2.6. Service laterals will be Schedule 40 PVC in accordance with ASTM D 1785 and D2665.

10.2.2.7. Mark all pipe and fittings.

10.2.3. **Ductile Iron Pipe (DIP).** These standard specifications designate the requirements for furnishing and installing DIP for sanitary sewage. Furnish all materials, equipment, tools, labor, superintendence, and incidentals required for the complete construction of the work designated.

Quality Assurance. Manufacturer must have a minimum of ten years successful experience in designing and manufacturing DIP, pipe joints of similar design, pipe diameter, and pressure class of the type specified. The entire pipeline will be the product of one manufacturer. Pipe must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 "Drinking Water System Components - Health Effects" and be certified by and organization accredited by ANSI. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted.

Submittal. Submit documentation on pipe products, fittings, and related materials as required by the plans or Engineer. Review all submittals prior to submission. Submit in a timely manner so as not to delay the project. Allow sufficient time for Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the DIP complies with appropriate AWWA Standards and ANSI/NSF Standard 61. Provide by an affidavit from the manufacturer or vendor as evidence of compliance. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. If requested, provide copies of results of factory hydrostatic tests.

Standards. Comply with applicable requirements of the following items listed below:

- ASTM A-746 Specification for Ductile Iron Gravity Sewer Pipe,
- AWWA C-104 Standard for Cement Mortar Lining for Ductile Iron Pipe and Fittings,
- AWWA C-105 Standard for Polyethylene Encasement for Ductile Iron Piping,
- AWWA C-110 Standard for Ductile Iron and Gray Iron Fittings,
- AWWA C-111 Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings,
- AWWA C-150 Standard for Thickness Design of Ductile Iron Pipe, and
- AWWA C-151 Standard for Ductile Iron Pipe.

Pipe Materials. Manufacture DIP in accordance with AWWA C-151 and conform to ASTM Specification A-746 with physical properties of Grade 60-40-18 with a minimum pressure class rating of 150 psi, unless otherwise specified. Design pipe for 5 ft. of cover or for the depths shown on the plans, whichever is greater. Provide a standard joint length of 18 or 20 ft. and the inside diameter will be industry standard. Replace any material found to be damaged or defective in manufacture at Contractor's expense.

Joints. Provide push-on standard joints for DIP manufactured in accordance with AWWA C-111, AWWA C-151. Where indicated on the plans, joints will be mechanical or flanged. Flanged joints will have pressure ratings equal to or greater than adjacent pipe. Flange pattern will match pattern of valve, fitting, or appurtenance to be attached.

Fittings. Provide DIP in accordance with AWWA C-110 and Article 7 of this Specification. Fittings will be rated for a minimum working pressure of 250 psi, unless otherwise specified. Factory welded outlets, minimum pressure rating 250 psi, may be used in lieu of tee fittings for 18 in. and larger tee fittings. Do not use factory welded outlets near sources of vibration, such as pump stations or roads, unless specifically noted on the plans.

Exterior Coating. Provide a standard asphaltic coating in accordance with AWWA C-151, unless otherwise specified. The finished coating will be continuous, and smooth and strongly adherent to the pipe.

For DIP sizes 30 in. and smaller, use a 30 mils minimum thickness polyethylene wrap applied wrap in accordance with AWWA C-105/A21.5.

Tape coat DIP 36 in. and larger. The exterior of the pipe must have a prefabricated cold-applied tape coating system conforming to the requirements of ANSI/AWWA C-214, except as noted herein. Blast clean the surface to achieve a surface preparation at least equal to that specified in SSPC SP6. The blast profile must have an anchor pattern as specified by the tape manufacturer. Hold the coating back from the end of the pipe the minimum distance recommended by the pipe manufacturer for the type of joint used. Taper the tape wrap cut back. Provide a nominal thickness of 80 mils.

Interior Lining. DIP Pipe and fittings will have an epoxy lining in accordance with ASTM D714. Provide epoxy lining appropriate for wastewater pipe application with a minimum lining thickness of 40 mils.

Provisions for Thrust. Where indicated and where required for thrust restraint, joints must be restrained. Restrained joints will be mechanically interlocking joints. Provide restrained joints such as U.S. Pipe "TR Flex," American Cast Iron Pipe "Flex Ring," or Clow Corporation "Super-Lock" that are capable of sustaining

the specified design pressure. If thrust cannot be accommodated using restrained joints, such as bends adjacent to casing pipe, use approved thrust restraint devices.

Use thrust restraint devices to resist thrust at bends, tees, plugs, or other fittings. Do not use concrete thrust blocks unless approved by the Engineer. Acceptable thrust restraint devices are those as manufactured by EBAA Iron, Ford Uni-Flange, or approved equal.

NOTE: At connection of new sewer force main to existing main, use both concrete thrust blocking and thrust restraint devices as per Article 4.2.5 of this specification.

Use restrained joints for a sufficient distance from each bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, design pressure will be 1.5 times the design working pressure class indicated. Pipe manufacturer will determine length of pipe with restrained joints to resist thrust forces in accordance with the Handbook of Ductile Iron Pipe. Use the following parameters:

- Laying condition equal to AWWA C-600 Type 5 soil,
- Safety factor of 1.8,
- Unit bearing resistance equal to zero, and
- Factor for polyethylene encasement as recommended by DIPRA, if required.

Pipe Trenching, Installation, and Backfill. Except as noted, perform pipe trenching, installation, and backfill for DIP in accordance with AWWA C-600 and Article 6 of this Specification.

General. Repair any damage to polyethylene wrap according to AWWA C-105. Keep pipe clean during installation. Provide two coats of Koppers Bitumastic No. 50, or approved equal to exposed ferrous metal that cannot be protected with field-applied tape coating. Install pipe and fittings to line and grade indicated. In areas where the line and grades indicated cannot be achieved using standard manufactured bends and fittings, make slight adjustments by deflecting joints according to the limitations of AWWA C-600.

Pipe Zone Embedment. Unless otherwise specified, embed DIP in Class II material as defined in Article 6. Native material or imported material meeting or exceeding Class II requirements may be used. Class I material may be acceptable only in groundwater conditions if approved.

When required, machine cut DIP leaving a smooth cut at right angles to the axis of the pipe. Bevel ends of cut pipe to be used with a push-on joint bell to comply with manufactured spigot end. Do not damage cement lining.

As a precaution against corrosion, coat all flanges, bolts, nuts and other exposed metal surfaces underground with Texaco, Koppers, or equal rustproof compound.

Testing. Inspect DIP and test for leakage and deflection in accordance with Section 11.3.3.

10.3. **Sanitary Sewer System.** Furnish labor, materials, equipment and incidentals to install sewer service lines as indicated on the plans in accordance with MPU Standards.

10.3.1. **Sewer Service Connections.**

Materials. Conform to the material requirements of the City of McAllen' Plumbing Code and all amendments thereto. Fittings, service risers, and laterals are as specified for the material type utilized. Where additional service connections are required on an existing main line, install an approved service saddle compatible to the size and type of both the collection line and service lateral. Encase saddles with Class B (2,500 psi) concrete where PVC saddles with rubber seals and stainless steel bands are used in accordance with MPU Standards to protect the steel bands from corrosion and to add stability.

Tees and Riser. Install tee or wye fittings for future house service connections. Use bell-type fittings and seal on the branch outlet with an approved plug that can be easily removed for service riser or lateral line installation.

Where ground water is encountered, install the tee and a sufficient service line RISER, thereby raising the final bell above the ground water level. In deep trenches, extend the RISER to the depth of the intersecting service line, or to within 6 ft. of the surface, whichever is designated in the plans or appropriate for field conditions.

Install a maximum of four service connections at manholes located at the ends of street cul-de-sacs. Connect additional services to the main line at a minimum 24 in. spacing.

Service Connections and Laterals. Provide new sewer service laterals and re-connections of all existing sewer service laterals to new lines installed to replace lines to be abandoned where required on the plans. Verify location of laterals indicated on the plans and ensure service is not interrupted to homes or other establishments.

Install wyes, bends, tees, stacks, and other hardware, where required, for service laterals as shown in the plans or as directed. Unless otherwise specified, provide minimum 4 in. diameter lateral service lines. Although the maintenance of service laterals is the responsibility of private property owners, including the portion within public right-of-way, as established by Public Service Board Rules and Regulations, the Contractor is be responsible for the integrity of the installation or re-connection of all such service lines during the warranty period.

Use proper specials and fittings to suit the actual conditions for connections between new work and existing work, where required. When it is necessary to interrupt service to existing facilities in order to make connection to an existing line, connections may need to be made at some time other than during normal working hours at no additional cost to Department.

Prior to service line installation, coordinate with MPU through Engineer to have MPU personnel curb mark the locations of proposed service tees. Lay service lines and that the branch makes an angle of 45° with the vertical on the side of the main facing the lot to be served.

Install and extend new service lines 6 in. beyond existing or proposed improvements such as pavement, curb and gutter, sidewalk, etc. unless otherwise specified or shown in the plans. For standard subdivisions having curb and gutter for drainage, install new services lines at a minimum slope of 2% with a minimum cover at the terminus of 18 in. For subdivisions with flat terrain and on-site ponding (no curb and gutter), provide a minimum cover of 3 1/2 ft., unless otherwise directed.

Uniformly support service pipe on bedding having a density of not less than 90% of maximum density per ASTM D-1557. Carefully place and compact backfill on service lines in accordance with the requirements of Article 6.3.4. Plug the terminus of the service line with an approved universal end cap compatible with the pipe size and material.

Utilize a qualified licensed plumber who is bonded and approved by the City of McAllen to install service risers and lateral extensions. Provide evidence that plumber is licensed and insured in accordance with McAllen Public Utility requirements.

Location Marking and Recording. Maintain as-built records of the horizontal and vertical location of installed sewer service lines. In unpaved areas without curb, mark the plugged ends of risers or laterals using a 1 in. by 2 in. by 24 in. wooden stake set vertically at the plugged terminus, and a sufficient length of plastic metallic marking tape extended vertically from the terminus to within 6 in. of ground surface. An electronic marker disk may be used in lieu of metallic tape. MPU personnel will mark locations of the installed service line or riser ends by chipping an arrowhead mark on top of the curb directly over the service plug.

10.3.2.

Manhole Structures. Furnish all labor, materials, equipment and incidentals necessary to provide all manholes as required. Provide manholes for the various sized lines as listed.

- Standard Type "A" 48 in. inside diameter,
- Standard Type "B" 72 in. inside diameter,
- Drop Manhole constructed at the designated locations and in accordance with McAllen Public Utility Standard Details, and as otherwise indicated in the project plans,
- Construct pre-cast concrete sections as specified herein, and
- Construct concrete apron for all new and adjusted manhole tops.

Quality Assurance. Provide manholes free of visible leakage and test each structure for leaks. Repair all leaks in a manner subject to Engineer's approval.

Submittals. Provide complete manufacturer's shop drawings on the manhole sections, to include the joints, for approval. Revise shop drawings that do not meet specifications and re-submit approval. Include manufacturer's specification data and recommendations on the lifters and joint material. Submit documentation of compliance with ASTM C-478. Failure to provide either the detailed shop drawings, specification data and recommendation on lifters and joint material, or the letter certifying that all material provided meets specification is sufficient grounds to reject material.

Standards. Comply with the following applicable requirements:

- ASTM A-48 Specification for Gray Iron Castings,
- ASTM A-82 Specification for Steel Wire, Plain, for Concrete Reinforcement,
- ASTM A-185 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement,
- ASTM A-615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement,
- ASTM C-32 Specification for Sewer and Manhole Brick (Made from Clay or Shale),
- ASTM C-33 Specification for Concrete Aggregates,
- ASTM C-144 Specification for Aggregate for Masonry Mortar,
- ASTM C-150 Specification for Portland Cement,
- ASTM C-309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete,
- ASTM C-478 Specification for Pre-cast Reinforced Concrete Manhole Sections,
- ASTM C-923 Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipe, and
- ASTM D-1557 Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop.

10.3.2.1.

Manhole Structure Materials.

Frame and Cover. Provide manhole frame and cover of composite of the weight, dimensions, and pattern indicated by the McAllen Public Utility Standard Details. Provide composite manhole frame and cover from polymerized unsaturated polyester with mineral and fiberglass filler/reinforcement products, 316 stainless steel hardware, made in USA. Imprint "McAllen Public Utility" or other designation as approved by McAllen Public Utility on the cover. Acceptable manufacturer is Composite Access Products, L.P. (CAP) or approved equal.

Manhole Rings. Provide manhole rings used for a maximum 2 ft. final grade in conformance to the applicable requirements of ASTM Specifications C-32, Grade MS. Provide rings of HDPE or other polymer based materials that are corrosion resistant.

Cement. Provide Portland Cement conforming to ASTM Specifications C-150, Type V.

Mortar Sand. Provide mortar sand conforming to ASTM Specifications C-144.

Concrete Aggregates. Provide concrete aggregates conforming to ASTM Specifications C-33 except that the requirement for gradation will not apply to concrete manhole conical and riser sections.

Steel Reinforcement. Provide billet-steel bars conforming to ASTM Specifications A-615 and welded steel wire fabric conforming to ASTM Specifications A-82 or to ASTM Specifications A-185.

Water. Provide water that is clean, clear, free from oil, acid or organic matter and injurious amounts of alkali, salts or other chemicals or deleterious materials.

Mortar. Provide mortar that is composed of 1 part Portland Cement Type V and 3 parts mortar sand mixed in an approved manner with water to form a workable mixture.

10.3.2.2. **Fiberglass Manholes**

10.3.2.2.1. Fiberglass manholes must be in accordance with ASTM D3753. Refer to Section 02572 Fiberglass Manholes and Wetwells for manhole structure requirements.

10.3.2.2.2. Manhole must be of one-piece design including bottom, invert, bench, barrel, cone, and stubouts. Refer to MPU standard detail.

10.3.2.2.3. The inside diameter of the manhole barrel should be either 48-in. or 1.5 times the nominal pipe diameter of the largest pipe, whichever is larger, or as indicated on the Drawings.

10.3.2.2.4. A concentric cone over the barrel of the manhole will have an internal, clear opening diameter as required to accommodate grade adjustment rings and a frame and cover with a 30-in. clear opening. Cone will have minimum 4-in. wide brick ledge.

10.3.2.2.5. **Pipe connections.** Connections to manhole will be via factory-installed pipe stubouts of length equal to the pipe diameter or 12 in., whichever is greater. Attachment of pipe to stubouts will be by means of a bell-and-spigot pipe segment having the same material and rating of the pipe to be connected. Outlet stubouts and drop connection stubouts will be spigot end; inlet stubouts will be bell end.

10.3.2.2.6. **Bottom, Invert, and Bench.**

- The bottom of the manhole will be designed to withstand the hydrostatic head pressure, empty and water-to-grade, and include a 3-in. wide anchoring flange for embedment in the concrete slab foundation.
- The invert will be a "U" shaped channel that is a smooth continuation of the inlet and outlet pipes. Channel dimensions will be as follows based on the outlet pipe diameter:
 - 12-in. and smaller: channel depth will be at least 1/2 the outlet diameter,
 - 15 to 24-in. channel depth will be at least 3/4 the outlet diameter, and
 - 24-in. and greater: channel depth will be at least equal to the outlet diameter.
- In manholes with pipes of different sizes, the crown of the pipes will be placed at the same elevation and flow channels in the invert will be evenly sloped pipe to pipe.
- The bench provided above the channel will be sloped at a minimum of 1-in. per ft.
- Invert and bench will be constructed of non-corrosive materials encapsulated in minimum 1/4 in. thick fiberglass.

10.3.2.3. **Pre-Cast Concrete Manholes.** Design manhole riser and conical section for sewer and water installations in the diameters specified or shown. Provide all manhole sections with 5 in. wall thickness and tongue and groove, unless otherwise specified. Rings will be available in various lengths from 1 ft. to 4 ft. Design the conical sections to be concentric and adapted to the ring at one end and to McAllen Public Utility composite frame at the other. Provide the base ring with a flat bottom joint. Steps or rungs are not required. Manufacture manhole sections in conformance with ASTM C-478 and any additional specifications listed here forth.

Concrete. Concrete to have a minimum 28 days compressive strength of 4,000 psi. Water cement ratio to be 0.5 or less by weight or not more than 5.5 gal. per sack.

Aggregates. Conform to specifications outlined by ASTM C-33 except for lightweight aggregate. Aggregates will be free of deleterious substances causing reactivity with oxidized hydrogen sulfide. Grade both types of aggregates in order to produce a homogeneous concrete mix. Accurately weight all materials at a central batching facility for mixing.

Cement. Provide Portland Cement conforming to ASTM C-150, Type V (sulfate resistant) for sewer applications and sufficient to produce a minimum strength of 4,000 psi, or other design strengths required.

Placing. Handled all concrete from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients, until (the approved unit operation) is completed. Place concrete in layers not to exceed 2 ft. deep. Compact each layer by mechanical internal or external vibrating equipment. Limit duration of the vibration cycle to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

Quality Assurance. The Engineer reserves the right to inspect the manufacturing process at any time to make tests on materials used, and to have cores cut out of the completed manholes for compressive strength testing and placement of reinforcement.

Curing. For purposes of early re-use of forms, the concrete may be heated in the mold after the initial set has taken place. Do not exceed a temperature of 160°F and raise from normal ambient temperature at a rate not to exceed 40°F per hr. Do not remove the cured unit from forms until sufficient strength is obtained for the unit to withstand any structural strain that may be subjected during the form stripping operation. After the stripping of forms, further curing by means of water spraying or a membrane curing compound of a clear or white type, conforming to ASTM C-309-58 may be used.

Steel Reinforcement. Use reinforcing steel as outlined in ASTM C-478 and any additional specifications herein. Apply the minimum steel area of 0.12 sq. in. to both risers and cone sections and the maximum center to center spacing of 6 in. as well. Place reinforcing steel for one line circumferential reinforcement on the tension side of the wall (the inner half part of the wall with a minimum 1-in. cover) for two lines circular reinforcement, refer to ASTM C-478. Sufficiently tie all reinforcing to withstand any displacement during the pouring operation.

Joint Reinforcement. Both tongue and groove will contain a #4 rebar.

Lifters. Design lifters to handle the imposed weights placed per manufacturer's requirements.

Joint Material. Seal all joints using Ram-Nek joint sealer in sufficient quantities by the vendor as part of the manhole sections in sizes per manufacturer's recommendations.

10.3.2.4. **Cast-In-Place Concrete Manholes.** In special circumstances, construct cast-in-place concrete manholes as shown in the plans, and provide the wall thickness not less than 6 in. Ensure that the concrete is of good quality and well vibrated and the method of construction materials and type of forms used are approved by the MPU.

10.3.2.5. **Manhole Connectors.** At manholes, a water-tight resilient connection will be made between the wall and the pipe by use of an engineering approved manhole waterstop adaptor such as Indiana Seal Manhole Adaptor, Kor-N-Seal, or approved equal, meeting the requirements of ASTM C-923. The connector must be compatible to both the type of pipe wall and manhole wall, and be installed in strict accordance with the recommendations of the connector manufacturer.

10.3.2.6. **Installation.** Construct manholes at the location and details shown on the plans or as. After the excavation has been completed, pour the concrete base or bottom.

The riser work may proceed when the concrete has sufficiently set. Neatly form the invert in the bottom of the manhole with concrete after the manhole rise has been completed. Construct invert with a true curve of as large a radius as the size of the manhole will permit and with a smooth trowel finish.

10.3.3. **Inspection and Testing.** Test all piping as specified herein unless otherwise directed.

Standards. Adhere to the following requirements when inspecting and testing sewer lines and manholes.

- ASTM C-828 Recommended Practice for "Low-Pressure Air Test of Vitrified Clay Pipe Lines (4-12 in.),"
- ASTM C-1103 Standard Practice for "Joint Testing of Installed Pre-Cast Concrete Pipe Sewer Line,"
- ASTM D-3034 Specification for "Type PSM Poly(Vinyl Chloride)(PVC) Sewer Pipe and Fittings,"
- ASTM F-679 Specification for "Poly(Vinyl Chloride)(PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings,"
- UNI-BELL-6 "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe,"
- UNI-BELL-9 Polyvinyl Chloride (PVC) Large Diameter Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 18-48 in.)

Manufactured Products. Provide all testing apparatus including pumps, compressors, hoses, gauges and fittings, mandrels, and other equipment necessary to perform the required tests.

10.3.3.1. **Television Inspection.** Prior to placing lines into operation, completed sewer lines will be inspected by MPU personnel with a television camera as a condition of final approval of the installation. Thoroughly clean and flush all lines and notify Engineer that the line is ready for television inspection. Correct any defects discovered in the pipe or construction methods at no additional cost. MPU will bear cost of the initial TV inspection. Any additional inspections required due to failure of the initial inspection are the Contractor's responsibility.

10.3.3.2. **Leakage Testing.** To ensure the integrity of the pipe and joints, test all sewer lines installed under these specifications for leakage using the guidelines established by ASTM C-828 and UNI-BELL B6, and the methods and procedures here forth described.

General. Provide all testing apparatus including pumps, compressors, hoses, gauges and fittings and other equipment necessary to perform the required tests. Acceptable equipment can be as manufactured by **Cherne** Industries Incorporated or approved equal.

Conduct tests in the presence of the Engineer unless otherwise approved. Notify Engineer 48 hr. in advance of testing. Record test results on standard utility forms provided by MPU.

Low pressure air testing may be conducted by Contractor or an approved independent testing firm with the full understanding to all persons conducting an Air Test that an Air Test may be dangerous if conducted improperly.

Test sewer lines after the "pipe zone" backfilling is completed and prior to construction of finished surfacing.

Where house laterals are included as integral part of the project, perform testing on the main and laterals after the risers or laterals have been completed and backfilled.

Thoroughly clean pipes prior to conducting leakage tests. Repair pipelines that exceed the allowable leakage rate and retest at no additional cost to the Department.

10.3.3.2.1. **Exfiltration Air Testing.** A Low Pressure Air Test is the standard method for testing sewer lines. Seal test pneumatic plugs above ground using a random pipe section pressurized to 5 psig. Plugs should remain intact without bracing or movement out of the section. Test procedure is as follows:

- Seal off each end of the section of pipe to be tested at a manhole connection. Securely brace test plugs,

- Introduce air slowly into the test section through the test plug until an internal pressure of 4.0 psi is reached. Allow internal air temperature to stabilize. Adjust the internal air pressure to 3.5 psi, disconnect the air supply and begin the test, and
- Maintain the test pressure through section without losing more than 1.0 psi for a length of time as determined by Table 15. Sections losing more than 1.0 psi fail test and must be repaired and re-tested for acceptance. If the section being tested includes more than one size of pipe, calculate the test time for each size and add to determine the total test time for the section.

Table 15
Total Test Time

Nominal Pipe Size (d)	Time (t).
Inches	Minutes/100 ft.
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
30	4.8
36	6.0
42	7.3

10.3.3.2.2. **Infiltration Test.** Infiltration testing of sewer lines under groundwater is mandatory. Perform this test prior to initiating any service connections and after backfilling. At testing time, maintain the level of the groundwater over the entire section of the pipe or near its maximum level.

Measure the allowable infiltration for any portion of the sewer system by a weir or current meter placed in the appropriate manhole and do not exceed 50 gal. per in. of internal pipe diameter per mile per day, including manholes.

Provide suitable plugs or other facilities in order to measure the amount of infiltration. If infiltration is excessive, immediately proceed to locate the source of leakage. Once located, seal the source of leakage by grouting, cementing and rebuilding as required, or by approved methods.

10.3.3.2.3. **Joint Testing.** At Engineer's direction, perform individual joint testing of pipe larger than 24 in. in diameter in accordance with ASTM C-1103 for special conditions not covered by other test methods.

10.3.3.2.4. **Inspection of Sewer Manholes.** Visually inspect manholes installed under groundwater for infiltration leakage through all joints and the manhole base. Repair all leaks or cracks with an approved hydro-cement grout.

10.3.3.3. **Deflection Testing.** As a condition for acceptance of the pipeline, perform a mandrel test (deflection test) to verify the roundness and proper installation of the flexible pipeline. Within 30 days, but not less than 7 days after the installation and backfilling of the flexible sewer line, including any service connections, in the presence of the Engineer, test deflection of the pipe with a mandrel (GO-NOGO device).

Mandrel Fabrication. Provide mandrels of high quality fabrication and precision as commercially available by Cherne Industries Incorporated, or approved equal. Mandrels require Engineer's approval and must be equipped with proven rings and meet the following requirements:

- Fabricate mandrel outside diameter (gauge dimension):

Mandrel O.D. = Pipeline Base I.D. - (% deflection limit x Pipeline Base I.D.) in accordance with
ASTM D-3034, F-679, or UNI-BELL-9

- Design mandrel open preventing debris buildup between channels of adjacent fins. Include a minimum of nine fin sets that are removable from the mandrel core. Assemble gauges of various diameters by substituting fin sets of appropriate dimension. Provide a length of the minimum radius portion of the mandrel not less than 1/3 of the nominal diameter of the pipe being tested.

Execution. Prior to testing, flush pipe and clean. Flow is not permitted in the pipeline throughout the duration of the deflection test. Manually pull mandrel through the pipeline with a suitable rope or cable that is connected to an eyebolt at one end of the gauge. Attach a similar rope or cable to the eyebolt at the opposite end of the mandrel and apply tension to it. This will ensure that the mandrel maintains its correct position during testing, while providing easy removal of the mandrel should it become lodged in an excessively deflected pipeline. Winching or other methods of forcing the mandrel through the pipeline is unacceptable.

For pipeline tested within 30 days of installation, do not exceed a deflection of 5% of the base inside pipe diameter as established by ASTM Standards D-3034 and F-679 listed in Table 16.

Table 16
Deflection Gauge Dimensions: SDR35 OR RSC 160

Nominal Size	Average I.D.	Base I.D.	5% Deflection Gauge
6in.	5.893	5.742	5.46
8in.	7.891	7.665	7.28
10in.	9.864	9.563	9.08
12in.	11.737	11.361	10.79
15in.	14.374	13.898	13.20
18in.	17.564	16.976	16.13
21in.	20.707	20.004	19.00
24in.	23.296	22.480	21.36
27in.	26.258	25.327	24.06

For pipeline tested beyond 30 days of installation, do not exceed a deflection of 7.5% of the nominal inside diameter or as established otherwise by the applicable governing body. Adjust mandrel gauge for 7.5% and seek Engineer approval. Make every effort to test for deflection prior to the 30 day expiration.

Maintain a permanent record of all testing with locations where excessive pipeline deflections occur and forward to Engineer after completion of testing on each line.

Replace all sections of pipe that deflect more than 5% (or 7.5%). Lay pipelines with acceptable ovality such that the larger diameter is situated in the vertical direction. All expenses for re-trenching, backfill, compaction, paving, and related work necessary due to failure to satisfy deflection test requirements are Contractor's responsibility.

- 10.4. **Sewer Line Bypassing and Draining.** This section specifies the requirements for temporary bypassing, draining, flushing and abandonment of sewer lines. Keep excavations free from water during construction. Do not damage property or create a public nuisance when disposing water. Provide hand pumping equipment and machinery in good working condition for emergencies and have workers available for its operation.
- 10.4.1. **Requirements.** Provide labor, equipment, materials and supervision to temporarily bypass flow around work during sewer construction and during work associated with sewer construction when necessary. Drain and flush all sewers to be abandoned with a minimum of twice the sewer's volumes of water. Drain all sewers lines to be abandoned. Coordinate all work with the Engineer.
- 10.4.2. **Submittals.** Twenty-one (21) calendar days prior to commencement of construction activities, the contractor shall provide a submittal with drawings and complete design showing the methods and equipment proposed

to be utilized in the sewer bypass and draining system for review and approval. Include the following information:

- Drawings indicating the location of temporary sewer plugs and bypass discharge lines,
- Schedule times for bypasses,
- Capacities of pumps, prime movers, and standby equipment, and
- Design calculations proving adequacy of the system and selected equipment.

10.4.3. **Job Conditions.** Existing sewer system map of the project area can be obtained from McAllen Public Utility and are available for review at their office – 1300 Houston Avenue, McAllen, TX. 78501, during regular business hours.

Protection. Where bypassing or draining of the contents of a line is required, ensure that service for connecting sewer laterals are not disrupted. Discharge all flow into the nearest downstream manhole and only after consultation with MPU operations to coordinate the discharge. Do not surcharge sewers or interfere with normal operation of related sewer facilities when bypassing and draining of the contents of a line. Discharging to the ground surface, receiving streams, storm drains, or discharging that result in groundwater contamination or potential health hazards is not permitted. In the event accidental discharging is caused by the Contractor's operations, MPU is immediately entitled to employ others to stop the discharging without giving written notice to the Contractor.

Contractor is responsible for penalties imposed on the MPU as a result of any discharge by the actions of Contractor's employees or subcontractors including legal fees and other expenses to the MPU resulting directly or indirectly from the discharge.

Scheduling. Do not shut down the bypassing systems between shifts, on holidays or weekends, or during work stoppages without written permission from the ENGINEER. Submit a detailed outage plan and time schedule for operations when necessary to remove a sewer line or structure from service. Coordinate schedule with the Engineer and meet the restrictions and conditions specified in this section. In the detailed plan, describe the method for preventing accidental discharges, the length of time required to complete said operation, the necessary plan and equipment to be used in order to prevent accidental discharges. Observe the following restrictions:

- Systems or individual equipment items will be isolated, drained, decommissioned, de-energized, or depressurized in accordance with the detailed outage plan and schedule, and
- Notify Engineer, in writing, at least one week in advance of the planned operation.

10.4.4. **Sewer Line Draining.** Flush sewers to be abandoned with two pipeline volumes of water and allow to drain fully prior to abandoning.

10.4.5. **Sewer Bypassing.** Accomplish sewer bypassing by pumping or diverting the upstream flow around the proposed work and as directed. Provide temporary pumps, conduits, and other equipment to bypass the sewer flow.

Furnish the necessary labor, equipment and material, and supervision to set up and operate the pumping and bypass system. Equip equipment engines with mufflers and/or enclosed to keep the noise level within local ordinance requirements during pumping operations. Provide pumps and bypass lines of adequate capacity and size to handle the flows.

Unless otherwise directed, bypass flow around proposed work whenever the depth of flow, as measured at the inlet pipe to the upstream manhole adjacent to proposed work, exceeds the crown elevation of the pipe; or whenever the equipment operating in the sewer provides an obstruction that restricts flow and causes the depth of flow to exceed the crown elevation.

10.4.6. **Standby Equipment.** Maintain on site sufficient equipment and materials to ensure continuous and successful operation of the bypass and dewatering systems. Maintain standby pumps fueled and operational at all times. Maintain on site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs,

pipng and other parts or system hardware to ensure immediate repair or modification of any part of the system as necessary.

10.4.7. **Acceptance Test for Sewer Pipelines**

10.4.7.1. **General.**

- Notify Engineer, in writing, at least one week in advance of the planned operation,
- Lines will pass a leakage and deflection test. A low pressure air test will be used for leakage testing. Deflection testing will be by passage of an approved mandrel,
- If infiltration is observed, lines will be rejected regardless of air test results,
- After backfilling and removing debris from each section of sewer line, conduct line acceptance tests under observation of the Engineer. Copies of all test results will be made available to the Engineer upon request,
- Perform test on piping systems including piping installed between or connected to existing pipe,
- Conduct tests on buried pipe after the trench is completely backfilled but before any surface course of permanent pavement is installed. If field conditions permit and if approved by the Engineer, partially backfill the trench and leave the joints open for inspection and for conducting the initial service leak test. Do not conduct the acceptance test until backfilling is complete,
- On exposed, non-buried piping, conduct the test after the piping is completely installed, including supports, hangers, and anchors,
- Do not perform testing on pipe with concrete thrust blocking until the concrete has cured at least five (5) days,
- Determine and remedy the cause of the excessive leakage for any pipe failing to meet the specified requirement for water or air tightness, and retest until the installation is proven satisfactory,
- Tests must be successfully completed and reports filed before piping is accepted. Submit test reports to Engineer for review,
- Submit the plan for testing to the Engineer for review at least 10 days before starting a test,
- Remove and dispose of temporary blocking material and equipment after completion and acceptance of the piping test,
- Repair any damage to the pipe coating,
- Clean pipelines so they are completely free of debris, mud, or soil prior to final acceptance, and
- Test piping independently from tests on structures.

10.4.7.2. **Low Pressure Air Test.**

- Test piping independently from tests on structures,
- Provide the equipment with an air regulator valve or air safety valve set to an internal air pressure in the pipeline that cannot exceed 6 psig. Monitoring pressure gauge will have minimum divisions of 0.10 psi with an accuracy of ± 0.04 psi,
- Pass air through a single control panel,
- Provide pneumatic plugs that have a sealing length equal to or greater than the circumference of the pipe to be tested,
- Provide pneumatic plugs that resist internal test pressures without requiring external bracing or blocking,
- Provide an air compressor of adequate capacity for charging the system,
- Check air connections for leakage with a soap solution. If leaks are found, release the air pressure, repair the leak, and retest with soap solution until results are satisfactory, before resuming air test,
- Introduce low pressure air until internal air pressure is 4.0 psi greater than the average back pressure of ground water above the pipe flow line. Unless demonstrated otherwise in a test pit, ground water will be assumed at the natural ground surface,
- Allow two min. for air pressure to stabilize, and then disconnect air supply hose from the control panel,

- The minimum allowable time for the pressure to drop from 3.5 psig to 2.5 psig greater than average back pressure of any ground water above the pipe must be determined as follows:

$$T = \frac{0.085 \cdot D \cdot K}{Q}$$

Where K = 0.000419·D·L or 1.0, whichever is greater

T = time in seconds for the pressure to drop 1.0 psi

D = average inside diameter in inches

L = length of line of the same pipe size in ft., and

- Q = 0.0015 cu. ft. per min. per square foot of internal surface. Alternately, the following table may be used to calculate allowable times based on the preceding formula:

Table 17
Allowable Times For A 1 PSI Pressure Drop

Pipe Diameter (in.)	Minimum Time (i.e. K = 1.0) (sec.)	Length for Minimum Time (i.e. K = 1.0) (ft.)	Time for Long Length (i.e. K > 1.0) (sec.)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
36	2040	66	30.768 (L)

10.4.8. **Acceptance Tests for Sewer Manholes**

10.4.8.1. **Manhole Testing.** Successful passage of a vacuum test will be required for acceptance of sanitary sewer manholes and sanitary sewer structures. If a manhole fails a leakage test or visible leaks are observed, the manhole must be repaired, made watertight, and retested.

10.4.8.2. Vacuum testing will be performed in accordance with the requirements of ASTM C- 1244, Specifications for Standards Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

10.4.8.2.1. Perform test after installation with all connections in place. Final acceptance in accordance with the requirements of this specification will consist of a vacuum test of the completed and backfilled manhole including manhole, adjustment rings, and manhole frame and cover.

10.4.8.2.2. **Materials.** Vacuum testing apparatus will consist of a minimum of the following: Engine, Vacuum Pump, Hose, Test Head device capable of sealing opening in manhole frame as required, and Pneumatic Test Plugs having a sealing length equal to or greater than the diameter of the connecting pipe to be sealed.

- 10.4.8.2.3. **Test Procedure:**
- The test head will be placed at the top of the manhole frame in accordance with the manufacturer's recommendations,
 - A vacuum of 10 in. of mercury will be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off,
 - The vacuum pressure will be monitored for a period of 120 sec. The test will be considered to pass the vacuum test if the vacuum reading drops no more than 0.5 in. of mercury, and
 - If the manhole fails the initial test, necessary repairs will be made by an approved method. The manhole will then be retested until a satisfactory test is obtained.
- 10.4.8.2.4. **Testing and Certification.** Testing will be done by the contractor and witnessed by the Engineer or his representative. All manholes and structures will be tested as finished and completed for final acceptance. Any detective work or materials will be corrected or replaced by the Contractor and retested. This will be repeated until all work and materials are acceptable.
- 10.4.9. **Damages.** Repair, without additional cost to the Department, any damage that may result from negligence, inadequate or improper installation, maintenance, and operation of bypassing and draining equipment, including mechanical or electrical failures.
- 10.5. **Flowable Backfill.** When indicated on the plans, backfill trenches to the elevations shown with stabilized backfill meeting requirements of Item 401.
- 10.6. **Cutting and Restoring Pavement.** Where sewers must be installed in streets or other paved areas, the work includes saw cutting of the pavement and base to neat lines and prompt replacement of these materials after sewer excavation and backfill are completed. The replacement materials, as to type and thickness, are shown on the plans. Any work done or damage to base or pavement outside the limits shown on the plans will not be measured for payment and must be restored at no additional cost to the Department.
- 10.7. **Measurement.**
- 10.7.1. **Sanitary Sewer Mains (PVC).** Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer by the foot of the various sizes of sewers in place, in accordance with these specifications, complete and approved. The lengths of sewer mains will be measured center of manholes where the installation involves connection of the sewer into a manhole at each end of the line being measured. Where the installation involves a connection to an existing sewer line, the measurement will be made from the end of the existing sewer line to the center of the manhole on the work being measured.
- 10.7.2. **Sanitary Sewer Mains (DIP).** Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer by the foot of the various sizes of sewers in place, in accordance with these specifications, complete and approved. The lengths of sewer mains will be measured center of manholes where the installation involves connection of the sewer into a manhole at each end of the line being measured. Where the installation involves a connection to an existing sewer line, the measurement will be made from the end of the existing sewer line to the center of the manhole on the work being measured.
- 10.7.3. **Sanitary Sewer Manhole.** All sanitary sewer manholes satisfactorily completed in accordance with the plans and specifications will be measured by each of the various manhole types based on a standard 6 ft. depth.
- 10.7.4. **Sanitary Sewer Manhole (Extra Depth).** This measurement will be measured by the foot and is the distance from the top of the frame to the invert of the manhole minus 6 ft..

- 10.7.5. **Adjusting Manhole.** Existing manholes remaining in service and required to be adjusted to proposed grade will be measured by each manhole adjusted. Replacement of steel frame and cover to that of composite frame and cover is considered subsidiary to this bid item.
- 10.7.6. **Remove Existing Manholes.** Existing manhole structures to be completely abandoned and removed as identified in the plans will be measured for each manhole removed.
- 10.7.7. **Sewer Service Re-Connections (Service Laterals).** Sewer Service Re-Connections (Service Laterals) will be measured by each sewer service re-connection of a particular size installed and accepted.
- 10.7.8. **New Sewer Service (Service Laterals).** New Sewer Service (Service Laterals) will be measured by each new sewer service connection of a particular size installed and accepted.
- 10.7.9. **Abandon and Fill Existing Sanitary Sewer Pipe.** This Item will be measured by the foot of existing sanitary sewer main that is abandoned in place.
- 10.7.10. **Remove Existing Sanitary Sewer Pipe.** This Item will be measured by the foot of existing sanitary sewer main pipe that is removed as identified in the plans.
- 10.7.11. **Flowable Backfill.** This Item will be measured by cubic yard as shown under Item 401, "Flowable Backfill."
- 10.7.12. **Cutting and Restoring Pavement.** This will be measured by the square yard as shown under Item 400, "Excavation and Backfill for Structures."
- 10.8. **Payment.**
- 10.8.1. **Sanitary Sewer Mains (PVC).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Pipe (PVC)" of the type and size specified, complete in place.
- This price is full compensation for furnishing all required materials and labor; potholing; excavation, including hand-digging, if needed, embedment and backfill; compaction and compaction testing for utilities, all fittings; removal and disposal of existing manholes, except where indicated as being covered under a specific bid item; pipe connections to existing manholes; relocation or replacement of existing water and sewer lines required for placement of new sewer line; pipe concrete caps; plugs (temporary and permanent); air/vacuum release valves; blow-off valve assemblies; testing; dewatering of groundwater, if needed; bypassing and any work related to the bypass including traffic control related to bypasses; removal and replacement of storm drains; removal and replacement of drainage structures; placing and joining of pipes and fittings; traffic control required for sewer work outside Project limits; coordination with utility companies, MPU, and Engineer; locating and protecting of existing utilities; and for all other items of material, labor, equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications
- 10.8.2. **Sanitary Sewer Mains (DIP).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Pipe (DIP)" of the size specified, complete in place.
- This price is full compensation for furnishing all required materials and labor; potholing; excavation, including hand-digging, if needed, embedment and backfill; compaction and compaction testing for utilities, all fittings; removal and disposal of existing manholes, except where indicated as being covered under a specific bid item; pipe connections to existing manholes; relocation or replacement of existing water and sewer lines required for placement of new sewer line; pipe concrete caps; plugs (temporary and permanent); air/vacuum release valves; blow-off valve assemblies; polyethylene wrap; testing; dewatering of groundwater, if needed; bypassing and any work related to the bypass including traffic control related to bypasses; removal and replacement of storm drains; removal and replacement of drainage structures; placing and joining of pipes and fittings; traffic control required for sewer work outside Project limits; coordination with utility companies, MPU, and Engineer; locating and protecting of existing utilities; and for all other items of material, labor,

equipment, tools and incidentals necessary to complete the work in accordance with the plans and specifications.

- 10.8.3. **Sanitary Sewer Manhole.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Manhole (6 ft. Depth)" of the size and type specified or indicated on the plans." This price is full compensation for furnishing all required materials, labor, gaskets, rings, covers, concrete collars, pipe penetrations, drop connections, grout, groundwater dewatering, testing, concrete, excavation and backfill, grouting of inverts, coating interior and exterior where required, adjustment of new manhole to both temporary and finished grades, and tools and incidentals necessary to complete the work in accordance with the plans and specifications.
- 10.8.4. **Sanitary Sewer Manhole (Extra Depth).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Sanitary Sewer Manhole (Extra Depth). This price is full compensation for furnishing all required materials labor, equipment and performing all operations necessary to construct the depth of sanitary sewer manhole in excess of 6 ft.; including but not limited to providing an external protective bituminous coating, such as coal-tar epoxy.
- 10.8.5. **Adjusting Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "Adjusting Manhole." This price is full compensation for furnishing all required materials and labor, plugs (temporary and permanent), excavation and backfill, cement stabilized backfill, groundwater dewatering, removal, disposal of materials, and all other incidentals necessary to necessary to complete the work in accordance with the plans and specifications.
- 10.8.6. **Remove Existing Manholes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will paid for the at the unit price bid for "Remove Existing Manhole." This payment will be for all labor, materials, plugs (temporary and permanent), excavation and backfill, cement stabilized backfill, groundwater dewatering, removal, disposal of materials, and all other incidentals necessary to complete the work in accordance with the plans and specifications.
- 10.8.7. **Sewer Service Re-Connections (Service Laterals).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will paid for the at the unit price bid for "Sewer Service Re-Connection" of the particular size installed. This price is full compensation for furnishing all required materials, labor and materials for the pipe, excavation and backfill, fittings, cutting, bypassing, coordination, testing, and plugging/capping of abandoned utilities, draining of lines, vertical and horizontal adjustments, connections to existing sewers, and all other incidentals necessary to complete the work in accordance with the plans and specifications.
- 10.8.8. **New Sewer Service (Service Laterals).** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" herein will be paid at the unit price bid for each "New Sewer Service Lateral" of the particular size installed. This price is full compensation for furnishing all required materials and labor. excavation and backfill, fittings, cutting, bypassing, coordination, testing, and plugging/capping of abandoned utilities, draining of lines, vertical and horizontal adjustments, connections to existing sewers, and all other incidentals necessary to complete the work in accordance with the plans and specifications.
- 10.8.9. **Abandon and Fill Existing Sanitary Sewer Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Abandon and Fill Existing Sanitary Sewer Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation, complete flushing and draining (dewatering) of pipe, flowable backfill, cutting, capping/plugging, complete filling with approved flowable backfill of sanitary sewer mains to be abandoned, proper abandonment of all manhole structures with flowable backfill as indicated on the plans, and all other items for the project not indicated as being covered under the other specific bid items.

- 10.8.10. **Remove Existing Sanitary Sewer Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Remove Existing Sanitary Sewer Pipe" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation and backfill, complete draining (dewatering) of pipe, groundwater dewatering, flowable backfill, cutting, capping, removal of pipe, disposal of materials, and all other items for the project not indicated as being covered under the other specific bid items.
- 10.8.11. **Flowable Backfill.** Flowable Backfill will be paid for in accordance with Item 401, "Flowable Backfill."
- 10.8.12. **Cutting and Restoring Pavement.** Cutting and Restoring Pavement will be paid for in accordance with Item 400, "Excavation and Backfill for Structures."

11. CASINGS

- 11.1. **Description.** Furnish all labor, materials, equipment and incidentals required to construct steel casings and install approved carrier pipes within the casing of various sizes including all necessary field welding, carrier pipes and accessories as shown on the plans and as specified herein.
- 11.2. **Materials.** Furnish new, unused steel casing pipe suitable for the purpose intended with a minimum yield strength of 36,000 psi. Provide casing that meets ASTM A-53 or approved equal requirements. Coat and line pipe with coal tar epoxy (15 mils min.) in accordance with AWWA C-210. Weld pipe joints in accordance with AWWA C-206. After pipe is welded, repair coating and lining. Unless specified otherwise, provide the steel casing pipe with a minimum wall thickness of 5/16 in. Provide required vent piping, casing insulators (casing insulated spacers), end seals, pipe supports and skids, and other incidental features required to complete work described in this section and as shown on the plans.

Construct tunnel liner of cold-formed steel plates of the sizes, thickness, and dimensions required, as indicated on the plans, and as manufactured by Commercial Shearing, Contech, or equal.

Provide reinforced concrete pipe for casing where specified or shown that is straight-wall RCP pipe casing conforming to ASTM C-76 Class IV of the size and length specified.

Provide welded half coupling grout holes. Provide tapped holes with a pipe plug screwed in place.

Provide bolts and nuts with liner plates that are not less than 1/2 in. diameter and conform to ASTM A-307 Grade A.
- 11.2.1. The steel casing will be seamless or electric resistance- welded tubing for sizes under 24-in. O.D. and standard double- submerged is weld for sizes over 24-in.
- 11.2.2. Tubing will be A-106, Grade B with beveled ends.
- 11.2.3. The following table notes the steel casing size and thickness as related to the carrier pipe.

Table 18
Steel Casing Diameter Requirement

CASING SIZE VERSUS CARRIER SIZE		
Steel Casing Diameter (in.)	Wall Thickness	Carrier Pipe Diameter
14	0.250	6
16	0.250	8
18	0.344	10

22	0.344	12
24	0.344	14, 15
26	0.344	16
30	0.375	18
36	0.375	24
48	0.625	36

- 11.2.4. **Submittals.** Submit complete working drawings that show details of the proposed method of construction and the sequence of operations to be performed during construction. The plan will show the method of jacking, boring, or tunneling, muck removal and disposal, type and method of installation of the primary casing or tunnel liner, access pit size and construction shoring and bracing, and dewatering methods proposed. Drawings should be sufficiently detailed to allow the Engineer to judge whether or not proposed materials and procedures will meet the contract requirements.

Include the design criteria used and a certification that the structural design of the casing or tunnel liner meets these design criteria and that the material meets the required ASTM Standards. The tunnel liner must be capable of carrying H-20 vehicle load distributions in accordance with AASHTO as well as the anticipated dead loads and include an appropriate design factor of safety.

Include the layout and design of the access shafts. Provide a certification that the structural design of the shoring and bracing meets the design criteria as submitted. All structural designs must be sealed by a Professional Engineer licensed in the State of Texas and qualified to perform such work.

- 11.2.5. **Standards.** Apply all OSHA regulations and all requirements of the specific private and governmental agencies under whose facilities the casings and pipe area to be installed.

Protect the facilities under which the casings and pipe are installed, provide protection at the excavations, and carry out the trench safety procedures in accordance with all required OSHA regulations.

Referenced within this section is the "Standard Specification for Construction of Highways, Streets and Bridges," most current edition of the Department..

- 11.3. **Construction.**

- 11.3.1. **General.** Install casings at the locations and to the lines and grades indicated on the plans, of the sizes indicated, using either jacking, boring, tunneling, or approved open-cut methods.

Provide adequate lights, ventilation, signal systems, fire extinguisher, safety equipment, and other equipment required and maintain such equipment in good repair.

Determining soil conditions at the various locations where casings are to be installed, and make such other investigations to obtain that information as deemed necessary subsidiary to this Item.

The methods of construction, whether by tunnel boring machine or by hand digging, is Contractor's option subject to the approval of the governing agencies and Engineer.

Execute work of excavating, lining, grouting and construction of the casing or tunnel so that ground settlement is minimized.

Where casings are installed by open-cut method, all requirements for trenching and backfilling as described in these specifications apply, except as otherwise required by the plans or supplemental specifications.

Locate access shafts or pits at the beginning and end of each casing or tunnel segment to be constructed.

Unless superseded by the requirements of other governing authorities under whose facilities or right-of-way the casing is to be installed, install the face of any shaft at least 20 ft. from existing adjacent roadways or structures. Ensure that the size of shafts or pits provide adequate room to meet operational requirements for tunnel construction.

- 11.3.2. **Installation of Casings.** Install casings using either jacking, boring, or tunneling methods. Provide equipment of such size and capacity as to allow the placement of the casings to proceed in a safe and expeditious manner.

Install casing pipe from the end which will create a minimum of access and utility relocation problems. Prior to casing installation, pothole utilities and all other permanent structures within the project area in order to identify potential conflicts. In the event a conflict exists, notify Engineer before proceeding with casing installation so a solution can be formulated.

Permissible lateral or vertical variation in the final position of the pipe casing from the established line and grade established is only to the extent of 1 in. in 10 ft., provided that such variation is regular and only in the direction that will not detrimentally affect the function of the carrier pipe. Remove or abandon casing pipe found to be considerably off-grade or alignment and re-install at no additional cost.

Repair any detectable settlement of the roadway overlying the casing or tunnel immediately. Slight settlement of the roadway, should it occur, will result in cessation of casing/tunneling operations, posting of appropriate highway safety signs, and placement of an asphaltic hot-mix overlay to return the roadway to original grade. For over-cutting in excess of 1 in., pressure grout the entire length of the bore with 7 sack cement per cubic yard of soil mixture. Where applicable, provide hot-mix in accordance with the requirements of Department Specifications. Prime the surface to receive hot-mix as directed. Submit an emergency road repair procedure plan to the Engineer, prior to beginning any casing/tunneling operations. Labor and equipment necessary for this work is the Contractor's responsibility and will be provided at no additional cost.

When installing casing by boring, install casing, excavate and remove material within the casing simultaneously. Ensure the completed casing is free of dents, bends, weld protrusions, or other obstructions to allow the smooth sliding of the carrier pipe through the casing.

- 11.3.3. **Installation by Tunneling.** Excavate tunnel of sufficient size to permit efficient excavation operations, to provide sufficient working space for placing the tunnel lining, and to allow for construction of the carrier pipe as shown on the plans and indicated on the specifications. Determine adequate tunnel size and section to meet these requirements. Dimensions shown on the plans represent the acceptable approximate dimensions and do not necessarily represent the size or section suitable for the construction methods or operational procedures as may be proposed or conducted by the Contractor.

Use structural steel plates assembled from the inside of the tunnel and field bolted to provide a full round casing pipe when installing casing pipe by tunneling method. Hold tunnel excavation to the minimum possible diameter required for installation of liner plate.

Minimize excavation limits as required to prevent caving. Pressure grout the annular space between the tunnel liner and the tunnel bank by providing 2 in. diameter plugs in the liner plates at spacing of 5' 0" or as directed. Remove any excess groundwater encountered in a manner to allow the tunneling operation to proceed according to schedule.

- 11.3.4. **Installation of Carrier Pipe in Casing Pipe or Tunnel Liner.** Install carrier pipe in the casing in accordance with the recommendations of the pipe manufacturer. After the casing or tunnel liner has been

installed and approved, push or pull the carrier pipe through the casing by exerting pressure on the barrel of the pipe in such a manner that the pipe joints are always in compression.

Use insulated spacers when specified for providing cathodic protection consisting of pre-manufactured steel bands with plastic lining and plastic runners. Casing spacers must fit snug over the carrier pipe. Position the carrier pipe approximately in the center of the casing pipe, to provide adequate clearance between the carrier pipe bell and the casing pipe. Use casing spacers that are Model C12G-2, coated for the ultimate in strength, toughness and corrosion resistance, or Model A12G-2, painted for unusually heavy pipe, for long casings or whenever maximum strength and toughness are required for carrier pipes 4 in. – 56 in. in diameter and as directed. Casing spacers can be as manufactured by Pipeline Seal and Insulator, Inc. (PSI) or approved equal.

If tunnel liner is used, grout the bottom 120° of the liner to the top of the tunnel liner ribs to aid in the installation of the carrier pipe.

Seal ends of pipe after installation of the carrier pipe inside the casing pipe or tunnel liner to prevent water or other material from entering the casing or liner and causing corrosion by one of the following methods:

- Brick and Mortar Method,
- Bulkhead and Grout Method, and
- Synthetic rubber end seal - type PSI, Inc. Standard Pull-On (Model C), or approved equal, appropriate for the size and type of carrier pipe and casing.

Include a precautionary outlet and bonnet box at each end of the casing as shown on the plans when using steel casings.

- 11.3.5. **Grouting.** Use ordinary cement-sand grout, as described in Article 5, unless otherwise specified or directed. Fill all excavation outside the casing or tunnel liner with pressure-applied grout or other approved fill unless otherwise directed.

Exercise care in grouting operations to prevent damage to adjacent utilities or other properties. Ensure that pressure used in grouting is not great enough to distort or imperil any portion of the work.

Completely fill with grout all voids outside the limits of the casing or tunnel excavation created by caving or collapse of earth cover over the excavation, or by other cause. All grouting to eliminate voids outside the casing or tunnel limits is subsidiary to this item.

When hand-tunneling methods are used, place grout behind the tunnel liner at the end of each day or at every 10 ft. of tunnel installed whichever spacing is acceptable.

Treat the annular space between the casing and carrier pipe by one of the following methods as directed or specified. Where applicable, fill the annular space according to the regulations specified by the governing agency for the area where the casing is to be installed.

- Leave annular space open for cathodically protected systems where both casing and carrier pipes are metallic material,
- Fill annular space with pneumatically placed sand as the standard method for pipes in all installations other than groundwater, and
- Fill annular space with grout. Do not damage or distort pipe using pressure to install grout. Submit method for approval prior to starting work. This method is mandatory for installations in groundwater, optional on all other dry installations.

- 11.4. **Measurement.** Casings will be measured by the foot complete in place. Casing for temporary water and sanitary sewer by-pass lines will not be measured for payment and are incidental to pertinent pay items.

- 11.5. **Payment.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Casing" of the type, size and installation method specified. This price is full compensation for coordination, excavation, disposal of excess material, grouting, backfilling, compaction, compaction testing for utilities, furnishing and installing the approved carrier pipe, precautionary outlet with bonnet box, and accessories as per specifications and standard details by means of open cut (where indicated), and bore and jacking methods (where indicated), welding, furnishing and installing steel casing insulators, and all appurtenances described herein to include, but not limited to the following items: locating, protecting, supporting, relocating if required, and repairing damage to any utilities or structures encountered in the process of the work, dewatering and disposal for water where required, paving cut, removal and repair as needed, traffic control plan, excavation for bore pits, and all other items of the project not indicated as being covered under the other specific bid items shown on the Proposal. Such payment is complete compensation for the complete performance of the work in accordance with the plans and the provisions of these specifications.