Special Specification 7243
Water Lines

1. DESCRIPTION

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

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

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

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

2. MATERIALS

Where specific products or manufacturers are mentioned in this specification, approved equals may be used.

2.1. Ductile-Iron Pipe and Fittings.

2.1.1. Ductile-Iron Pipe: 3-in. through 64-in.

All ductile-iron pipe is to be manufactured by process of centrifugal casting and is to conform to AWWA Standard C-151, “American Standard for Ductile-Iron Pipe Centrifugally Cast with push-on or mechanical joints for Water or Other Liquids,” unless otherwise modified or supplemented herein.

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

Table 1	
3” through 12”	350 psi
16” through 20”	250 psi
24”	200 psi
30” through 64”	150 psi

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

All pipe is to have a standard water works cement mortar lining in accordance with AWWA Standard C-104 with outside coating per Section 51.8.1 of AWWA Standard C-151.

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

Rubber joint gaskets used on ductile-iron pipe are to conform with AWWA Standard C-111.

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

The Contractor is to use a manufacturer that takes adequate measure during pipe production to assure compliance with AWWA Standard C-151 by performing quality-control tests and maintain results of those tests as outlined in Section 51.14 of that standard.

The Engineer may, at no cost to the Contractor, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects or failure to meet quality standards here in will be grounds for rejecting the pipe.

2.1.2. Fittings for Ductile-Iron Pipe.

Unless otherwise modified or supplemented herein, WWA Standard C-110 for Ductile-Iron Fittings, 3-in. through 48-in. for “Water and Other Liquids” and AWWA Standard C-153 for “Ductile-Iron Compact Fittings,” is to govern the design, manufacture, and testing of all fittings under this specification.

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

Fittings are to be furnished with the type of end combination specified.

Mechanical joint fittings and anchor type fittings are to be furnished complete, with glands, gaskets, and bolts. Bolts for mechanical joints are to be ASTM A-536 specially alloyed and heat treated ductile iron conforming to ANSI/AWWA Standard CIII/A21.IL.

Flanged fittings are to be faced and drilled in accordance with ASA Specifications B 16.1, Class 125.

Anchor fittings are to be furnished in size and type or length as specified.

The exterior of all fittings is to be provided with a petroleum asphaltic coating in accordance with AWWA Standard C-110. The interior of flanged fittings supplied under this Item is to be either cement-mortar lined in accordance with AWWA Standard C-104 or lined with a petroleum asphaltic material in accordance with AWWA Standard C-110 as specified. The interior of all other fittings supplied under this Item is to be cement-mortar lined in accordance with AWWA Standard C-104.

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

2.2. Polyvinyl Chloride Pipe and Fittings.

2.2.1. Polyvinyl Chloride Pipe, 2-in. through 12-in. (ASTM 2241).

2-in. through 12-in. polyvinyl chloride (PVC) pressure pipe is to be made from class 12454A or 12454B compounds as determined by ASTM Standard D-1784 and providing for a hydrostatic test basis (HBD) of 4000 psi.

All PVC pipe shall conform to applicable AWWA standards. The Contractor shall supply the Engineer a manufacturer's affidavit that the materials supplied comply with all applicable requirements of AWWA.

All ASTM 2241 PVC pipe shall have a standard dimension ratio (SDR) of 26 (160 psi pressure class) or an SDR of 21 (200 psi pressure class). All PVC pipe 4" and smaller shall have an SDR of 21. It shall be furnished in nominal 20-ft. lengths and shall be self-extinguishing.

Dimensions and tolerances for each nominal pipe size are to be in accordance with PVC Pipe Dimensions as published in the Handbook of PVC Pipe, as published by the Uni-Bell Plastic Pipe Association.

Each pipe shall have an integral bell formed on the pipe end and designed to be at least as strong as the pipe wall.

An elastomeric gasket shall be designed with a retainer ring that locks the gasket into integral bell groove and shall be installed at the point of manufacture. The dimensions and design of the gasket joint, provided for the PVC pipe, shall meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket shall be reinforced with a steel band and shall conform to ASTM F-477.

Each length of pipe furnished is to bear identification markings in conformance with Section 2.6 of AWWA C-900.

2.2.2. Polyvinyl Chloride Pipe, 4-in. through 12-in. (C-900).

4-in. through 12-in. polyvinyl chloride (PVC) pressure pipe is to be made from class 1245A or 1245B compounds as determined by ASTM Standard D-1784 and providing for a hydrostatic test basis (HBD) of 4000 psi.

All PVC pipe shall conform to AWWA Standard C-900. The Contractor shall supply the Engineer a manufacturer's affidavit that the materials supplied comply with all applicable requirements of AWWA.

All AWWA C-900 PVC pipe shall have a pressure rating of 150 psi and a dimension ratio of 18 with cast iron equivalent outside diameters unless otherwise specified. It shall have a sustained pressure requirement of 500 psi and a minimum burst pressure of 755 psi. AWWA C-900 PVC pipe installed in High Pressure Zones to have a pressure rating of 200 psi and a dimension ration of 14, a sustained pressure requirement of 650 psi and a minimum burst pressure of 985 psi. It shall be furnished in nominal 20-ft. lengths and shall be self-extinguishing.

Dimensions and tolerances for each nominal pipe size are to be in accordance with Section 2.2, Table 1 of AWWA C-900.

Each pipe shall have an integral bell formed on the pipe end and designed to be at least as strong as the pipe wall.

An elastomeric gasket shall be designed with a retainer ring that locks the gasket into integral bell groove and shall be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC pipe shall meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket shall be reinforced with a steel band and shall conform to ASTM F-477.

Each length of pipe furnished is to bear identification markings in conformance with Section 2.6 of AWWA C-900.

2.2.3. Polyvinyl Chloride (PVC), 14-in. through 36-in.

2.2.3.1. Scope. This product specification covers 14-in. nominal diameter through 36-in. nominal diameter polyvinyl chloride (PVC) potable water transmission pipe with integral bell and spigot joints. The pipe shall be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D-1784 and provide for a hydrostatic design basis (HDB) of 4,000 psi. The pipe outside diameters shall conform to dimensions of cast iron pipe (CI). All pipe furnished shall be in conformance with AWWA C-905-97, or latest revision thereof.

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

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

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

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

2.2.3.3. General

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

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

2.2.3.3.3. Pipe shall be gauged full length and furnished in standard laying lengths of 20 ft. ± 1 in. unless otherwise noted. Each pipe shall have an integral bell formed on the pipe end and designed to be at least as strong as the pipe wall.

2.2.3.3.4. An elastomeric gasket shall be designed with a retainer ring, which locks the gasket into integral bell groove and shall be installed at the point of manufacture. The dimensions and design of the gasket joint provided for the PVC transmission pipe shall meet requirements provided in ASTM D-3139 and ASTM D-2122. The gasket shall be reinforced with a steel band and shall conform to ASTM F-477.

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

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

2.2.3.3.5.2. PVC.

2.2.3.3.5.3. Dimension Ratio (for example, DR 25.)

2.2.3.3.5.4. AWWA pressure rating (for example, PR 165.)

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

2.2.3.3.5.6. Manufacturer's name or trademark.

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

2.2.4. AWWA C-900 and C-905 Requirements.

2.2.4.1. Bundle pipe in pallets for ease of handling and storage. Package pipe bundles to provide structural supports to insure that weight of upper units do not cause deformation to pipe in lower units.

Pipe bundles showing evidence of ultra-violet radiation "sunburn" on exposed pipe as caused from extended unprotected storage conditions will not be accepted.

2.2.4.2. The pipe must be in compliance with AWWA Standards C-900 or C-905-97 as applicable by performing quality control-control test and maintaining results of those tests as outlined in Section 3 of that standard. Submission of product constitutes certification of compliance with standard.

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

2.2.4.4. Provide a one-year warranty for all material sold and delivered for use and incorporation into water system. Warranty takes effect on the date that pipe is accepted by the City of Haslet.

2.2.4.5. Test.

2.2.4.5.1. For both C-900 and C-905, water system may at no cost to the Contractor, subject random lengths of pipe for testing by an independent laboratory for compliance with this specification. Any visible defects of failure to meet quality standards herein will be grounds for rejecting entire order.

2.2.4.5.2. For C-905: The Contractor shall ensure that the manufacturer pressure tested all pipe, including the joint, which is marked with the designation number of AWWA C-905-97 at 73.4º F. +/- 3.6ºF (23ºC +/- 2ºC). Each length of pipe shall be proof tested at twice the pressure rating listed in Table 3 Transmission-Pipe Pressure Rating of AWWA C-905-97 Sec. 4.6 "Pressure Strength and Hydrostatic Proof."

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

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

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

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

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

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

2.2.5. Bends and Fittings for PVC Pipe 4-in. through 36-in. All bends and fittings shall conform to the same requirements subparagraphs 2.A.2 Fittings for Ductile-Iron Pipe.

2.2.6. Joint Restraint System for PVC C-900/C-905.

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

Joint restraint systems are classified as "compression, "mechanical joint," or "non-metallic restrained joint" for the specific type of pipe joint to be restrained.

2.2.6.2. General Requirements.

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

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

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

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

2.2.6.3. Specific Requirements.

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

2.2.6.3.1.1. Pipe restraints shall be used to prevent movement for push-on D.I. or PVC (C-900&C-905) (compression type) bell and spigot pipe connections or where a transition or flexible coupling has been used to join 2 sections of plain-end pipe D.I. or PVC (C-900&C-905.) The restrainer may be adapted to connect a plain end D.I. or PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. The restrainer must not be directionally sensitive.

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

2.2.6.3.1.3. Bolts and nuts used to attach the split retainer ring shall comply with ANSI B-18.2/18.2.2, SAE Grade 5. Tee-bolts, nuts, and restraining rods shall be fabricated from high-strength, low-alloy steel per AWWA C-111-90, ANSI/AWWA C-111/A-21.11.

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

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

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

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

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

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

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

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

2.2.6.3.2.5. The restraint system shall be capable of a test pressure twice the maximum sustained working pressure shown in Table 2 below.

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

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

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

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

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

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

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

2.2.6.3.4. Retainer Gland for Ductile Iron Pipe (only):

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

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

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

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

2.2.6.3.5. Maximum Sustained Working Pressure Requirement.

Table 2		
Nominal Diameter	PVC C-900 / C-905	Ductile Iron
4 & 6 in.	150 psi. (DR18) / 200 psi. (DR14)	350 psi.
8 in.	150 psi. (DR18) / 200 psi. (DR14)	250 psi.
10 & 12 in.	150 psi. (DR18) / 200 psi. (DR 14)	200 psi.
14 & 16 in.	150 psi. (DR 18) / 200 psi. (DR 21) / 235 psi. (DR 18)	200 psi.
20 & 24 in.	150 psi. (DR18) / 200 psi. (DR 21) / 235 psi. (DR18)	200 psi.

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

2.2.6.3.7. Product List. Other approved equal products from other manufacturers meeting these specifications may be submitted for review.

2.2.6.3.7.1. Slip on Joint Restraint Systems:

Table 3			
Manufacturer	PVC C-900/C-905	Ductile Iron (D.I.)	D.I., 16" Above
Ford / Uni-Flange Corporation	Series 1390C	Series 1390C	1390C
EBBA Iron Sales, Inc.	1500	1700	1700
Romac Industries, Inc. 4-8 inch	Model 611	Model,611	47 OSJ
Star Pipe Products	1100	1100	1100

2.2.6.3.7.2. Compression Ring Systems:

Table 4		
Manufacturer	PVC C-900	Ductile Iron
Romac Industries, Inc.	Grip Ring-DI	Grip Ring-DI
Tyler Corporation	MJR Gland	MJR Gland
Star Pipe Products	Ring Lock 3500 Series	

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

Table 5		
Manufacturer	PVC C-900	Ductile Iron
CertainTeed Corporation, Certa-Lok C-900/RJ	4" – 12"	Class 150 (DR-18)
	4" – 8"	Class 200 (DR-14)

2.2.6.3.7.4. Retainer Gland (MJ):

Table 6		
Manufacturer	PVC C-900	Ductile Iron
EBBA Iron Sales, Inc.	2000 PV	MEGALUG 1100
Romac Industries, Inc.	Not Approved	Not Approved
Ford/UniFlange	UFR-1500-C 4" – 24"	Series 1400
StarPipe Products	Stargrip 4000	Stargrip 4000
Sigma Corporation	One Lok SLC	One Lok SLD

2.2.6.3.7.5. Restrained Flange Adapters:

Table 7		
Manufacturer	PVC C-900	Ductile Iron
EBBA Iron Sales, Inc.	2100 Megaflange	2100 Megaflange
Ford/UniFlange	900	200, 400, 420

2.3. Gate Valves, Tapping Valves, and Tapping Sleeves.

2.3.1. Gate Valves.

2.3.1.1. General Requirements.

2.3.1.1.1. Except as otherwise modified or supplemented herein, AWWA Standard C-509-01 or the latest revision thereof, shall govern the design, component materials, construction, manufacture, and testing of all resilient seated gate valves. Valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be NSF-61 certified. All valves and tapping sleeves shall meet the City of Haslet's requirements and details.

2.3.1.1.2. Approved manufacturers are shown in Table 12, provided such resilient seat gate valves conform to the provisions contained herein.

Table 12	
APPROVED MANUFACTURER	PRODUCTS LIST
Manufacturer	Sizes 4 through 12 In.
Mueller Inc.,	
M & H Valve and Clow Valve, Inc.	Waterous Hydrants & Valves (American Flow Control)

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

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

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

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

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

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

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

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

2.3.1.1.11. All gate valves shall open left (counter-clockwise,) unless otherwise specified.

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

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

The design shall be such that the seal above the stem collar can be replaced with the valve under full pressure in the fully open position.

Materials for the "O" ring packing plate shall be in accordance with Section 4.8.3 of the ANSI/AWWA C509-01 Standard or the latest revision thereof.

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

2.3.1.1.15. The Contractor shall submit three sets of certified drawings showing the principal dimensions, general construction, and material specification of the valve proposed. The number of turns to open or close shall be clearly noted in the valve information. The number of turns to open or close the valve shall be consistent for each valve size for each approved manufacturer.

2.3.1.1.16. Valves furnished under this specification shall be supplied from the approved manufacturer list. To be included on the qualified product list, the manufacturer shall provide an Affidavit of Compliance in accordance with the Section 1.5 of the ANSI/AWWA C-509-01 Standard or latest revision thereof. Records of all tests performed in accordance with Section 6.1 and Section 6.2 of the ANSI/AWWA C-509-01 Standard or latest revision thereof will be made available or provided. These records will be representative test results for Section 6.1 and certificate of testing for Section 6.2. An affidavit of testing for the valve assembly as outlined in Section 6.2.2 of the ANSI/AWWA C-509-01 Standard, (350 ft-lbs) will also be provided. A copy of the manufacturer's Quality Assurance Program will be submitted. Blueprints and parts list for the valve shall also be provided.

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

2.3.1.1.18. Resilient seats shall be applied to the gate and shall seat against a corrosion resistant surface. The non-metallic seating surface shall be applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface shall have a corrosion resistance equivalent to or better than bronze. A non-metallic surface shall be in compliance with ANSI/AWWA C-550. The gate must be

fully encapsulated by an elastomer without thin spots or voids. Resilient seats shall be bonded. ASTM D-429 either method A or method B shall prove the method used for bonding or vulcanizing. For method A, the minimum strength shall not be less than 250 psi. For method B, the peel strength shall be 75 lbs. per in.

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

2.3.1.1.20. Mechanical Joint Ends: Mechanical joint bell dimensions shall conform to ANSI/AWWA C-111/A21.11.

2.3.1.1.21. Push-on Joints: Push-on joints shall conform to the requirements of ANSI/AWWA C-111/A21.11.

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

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

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

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

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

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

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

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

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

2.3.1.1.31. The Engineer may, at no cost to the Contractor, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.3.1.1.32. Table 12 identifies specified manufacturers that are approved.

2.3.1.2. Workmanship.

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

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

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

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

2.3.1.2.5. The resilient seat gate valves shall be well fitted.

2.3.1.2.6. Operation of the resilient seat gate valve shall be smooth.

2.3.1.2.7. All parts shall be free of structural defects.

2.3.1.2.8. The resilient seat gate valve shall be watertight.

2.3.1.3. Painting.

2.3.1.3.1. All exterior and interior surfaces of the valve shall be coated with epoxy, N.S.F. 61 certified. The epoxy shall have a nominal dry film thickness of 8 mils and shall be in accordance with AWWA C-550, latest revision.

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

2.3.1.4. Testing.

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

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

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

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

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

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

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

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

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

2.3.1.5. Quality Assurance.

2.3.1.6. Manufacturers shall have an ASME or I.S.O. 9001 registered commercial quality system. Noncompliance to this registered commercial quality system requirement will result in removal of the manufacturer's product from the approved manufacturer's list shown in Table 12 of this specification. If on receipt of resilient seat gate valves they are found to be non-compliant, the Contractor shall replace the defective resilient seat gate valves according to resilient seat gate valve size with a resilient seat gate valve that meets these specifications at no cost to the City of Haslet.

2.3.1.7. References.

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

2.3.1.7.2. Manufacturers Standardization Society MSS SP-60.

2.3.2. Tapping Valves and Tapping Sleeves.

2.3.2.1. Tapping Sleeves.

Band shall conform to the minimum OD size ranges and lengths specified in this specification. The flange shall be manufactured in compliance with AWWA C-223.07, Class D ANSI B.16.1 drilling, recessed for tapping valves MSS_SP60. Mechanical Joint tapping sleeve outlet shall meet or exceed all material specifications as listed below and be suitable for use with standard mechanical joint resilient wedge gate valves per AWWA C-509-94.

2.3.2.1.1. General Requirements.

2.3.2.1.1.1. Tapping sleeves 4 in. – 12 in.:

Entire fitting to be stainless steel type 304 (18-8.) The body, lug, and gasket armor plate to be in compliance with ASTM A-240. The flange shall be cast stainless steel in compliance with ASTM A-743. The MJ outlet shall be one-piece casting made of stainless steel.

The test plug shall be 3/4-in. NTP in compliance with ANSI B2.1 and shall be lubricated or coated to prevent galling. All metal surfaces shall be passivated after fabrication in compliance with ASTM A-380.

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

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

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

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

The sleeve construction shall provide a positive means of preventing gasket cold flow or extrusion.

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

2.3.2.1.1.2. Tapping Sleeves 16 in. and large nominal pipe diameter:

The body shall be in compliance with ASTM A-285 Grade C or ASTM A-36. Test plug shall be 3/4-in. NPT conforming to ANSI B2.1.

The gasket is to provide a watertight sealing surface of such size and shape to provide an adequate compressive force against the pipe. After assembly, the gasket will insure a positive seal under all combinations of joint and gasket tolerances. Gasket shall be formed from vulcanized natural or synthetic rubber with antioxidant ingredients to resist set after installation. No reclaimed rubber shall be used. Bolts and nuts shall be type high strength, corrosion resistant, low alloy per AWWA C-111, ANSA A21.11

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

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

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

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

2.3.2.1.2. Standard Ranges.

Table 13			
Nominal Dia (in) x Min Length (in)	Flange Outlet (in)	Range	Min OD Range (in)**
4 x 16	4	A	4.75 – 4.95
		B	4.90 – 5.10
6 x 16	4	A	6.70 – 7.10
		B	7.00 – 740
		C	7.35 – 7.75
6 x 16	6	A	6.80 – 7.15
		B	7.05 – 7.40
		C	7.40 – 7.75
8 x 16	4 & 6	A	9.00 – 9.45
		B	9.35 – 9.70
		C	9.70 – 10.00
8 x 20	8	A	9.00 – 9.35
		B	9.35 – 9.70
		C	9.70 – 10.00
10 x 16	4 & 6	A	11.03 – 11.47
10 x 20	8	B	11.60 – 12.00
10 x 24	10		
12 x 16	4 & 6	A	13.00 – 13.40
12 x 20	8	B	13.40 – 13.80
12 x 24	10	C	14.10 – 14.50
12 x 32	12		
16 x 12	4 & 6		17.33 – 17.87
16 x 16	8		18.62 – 19.19
16 x 20	10		
16 x 24	12		
16x 36	16*		
20 x 12	4 & 6	A	21.51 – 22.15
20 x 16	8	B	23.46 – 24.16
20 x 20	10		
20 x 24	12		
20x 36	16*		
20 x 40	20*		
24 x 12	4 & 6	A	25.71 – 26.41
24 x 16	8	B	28.14 – 28.84
24 x 20	10		
24 x 24	12		
24 x 36	16*		
24 x 40	20*		
24 x 48	24*		
30 x 12	4 & 6	A	29.78 - 30.48
30 x 16	8	B	31.52 – 32.22
30 x 20	10		
30 x 24	12		
30 x 36	16*		
30 x 40	20*		
30 x 48	24 x 30*		

*Range to be specified when ordered.

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

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

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

Table 14 lists identified specific manufactured items by catalog number that are approved:

Table 14		
Manufacturer	Model	Size Range (in)
JCM Industries	#432	4 - 12
	#412	16 and larger
Power Seal	#3490AS or 3490MJSS	4 - 12
	3490MJSS	16 and larger
Romac Industries	SST III	4 - 12
	SST III	16 and larger
Ford Meter Box	FTSS	4 - 12
	FTS	16 and larger
Dresser	Style 610/630	4 - 12
	Style 610/630	16 and larger
Cascade	CST-1	4 - 12
Smith Blair	#622	16 and larger

2.4. Valve Boxes.

All valve box assemblies are to conform to the City of Haslet's requirements and details shown on the plans. Each valve box assembly is to consist of a base, top section, and lid.

Valve boxes are to be of a single size with a nominal diameter of 6-in.

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

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

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

2.5. Meter Boxes.

For non-traffic bearing locations, the meter box assembly for 5/8-in. through 1-in. meters box and lid is to be black and constructed out of modified polyethylene material for maximum durability and corrosion resistance. The black material is for maximum UV protection and shall be uniform throughout meter box and lid for maximum longevity and not have a foaming agent that creates air pockets within the plastic wall. The body and lid shall withstand a 20,500 lb. loading in a non-deliberate and incidental traffic. Plastic Lid is to have the following:

- "Water Meter" and "{Utility Owners Name}" molded into the lid;
- seat securely and evenly inside the meter box and shall not overlap the top edge of the meter box;
- "Overlap" and securely and evenly on the existing cast iron meter box with like dimensions;

- a diamond pattern for skid resistance and an AMR Slide Mount molded into the lid on the underneath side and off center for placement for an AMR transponder, if specified on the plans, to help in the protection of the radio antenna;
- a brass worm gear lock that will secure the existing cast iron meter box of like dimensions and secure the plastic meter box;
- a molded receptacle for placement of key; and
- one (1) piece of 1/2-in. rebar secured in lid.

Plastic body is to have the following:

- a crush resistant ribbing along the outside of box;
- a flange around the top opening to help prevent setting and aide in adjustment to grade; and
- designed to accommodate all plastic lids.

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

The castings are to be dipped in coal tar at a temperature of 350ºF and the metal is to be at a temperature of 300ºF before dipping. The casting is to be dipped and cured independently and the coating is to have ceased to be “tacky” within 72 hours after dipping.

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

The meter box is to have an ultimate tensile strength of 25,000 psi and is not to be brittle.

The casting is to have an “as cast” clean smooth surface and be free from internal porosity; castings that are made smooth by grinding are unacceptable.

Quality Assurance: If on receipt of meter boxes or lids they are found to be non-compliant, the Contractor is to replace defective product at no cost to the City of Haslet. Any visible defect of failure to meet specification will be grounds for rejecting entire order.

Approved Plastic Meter Box and Lid Manufacturer (or equal):

- HEFCO PLASTIC BOX MODEL # 15 AMR

2.6. Fire Hydrants.

2.6.1. General Requirements.

2.6.1.1. Fire Hydrants to be furnished shall be manufactured by the manufacturers listed in Table 15, or approved equals.

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

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

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

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

2.6.1.3.3. The design safety factor of the operating mechanism shall not be less than 5 and shall be based on the foot-pounds of torque required for the closing and opening of the hydrant at a working pressure of 200 psig.

Hydrants shall be functional and capable of being opened or closed without difficulty following an application of an operating torque of 200 lbf-ft at the operating nut in the opening direction with the hydrant fully opened and the closing direction with the hydrant fully closed. The torque requirements apply only to hydrants of 5-ft. bury or less.

2.6.1.4. The length of bury shall be as specified.

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

2.6.1.6. The nominal inside diameter of the hose nozzle shall be 2-1/2 in.

2.6.1.7. The nominal inside diameter for the pumper nozzle shall be 4-1/2 in.

2.6.1.8. The outlet-nozzle threads are to conform to the National Fire Protection Association (NFPA) 2003, Standard for Fire Hose Connections.

2.6.1.9. The nominal diameter of the main valve opening shall be 5-1/4 in.

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

2.6.1.11. The fire hydrant shall open on left turn (counter-clockwise.)

2.6.1.12. The color of the finish paint above the ground line shall be red.

2.6.1.13. The fire hydrant shall have a non-rising stem.

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

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

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

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

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

2.6.2. Workmanship.

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

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

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

2.6.3. Paint.

2.6.3.1. The exterior surface of the hydrant shall be painted fire hydrant red with high gloss exterior paint that is water based.

2.6.4. Testing and Inspection.

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

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

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

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

2.6.5. Quality Assurance.

2.6.5.1. Manufacturers shall have an ASME or I.S.O. 9001 registered commercial quality system. Noncompliance to this registered commercial quality system requirement will result in removal of the manufacturer's product from the approved manufacturer's list shown in Table 15 of this specification. Fire hydrants, found to be noncompliant, shall be replaced, by the Contractor, with a fire hydrant that meets this specification, according to the hydrant size, at no cost to the City of Haslet.

APPROVED FIRE HYDRANT MAINTENANCE KITS

The Water System Utility Owner will attempt to use fire hydrant maintenance kits in the approved hydrants. Table 16 of this specification provides the product model numbers.

2.6.6. References.

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

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

APPROVED MANUFACTURERS

The manufacturers listed in Table 15 are approved.

Table 15	
Manufacturer	Model
Clow Valve, Inc	Medallion
M & H Valve	Reliant Model 929
Waterous	Pacer 100

The fire hydrant maintenance kits listed are the reference product model numbers.

Table 16	
Manufacturer	Model
Clow Valve Company	Medallion
M & H Valve Company	Reliant Model 929
Waterous	Pacer 100

2.7. Polyethylene Wrapping Material.

2.7.1. Polyethylene wrapping material is to be used to encapsulate all ductile and cast-iron pipe.

Polyethylene wrapping for ductile and cast-iron water mains is to consist of a 4 mil tubular section of cross-laminated high-density polyethylene, which has a high dielectric and tensile strength, for use in insulating cast-iron and ductile-iron pipe from the electrolytic action encountered in highly active soils.

Polyethylene wrapping is to consist of opaque cross-laminated high-density polyethylene sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 17 for size and length chart, in accordance with AWWA C-105 (Table 1) for minimum requirements. When supplied in specific pipe lengths, the tubes are to contain a minimum of 4-ft. over the actual pipe length to allow for overlap.

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

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

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

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

Marking Requirements

The polyethylene film supplied shall be clearly marked, at a minimum of every 2-ft along its length, containing the following information:

- manufacturer's name or trademark,
- year of manufacture,
- ANSI/AWWA C-105/A21.5,
- minimum film thickness and material type,

- applicable range of nominal pipe diameter sizes, and
- Warning-Corrosion Protection-Repair any Damage.

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

Table 17	
4 MIL POLYETHYLENE WRAPPING MATERIALS	
SIZE & LENGTH (All sizes lay flat size)	
Pipe Size	Product Size Width x Length
4", 6" & 8"	20" x 200/500
8", 10" &12"	27" x 200/500
16" & 18"	37" x 200/500
20"	41" x 200/500
24"	54" x 200/500
30"	67" x 140/500
36"	81" x 120/500
48"	95" x 100/500
54"	108" x 100/500

APPROVED MANUFACTURER AND PRODUCTS LIST

Table 18	
Manufacturer	Product
Van Leer Flexibles Inc.	Valeron
Manufactured Plastics and Distribution Inc.	Cross Tuff 450 Black

2.8. Mechanical Couplings.

Mechanical coupling of Dresser or similar type is to be used to connect plain ends of concrete steel cylinder pipe and plain ends of steel and ductile-iron pipe and to connect new and existing ductile iron water main in conjunction with casing installation in accordance with the details shown on the plans.

The mechanical coupling is to consist of a cylindrical steel middle ring, 2 steel follower rings, 2 rubber compound gaskets, and a set of steel bolts. The middle ring is to be flared at each end to receive the wedge-shaped gasket which is compressed between the middle ring flare and the outer surface of the pipe by pressure exerted on the follower rings through the bolt circle.

The flexible and transition couplings are to be manufactured to fit the type size and class of pipe specified. Bolts are to be high strength low alloy steel meeting the requirements of AWWA Standard C-111.

2.9. Air Release Assemblies.

2.9.1. Valve body and cover is to be cast iron fabricated in accordance with ASTM A-48-35 or ASTM A-126 Class B. Non-metallic Valve Body shall be fabricated from fiberglass reinforced nylon. Inlet sizes through 2-in. are to be screwed (National Pipe Taper Thread, NPT.) Pipe sizes above 3-in.and above are to have flanged inlets (125 pounds ANSI B16.1.) A protective hood or cowl is to be installed on the outlet of flange-bodied valves.

Internal seat trim float arm and pivot pin is to be stainless steel Type 303 or 304 or 316. Floats are to be stainless steel ASTM A-240. Other internal parts are to be stainless steel ASTM A-240 or ASTM A-276.

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

Internal seat or orifice button is to be of Buna-N rubber compounded for water service. Cover gasket is to be composition-type, equal to Armstrong CS-231, Garlock 3000, or Lexide NK-511. Cover bolts are to be alloy steel. Rolling seals shall be furnished for non-metallic valves 2-in. and below.

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

The air release valve is to be designed to vent accumulated air automatically. The outlet orifice is to be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve is to be either simple lever or compound lever, depending upon venting volume requirements.

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

Combination valves are to provide for both automatic air release under system pressure and to allow air movement during filling or draining operations. The combination valve may be housed in a single casting. The housing is to be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sizes (4-in. and larger) may be furnished in a dual housing. When dual castings are used, a bronze manual isolation valve is to be installed. This will allow the air release valve to be serviced when the system is under pressure.

The Engineer may at no cost to the Contractor, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failures to meet the quality standard herein will be grounds for rejecting the entire order.

The following qualified products list identifies specific manufactured items by catalog number that are approved.

Approved Manufacturers and Models:

2.9.2. Air Release Valves (Inlet x Orifice)

Manufacture	1" NPT x 3/16"	2" NPT x 3/16"
Apco Valve Company	200A	200A
G.A. Industries, Inc. (Empire)	920	920
Multiplex Mfg. Co. (Crispin)	P1-10	PL-10A
Val-Matic Mfg. Co.	38	38
PowerSeal Corporation	5401-D	5401-E
ARI Flow Control	S-050 1T	D-040 2T

2.9.3. Air & Vacuum Valves (Inlet x Orifice)

Manufacture	2" NPT x 3/16"	4" flg. with cowl

Apco Valve Company	144	152
G.A. Industries, Inc. (Empire)	930	930-C
Multiplex Mfg. Co. (Crispin)	AL20	AL41
Val-Matic Mfg. Co.	102	104
PowerSeal Corporation	5402-B	5402-D
ARI Flow Control	SD-040 2T	K060 C-HF

2.9.4. Combination Air Valves (Inlet x Orifice)

Manufacture	1"NPT X 5/64"	2"NPT x 3/32"	4"flg. x 3/32 w/ cowl
Apco Valve Company	143C	145C	149C
G.A. Industries, Inc. (Empire)	945 (1" NPT)	945	960C
Multiplex Mfg. Co. (Crispin)	U10	UL20 (1/4")	UL41 (1/4")
Val-Matic Mfg. Co.	201C	202C	204C
PowerSeal Corporation	5403-A	5403-B	5403-D
ARI Flow Control	D-040 2T	D-040	D-060 C-HF
		D-060 C-HF	

2.10. Blow-off Assemblies and Jumper Connections.

The materials required for both permanent and temporary 2-in. and 4-in. blow-off assemblies and 4-in. jumper connections are shown on the plans.

2.11. Backfill.

2.11.1. Where services 3/4-in. – 2 in. copper are installed, initial backfill shall be sand conforming to the following requirements: Natural sand or sand produced from crushed gravel or crushed rock maximum 1/4-in.; 95% shall pass No. 4 sieve, free from clay and organic material, with a maximum 8% passing the No. 200 sieve. Larger services utilizing ductile iron pipe or PVC (C-900) pipe shall be backfilled the same as mains.

Bedding and Initial Backfill for Water Mains.

2.11.1.1. Well graded gravels or crushed stone meeting the following requirements:

Modified Grade 5 gravel:

Retained on 1/2-in. sieve	0%

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

The quantity and thickness of lifts and compaction of initial backfill materials is to be in accordance with subsection 3. D. 1 of this specification.

2.11.2. Secondary Backfill for Water Mains. Secondary Backfill shall consist of approved materials that are excavated from the trench and are free of brush, debris, large rock or stones, and earth clods 6-in. or larger. Secondary backfill material shall be primarily composed of compactable soil materials.

2.12. Concrete.

All concrete used as the concrete cap or encasement is to conform to Item 421, "Hydraulic Cement Concrete." Class "D" concrete is to be used for the trench cap and for blocking all other types, unless otherwise specified on the plans.

3. CONSTRUCTION METHODS

3.1. Excavation.

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

3.1.1. Trenches.

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

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

Where over-excavation occurs, the under-cut trench shall be restored to grade at no cost to the City of Haslet and replaced with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

The depth of cut indicated on cut sheets, as furnished by the engineer, is from the off-set or cut hub elevation to the invert.

3.1.2. Width of Trench.

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

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

3.1.3. Classification of Excavated Materials.

No classification of excavated materials will be made. Excavation and trench work are to include the removal and subsequent handling of all materials excavated in accordance with Item 400, "Excavation and Backfill for Structures."

3.1.4. Grade of Trench Bottom.

The trench is to be over-excavated to a depth of 6-in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe is to then be met by the addition of a layer of approved bedding material as directed.

3.1.5. Excavation Below Grade.

Any part of the bottom of the trench excavated below the limits specified in Section 3.A.4., "Grade of Trench Bottom," is to be corrected with approved material and compacted as directed. Should excessive over-excavation occur, except at bell holes, the grade is to be restored in accordance with the methods described in Section 3.A.6, "Unstable Conditions at Grade," at no cost to the City of Haslet.

3.1.6. Unstable Conditions at Grade.

Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials which in the judgment of the Engineer should be removed, the Contractor is to excavate and remove such unsuitable material to a depth at least 6-in. below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3-in. before compaction. The layers are to be slightly moistened and thoroughly compacted so as to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade is to be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints.

3.1.7. Trench Excavation Protection.

All trench excavation required on this project is to be accomplished as required by the provisions of Item 402, "Trench Excavation Protection."

3.1.8. Caution in Excavation.

The Contractor is to proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and utilities may be determined whether shown on the plans or not. Machine excavation is not permitted closer than 12-in. on either side of other existing underground utilities. The Contractor is to be responsible for the repair of such structures and utilities when broken or damaged. He is also to be responsible for adjusting alignment and trench grades with reference to such structures to obtain specified clearance for the water main construction.

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

3.1.9. Protection and Restoration of Underground Structures and Facilities.

The Contractor is to furnish temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work. All underground structures and utilities which are disturbed are to be restored by the Contractor at his expense. Materials and methods used for restoration are to be in accordance with the Local City Codes, of the local municipality, for Building, Electrical, Plumbing, and the requirements of the utility agency involved.

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

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

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

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

3.1.10. Backfill Material Derived from Excavation.

3.1.10.1. All excavated materials which the Engineer determines are suitable for reuse as trench backfill is to be separated where practicable from the general excavation material, or as directed.

3.1.11. Pavement.

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

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

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

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

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

3.1.12. Dewatering.

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

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

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

3.1.12.3. Dewatering devices shall be provided by the Contractor with filters to prevent the removal of fines from the soil.

Should the pumping system draw fines from the soil, the Engineer shall order immediate shutdown, and remedial measures will be the responsibility of the Contractor.

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

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

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

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

3.2. Pipe Laying.

3.2.1. General Requirements.

All water mains shall be constructed in accordance with the specifications herein outlined and in conformity with the required lines, grades, and details shown on the plans and as directed. Successful passage of the pressure testing and disinfection, as described under TCEQ 30 TAC 290.44 Criteria, shall be required for the acceptance of the mains.

Water Main Crossings: Where water mains are constructed in the vicinity of sanitary sewer mains, sanitary sewer force mains, sanitary sewer manholes, and other sanitary sewer facilities, including non-potable waters such as wastewater effluent used in “reuse” applications, the requirements of the TCEQ 30 TAC 290.44 (e) & (f) shall be met.

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

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

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

3.2.2. Crossing other Underground Lines.

New water mains crossing other utilities (not including sanitary sewer or ”reuse” facilities) are to have a minimum of 30-in. of cover over the top of the pipe unless otherwise waived or modified. Excavation around other utilities is to be done by hand for at least 12-in. all around. Any damage to the protective wrap on gas lines or electrodes is to be reported immediately to owner of the gas utility, contact information as shown on the plans. Any damage to other utilities shall be immediately reported to the utility owner.

3.2.3. Pipe Grade.

Water mains 16-in. or smaller shall have a minimum of 48 in. of cover from the proposed final finish ground or street elevation and 60 in. of cover when the main is installed in a parkway or under the pavement where there are no existing or proposed curb or existing drainage facilities. Water mains 20 in. and above shall have a minimum of 60 in. of cover over the top of the pipe from the proposed final finish ground or street elevation unless otherwise waived or modified by the Engineer.

Pipe grades are to be as required on the plans, or as directed. Grades are to be met as specified by Section 3.A, “Excavation”. Care is to be taken to insure that the pipe barrel has uniform contact with the bedding material for its full length except at couplings. The coupling is not to be in contact with the original trench bottom before backfill. Bedding material is to be placed under the coupling and compacted by hand before backfilling so as to provide an even bearing surface under the coupling and pipe. Change in grade is to be made only at joints.

3.2.4. Bedding and Bedding Materials.

Before placing pipe in a trench, the trench is to have been excavated to the proper depth as required in Section 3.A, “Excavation.” Approved materials are to be smoothly worked by hand across the entire width of the trench bottom to provide supporting bedding for the pipe.

Structures to Support Pipe: Where as the bottom of a trench at subgrade consist of material that is notably unstable by the Engineer and cannot be removed and replaced with approved material, may be properly compacted in place to support the pipe. The Contractor shall also construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer. Extra compensation will be allowed for the Contractor for the additional work done. Coordinate with Engineer for approval of extra compensation before beginning work.

3.2.5. Lowering Materials into Trench.

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

3.2.6. Installing Pipe.

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

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

At times when pipe laying is not in progress the open end of pipe in the trench is to be closed by a watertight plug or other means approved. Pipe in the trench which cannot temporarily be jointed is to be capped or plugged at each end to make it watertight. This provision is to apply during all periods when pipe laying is not in progress.

Should water enter the trench, the seal is to remain in place until the trench is completely dry. The Contractor is to provide plug & caps of various sizes required.

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

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

3.2.6.1.3. Length tolerance: Standard and special section shall be within 1/16 in. (plus or minus) of the specified or theoretical lengths.

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

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

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

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

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

All mains consisting of PVC (C-905) joint restraints shall be installed as specified in accordance with manufacturer’s recommendations. Joint restraints shall be non-directional and installed as shown on the Joint Restraint Standard Detail Drawing or as shown on the plan drawings. The Contractor may be required to restrain additional joints depending on the size of main and at the direction of the Inspector or Engineer.

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

Tracer Wire: Tracer wire shall be used for location purposes and tapped to the pipe. Tracer wire shall be of solid core (14 gauge insulated) and shall be taped to the main in minimum 10 in. increments. The tracer wire shall also come up to the top of valve extensions and fire hydrant stems, as directed by the Inspector. This item will be subsidiary.

3.2.6.3. Ductile Iron Pipe: Excavations at Bells and Collars: Ductile Iron pipe shall be installed as specified within these specifications. Bell holes of enough size shall be provided at each joint to permit the joints to be made properly. For mechanical type joints, the minimum clearance between the bell and natural ground shall be 6 in. in all directions. Subject to the above provisions, the length of excavation for bell holes below grade of the trench bottom shall be kept to a minimum.

Except as otherwise shown on the plans or as directed, anti-corrosion embedment shall be provided for all ductile iron pipe, fittings, and valves and at all valves, fittings, or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material shall conform to the requirements as set forth in Section 2.O.1.a Backfill.

The preparation of the trench shall be as set forth elsewhere in these specifications. After the subgrade has been prepared, the pipe shall be laid to grade in accordance with these specifications. The pipe, fitting, or valve shall be firmly embedded in and surrounded by an insulating blanket of the embedding material. The minimum thickness of this blanket shall be 6 in. in every direction.

Where ductile-iron pipe is to be installed in a bore, the pipe shall be thoroughly cleaned down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used shall then be applied to the pipe. Following the application of the prime coat, the pipe shall be wrapped with Scotchrap, Trantex V-10 polyvinyl tape, or an approved equal. The tape shall not be applied until the prime coat is completely dry.

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

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

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

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

Before placing pipe in the trench, a cushion of approved materials shall be placed in the trench as required by in the trenching specifications contained herein. Backfill material shall be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

The Contractor shall use care to protect and reserve the polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around the pipe over the

polywrap in the area to be tapped. The tap is to be made through the tape and polywrap. It is not necessary to remove and replace poly wrap. All exposed pipe, the corporation, and the first 3 ft. of the service shall be wrapped and taped to achieve a complete seal. In addition, a sand envelope shall extend over and around the connection to a depth of 8 in. above the main.

All bolts and nuts destined for underground service on valves, fire hydrants, cast-iron mechanical joint fittings, pipe joints, and other ferrous metal appurtenances shall be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to the proper tension, the joint including glands, flanges, bolt heads, and nuts shall be covered with an Engineer approved protective coating. Such protective coating shall be supplemental to anti-corrosive sand embedment as set forth elsewhere in these specifications. Coating and wrapping of joints will be considered incidental to the installation, and no separate payment will be made for this item. Asphaltic material such as Talcote, and other asphaltic type coatings, shall not be used.

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

3.2.7. Defective or Damaged Material.

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

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

3.2.8. Holes at Bells and Collars.

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

3.2.9. Deviations in Line or Grade.

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

Whenever it is necessary to deflect pipe from a straight line the deflection is to be as directed. In no case are the amounts shown in Table 19, “Maximum Deflections of Ductile-Iron Pipe,” for ductile-iron pipe, and Table 20, “Maximum Defections of Concrete-Steel Cylinder Pipe,” for concrete pipe to be exceeded.

Table 19

Maximum Deflections of Ductile-Iron Pipe

Norm Pipe Dia	Max Joint Open	Max Defl Angle	Max Deflection in Inches with Pipe Length of:		Approx Rad of Curve in Ft Produced by Succession of Joints with Pipe Lgth of:	
(Inch)	(Inch)	Deg/Min	18ft	20ft	18ft	20ft
6	0.58	4/25	16.7	18.5	234	260
8	0.65	3/51	14.6	16.2	268	297
10	0.75	3/42	14.0	15.5	279	310
12	0.75	3/08	11.9	13.2	327	363
16	0.75	2/21	8.8	9.7	440	488
20	0.75	1/55	7.2	8.0	540	600
24	0.75	1/35	6.0	6.7	648	720

Table 20

Maximum Deflections of Concrete-Steel Cylinder Pipe

Normal Pipe Diameter (Inches)	Maximum Deflection Angle Deg/Min	Maximum Deflection (Inches)		Approx Radius of Curve (Feet)	
		16' Lay Length	20' Lay Length	16' Lay Length	20' Lay Length
16	2/20	-	9.8	-	500
20	1/52	-	7.8	-	600
24	1/34	-	6.6	-	750
30	1/16	-	5.3	-	900
36	1/02	-	4.3	-	1100
42	0/54	-	3.8	-	1300
48	0/47	2.6	-	1170	-
54	0/44	2.5	-	1237	-
60	0/54	3.0	-	1024	-

3.2.10. Cutting Pipe.

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

Asbestos-Cement (AC): No field cutting will be allowed on asbestos-cement pipe. Repairs to AC pipe shall be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC or Ductile Iron pipe and fittings.

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

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

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

3.2.11. Coating and Wrapping Underground Pipe.

3.2.11.1. Ductile-Iron Pipe.

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

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

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

Before placing pipe in the trench, a cushion of approved materials is to be placed in the trench as required by Section 3.D., Backfill material is to be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

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

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

Tape is to be spirally and tightly wrapped on each section of pipe with 50% lap. Wrap shall be made to bell on bell end and to a point 6 in. from spigot end. Protect joint with tape 6 in. in width on pipe 12 in. or less in size and 8 in. on width on pipe greater than 12 in. in size.

3.2.12. Protective Coating and Wrapping on Joints.

All bolts and nuts installed for underground service on valves, fire hydrants, cast-iron mechanical joint fittings, pipe joints, and other ferrous metal appurtenances are to be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to proper tension, the joint including glands, flanges, bolt heads, and nuts are to be covered with an approved coating. Such protective coating is supplemental to anti-corrosive sand embedment. Asphaltic coatings such as Talcote, or other asphaltic type coatings, are not allowed. Coating and wrapping of joints is to be considered subsidiary to the installation and will not be paid for directly.

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

3.2.13. Joint Assembly.

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

3.2.13.2. Mechanical Couplings: The installation of mechanical couplings is to be assembled and installed according to the standards recommended by the manufacturer. Before the installation of the mechanical coupling, the pipe ends are to be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe is to be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts are to be drawn up finger tight. Uniform pressure on the gaskets is to be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Final tensioning is to be accomplished with a torque wrench and in a manner similar to the tightening procedure. The coupling is to then be left undisturbed for 24 hours to allow the gaskets to “pack-in.” Final torque check is to then be made before coating and wrapping the joint. Table 21, Torque for Mechanical Couplings, sets forth the proper torque for various sized mechanical couplings and is included for the convenience of the Contractor.

3.2.13.3. Restrained Joints: Install restraint joints as shown on plans or as directed. Install in accordance with manufacturer’s recommendations.

Table 21		
Torque for Mechanical Couplings		
Coupling Size	Bolt Diameter	Torque
2" to 24"	5/8"	75 ft/lb
2" to 24"	3/4"	90 ft/lb
30" and 36" (1/4"x7" Middle Rings)	5/8"	65 ft/lb
30" thru 36" (3/8" & heavier Middle Rings)	5/8"	70 ft/lb
30" to 48"	3/4"	80 ft/lb
48" to 72"	3/4"	70 ft/lb

3.2.14. Gray Iron and Ductile Iron Fittings.

3.2.14.1. Fittings: Fittings 6-in. through 12-in. in size are to be either mechanical joint, push-on joint short body, or push-on joint compact body unless otherwise stated on the plans. Fittings shall be installed with the thrust blocking or joint restraint shown in standard drawing DD-839 series. Fittings 16-in. through 24-in. in size are to be mechanical joint type unless otherwise specified on the plans. Adaptors are to be used where necessary to provide a transition between asbestos-cement pipe and the fittings. Restraint or thrust blocking is to be provided as specified on the plans or as directed. Anti-corrosion embedment incidental to all installed cast-iron fittings shall be provided as specified in and no separate payment will be made for this embedment.

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

3.2.15. Corrosion Protection for Ferrous Pipe, Fittings, and Valves.

Except as otherwise shown on plans or as directed, anticorrosion embedment is to be provided for all ductile-iron pipe, fittings, and valves and at all valve fittings or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material is to be Modified Grade 5 gravel washed sand which conforms to the requirements set forth in Section 2.O.

Prepare the trench in accordance with applicable provisions of Section 3.A. After subgrade has been prepared, lay pipe to grade in accordance with the plans and specifications. Pipe, fitting, or valve are to be firmly embedded in and surrounded by an insulating blanket of embedding material. The minimum thickness of this blanket is to be 6-in. in every direction.

3.2.16. Tie-in to Existing Mains.

The Contractor is to make all ties to existing mains shown on plans or as directed. Contractor is responsible for shutdowns and isolation of existing main; coordinating with the City of Haslet on site before cutting pipe for connection; dewatering the excavation; customer notification of shutdown; proper material; and all other requirements as directed to provide completion in a safe and secure manner. Tie-ins are to be done during normal work hours, (8 am – 5 pm). During construction, planned shutdown and tie-in shall be coordinated through and approved by the Engineer. Planned shutdown and tie-in is to be accomplished at a time which will be at the least inconvenience to customers. No additional compensation will be provided for tie-ins accomplished after normal working hours. Tie-in to existing mains of asbestos cement (AC) pipe, the Contractor shall observe and comply with all federal, state and local laws, ordinances and regulations regarding the management of asbestos containing materials.

Abandonment of Old Mains and Valves.

The Contractor is to accomplish all cutting, capping, plugging, and blocking necessary to isolate those existing mains retained in service from those abandoned. The open ends of abandoned mains and all other openings or holes in such mains occasioned by cutting or removal of outlets are to be blocked off by manually forcing cement grout or concrete into and around the openings in enough quantity to provide a permanent substantially watertight seal.

Valves abandoned in the execution of the work are to have the valve box and extension packed with sand to within 8-in. of the finished surface. The remaining 8-in. are to be filled with 2,500 psi concrete or an equivalent sand-cement mix and finished flush with the adjacent pavement or ground surface. The valve covers are to be salvaged and returned to the local utility Company. Abandoning old mains and valves is to be considered subsidiary to the installation and will not be paid for directly.

3.2.17. Cutting-in Valves.

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

3.2.18. Tapping Sleeves and Valves.

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

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

Place valve box in such a manner to prevent shock or stress from being transmitted to valve. Center valve box over valves operating nut with box cover flush with finished pavement surface or located at another level as directed. Valve boxes located in street or other areas subject to vehicular traffic shall be provided with concrete collars as shown on plans. Form collars around such valve boxes and finish off neatly and in a workmanlike manner.

3.2.19. Cutting-in Tees.

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

3.2.20. Pipe Joint Restraint System.

Pipe joint restraints shall be used to prevent movement for PVC push-on bell and spigot pipe connections. The restrainer may be adapted to connect a plain end PVC pipe to a ductile iron mechanical joint (MJ) bell fitting. Joint restraint is to be non-directional and installed to fully restrain system.

3.2.21. Concrete Encasement, Cradles, Saddles, and Collars.

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

Concrete Cradles. When concrete cradles are shown on the plans or when directed, the trench is to be prepared and the pipe supported in the same manner as described in Concrete Cradles, of this Section. The cradle shall be constructed in accordance with details and sections shown on the plans. Strap or Tie Downs shall be No. 4 rebar diameter minimum or better as determined by the Engineer.

Concrete Saddles. When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with Section 3.D. of this specification to the spring line and concrete placed for a depth and width conforming to details and sections shown on the plans.

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

3.3. Fire Hydrants and Miscellaneous Appurtenances.

3.3.1. Fire Hydrants.

Typically, the hydrant shall be placed in parkway 3 ft. behind the back of curb. Under condition where sidewalk is located directly behind curb or any other obstacles, the hydrant shall be placed as directed by the city engineer.

No obstruction of any type will be allowed within 3 ft. of the hydrant in any direction. The hydrant shall not be placed less than 3 ft. within back of curb or property lines.

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

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

Blue marker shall be placed as close to the centerline of the road as possible. If the hydrant is located at any intersection, the marker shall be placed as near to the center point of the intersection as possible. The blue marker shall be octagon or hexagon shaped so as to be visible from all sides of an intersection. (Check with the fire service if there are any questions.)

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

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

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

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

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

3.3.1.3. Salvage the existing fire hydrant and other materials as designated in the field by the Inspector and deliver to Water System Utility Owner at a location determined by the Engineer. Fire hydrant branches are to be abandoned by cutting and capping fire hydrant cast iron tee at the service main and surface restored to its original condition.

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

3.3.1.5. Pipe, fittings, and valves used in the placement of fire hydrants and connections to the main are to be considered subsidiary to the fire hydrant installation and not a part of the main construction and will not be paid for directly.

3.3.2. Valve Boxes, Adjustments.

Valves are to be provided with valve boxes, manholes, or valve pits as shown on the plans or City of Haslet's requirements and details.

The valve box is to be placed in such a manner to prevent shock or stress from being transmitted to the valve. It is to be centered and set plumb over the operating nut of the valve with the box cover flush with the surface of the finished pavement or at such other level as directed. Valve boxes located in streets or other areas subjected to vehicular traffic are to be provided with concrete collars as shown on the plans. Collars around such valve boxes are to be formed and finished off neatly.

Valve box is to be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box is to be set flush with the surface of the finished pavement or at such other elevations as specified. Pits are to be constructed to permit minor valve repairs and to afford protection to the valve and pipe from impact where they pass through the pit walls.

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

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

3.3.3. Air Release Assembly.

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

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

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

3.3.4. Blow-offs.

Permanent and temporary blow-off assemblies are to be installed at the locations shown on the plans or where otherwise directed. The permanent blow-off is to consist of all galvanized pipe, valve, and fittings of the various sizes detailed on the plans, 6-in. valve box assembly including the 6-in. valve box and concrete collar around the valve box where subjected to vehicular traffic. The temporary blow-off is to consist of all galvanized pipe, valve, and fittings of the various sizes detailed on the plans. Valve box is to be raised on installed to finished grade in accordance with details.

3.3.5. Buried Gate and Valves.

Valve installation shall include; valve, reaction blocking when required conforming to plans, cast iron boot, valve box extension (Ductile Iron Riser Pipe), valve box, concrete collar where subjected to vehicular traffic, and valve box lid. Valves constructed in terrace shall be constructed with No. 3 bars all around.

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

Valve pits shall be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box shall be set flush with the finished pavement surface or at other finish elevations as specified. Pits shall be constructed in such a manner to permit minor valve repairs and provide protection to the valve and pipe from impact where penetrating through pit walls. In a High-Pressure Distribution System, as specified in this specification, all valves 6-in. and larger, shall be supported on a concrete pad in accordance with plans.

3.3.6. Anchorage and Blocking.

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

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

All thrust blocking placed in conjunction with mains and appurtenances constructed in accordance with standard details provided in the construction drawings. In all cases, the design of thrust blocking shall be of enough size to withstand a soil pressure of 3000 psf, unless specified otherwise in the job plans or specifications. The maximum soil pressure value that will be allowed for the design of thrust blocking shall be 5000 psf. When soil pressure bearing values of 4000 psf or 5000 psf are recorded for design of thrust blocks, copies of soil tests, made for determining the bearing value of the soil in question, shall be submitted to the Engineer for verification.

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

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

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

3.4. Backfill.

3.4.1. Initial Backfill.

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

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

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

3.4.2. Secondary Backfill.

Secondary backfill is defined as backfill from 1-ft. above the top of pipe to the top of the trench. Secondary backfill is to be constructed in accordance with details shown on plans and these specifications.

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

3.4.3. Sand Backfilling of Cross Trenches and Open Holes.

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

3.4.4. Trench Backfill Across Traffic Arteries.

Any trench in or across traffic arteries is to be backfilled immediately after the pipe is installed, unless the Engineer determines unusual conditions exist that render immediate backfilling unfeasible.

3.4.5. Flowable Backfill.

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

3.5. Flushing and Testing Mains.

3.5.1. Flushing.

Immediately upon completion of pipe lying, the Contractor is to flush all mains. This flushing is to be at the direction of the Engineer and is to consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed.

The flow-through is to continue until the Engineer determines all dust, debris, or foreign matter, that may have entered during pipe laying operations, has been flushed out. The new line is to then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses are to be used to direct flushing water from the main into suitable drainage channels or sewers.

3.5.2. Operation of Valves.

No valve in the distribution system is to be operated by the Contractor without prior permission. The Contractor is to notify the utility owner when a valve is to be operated and is to only operate the valve in the presence of the Engineer's representative.

3.5.3. Hydrostatic Tests.

Except in high pressure sections of the water distribution system where test pressures will exceed 150 psi, all new mains are to be hydrostatically field tested at a maximum test pressure of 150 psi before approval by Engineer. Where designated as "high pressure area," all new mains shall be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance by the Engineer. All joints which are found to leak either by observation or during any test are to be made watertight by the Contractor. In case repairs are required, the hydrostatic field test is to be repeated until the pipe installation conforms to the specified requirements and is acceptable. The expense for tests which meet specified requirements is to be made in accordance with the unit price for the hydrostatic pressure test. No payment is to be made for tests which fail to meet specified test leakage requirements.

After the new main has been laid and backfilled as specified, but before chlorination and replacement of pavement, it is to be filled with water for a minimum of 24 hours and then subjected to a hydrostatic pressure test. The specified test pressure is to be supplied by means of a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters are to be furnished by the Contractor. Unless otherwise specified, the Water System Company will furnish water for filling lines and making tests through existing mains.

Before applying the specified test pressure, all air is to be expelled from the main. To accomplish this, taps are to be made, if necessary, at the points of highest elevation and afterwards tightly plugged at no cost to the City of Haslet. At intervals during the test, the entire route of the new main is to be inspected to locate any leaks or breaks. If any are found, they are to be stopped or repaired. The test is to be repeated until satisfactory results are obtained.

The hydrostatic test is to be made so that the maximum pressure at the lowest point does not exceed the specified test pressure. The duration of each pressure test is to be a minimum of 4 hours for new mains in excess of 1,000-ft. and a minimum of 1 hour for new mains less than 1,000-ft after the main has been brought up to test pressure. The test pressure is to be measured by means of a tested and properly calibrated pressure gauge acceptable to Engineer. All pressure tests are to be continued until the Engineer is satisfied that the new main meets the requirements of these specifications. Should any test of pipe in place disclose leakage greater than listed in Table 22 or 23, Hydrostatic Test Leakage Allowances, the Contractor is to, at his expense, locate and repair the defective joints until the leakage is within the specified allowance. Leakage is defined as the quantity of water supplied into the newly laid main, or any valve section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled. The Contractor is to notify the Engineer before beginning the test, and the Water System Company's Inspector is to be present during the pressure test.

PVC pipe leakage allowances shall conform to DI leakage allowances listed on Tables 22 and 23, Hydrostatic Test Leakage Allowances.

Table 22														
Hydrostatic Test Leakage Allowance (Maximum) @ 150 psi														
Pipe	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000
6”DI*	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	2.20	3.30	4.40	5.50
8”DI*	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.32	1.47	2.94	4.41	5.88	7.35
12”DI*	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	4.40	6.60	8.80	11.00
16”DI*	0.29	0.59	0.88	1.18	1.47	1.76	2.06	2.35	2.65	2.94	5.88	8.82	11.76	14.70
20”DI*	0.39	0.74	1.10	1.47	1.84	2.21	2.55	2.94	3.31	3.68	7.63	11.04	14.72	18.40
20”CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79	1.58	2.37	3.16	3.95
24”DI*	0.44	0.88	1.32	1.76	2.21	2.65	3.09	3.53	3.97	4.41	8.82	13.23	17.64	22.05
24”CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95	1.90	2.85	3.80	4.75
30”DI*	0.55	1.10	1.66	2.21	2.76	3.31	3.86	4.42	4.97	5.52	11.04	16.56	22.08	27.05
30”CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18	2.36	3.54	4.72	5.90
36”DI*	0.66	1.32	1.99	2.65	3.31	3.97	4.63	5.30	5.96	6.62	13.24	19.86	26.48	33.10
36”CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42	2.84	4.26	5.68	7.10
42”DI*	0.77	1.54	2.32	3.09	3.86	4.63	5.40	6.18	6.95	7.72	15.44	22.16	30.88	38.60
Table 22														
Hydrostatic Test Leakage Allowance (Maximum) @ 150 psi														
Pipe	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000
42”CSC	0.17	0.33	0.50	0.66	0.83	1.00	1.16	1.33	1.49	1.66	3.32	4.98	6.64	8.30
48”DI*	0.88	1.77	2.65	3.53	4.42	5.30	6.18	7.06	7.95	8.83	17.66	26.16	35.32	44.15
48”CSC	0.19	0.38	0.57	0.76	0.95	1.13	1.32	1.51	1.70	1.89	3.78	4.98	6.64	8.30
54”CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89					
60”CSC	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16					

* DI Pipe includes mechanical and push-on joints.

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

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

Table 23										
Hydrostatic Test Leakage Allowances (Maximum) @ 200 psi										
Nom	Allowable Leakage in Gallons Per Hour (GPH) **									
Dia-Ty	Pipe Length in Feet									
Pipe	100	200	300	400	500	600	700	800	900	1000
6"DI*	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8"DI*	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12"DI*	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.3	2.55
16"DI*	0.34	0.68	1.02	1.36	1.7	2.04	2.38	2.72	3.06	3.40
20"DI*	0.43	0.85	1.28	1.70	2.13	2.55	2.98	3.40	3.83	4.25
20"CSC	0.08	0.16	0.24	0.32	0.4	0.47	0.55	0.63	0.71	0.79
24"DI*	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.10
24"CSC	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95
30"DI*	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.73	6.37
30"CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18
36"DI*	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
36"CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42
42"DI*	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
42"CSC	0.17	0.33	0.5	0.66	0.83	1.00	1.16	1.33	1.49	1.66
48"DI*	1.02	2.04	3.06	4.08	5.1	6.11	7.13	8.15	9.17	10.19
48"CSC	0.19	0.38	0.7	0.76	0.95	1.13	1.32	1.51	1.7	1.89
54"CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10
60"CSC	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30

* DI Pipe includes mechanical and push-on joints.

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

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

3.6. Disinfection of New Mains Utilizing Machine Chlorination.

After the new mains have successfully passed the pressure test specified herein, Section 3.E.3, "Hydrostatic Tests," the Contractor shall disinfect mains as shown on the plans or otherwise directed as "Machine Chlorination." This disinfection is to include chlorination, flushing, and placing the mains in service. All other disinfection requirements shall also be accomplished by the Contractor.

3.6.1. Operation of Valves.

During and after the disinfection of mains, the Contractor will be notified by the Engineer, enough in advance, to enable the Contractor to have a competent representative present whenever valves are to be operated that will affect the pressure in any part of the work for which the Contractor is responsible.

3.6.2. Contractor's Personnel and Equipment.

The Contractor is to supply labor and equipment necessary to make all excavations required for chlorination, equipment connections, subsequent flushing, and placing the mains in service.

3.6.3. Safeguarding and Backfilling Open Holes.

The Contractor is to be responsible for safeguarding any open holes excavated or left open for flushing and disinfection purposes. Following completion of disinfection, the Contractor is to backfill such holes in accordance with appropriate provisions of Section 3.D, “Backfill.”

3.6.4. Disinfection of Mains Utilizing Dry Calcium Hypochlorite.

Mains are to be disinfected with dry calcium hypochlorite (HTH) where shown on the plans or as directed and shall not exceed a total length of 800 ft. This method will also be followed for main repairs. Contractor shall use appropriate safety measures to protect personnel during disinfection operation.

3.6.5. Dosage.

The Contractor is to disinfect the new or replaced mains with calcium hypochlorite (HTH) of 70% available chlorine. Enough calcium hypochlorite (HTH) is to be used to obtain a minimum chlorine concentration of 50 ppm. The following Table 24, Chlorine Dosage, is included for the convenience of the Contractor.

Table 24
Chlorine Dosage

Diameter of Pipe Inches	Ounces Per Foot To Obtain 50 ppm Chlorine Dosage
6	0.0138
8	0.0233
10	0.0364
12	0.0523
14	0.0708
16	0.0934
18	0.1175
20	0.1455
24	0.2080
30	0.3270
36	0.4690
42	0.6370
48	0.8330
54	1.0575
60	1.308

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

3.6.6. Filling the Main.

Those sections of main, to which dry calcium hypochlorite (HTH) has been applied, is to be filled slowly to allow for the even distribution of the disinfecting material. The manipulation of valves is to be under the direction of the Engineer in accordance with Section 3.F.1, “Operation of Valves.”

3.6.7. Holding Time.

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

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

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

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

3.6.8. Flushing.

Following the expiration of the specified holding time, the treated section of main is to be flushed thoroughly by the Contractor in accordance with the applicable provisions of Section 3.E, “Flushing and Testing Mains”. Flushing is to continue until no chlorine remains detectable by taste or odor or until the chlorine residual is less than 0.3 ppm. The Contractor must make provisions for the disposal and runoff of the flushing operations to minimize erosion or impact to residents.

3.6.9. Preventing Reverse Flow.

Valves are to be manipulated so that the strong chlorine solution in the line being treated will be flushed out of the main and will not flow back into the line supplying the water.

3.6.10. Supervision.

All disinfection is to be done as directed.

3.6.11. Additional Treatment.

Should the new main fail to meet minimum public health standards for bacteriological quality after flushing, further treatment is to be as directed. If further disinfection is required, chlorination is to be done in accordance with Section 3.F, “Disinfection of New Mains Utilizing Machine Chlorination.” In no case, however, is the new line to be acceptable as complete and satisfactory until the bacteriological quality of the water taken from the main meets the Standards of the TCEQ.

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

3.6.12. Safeguarding and Backfilling Open Holes.

The requirements for safeguarding and backfilling all holes excavated or left open for chlorinating and sampling is to be as specified in Section 3.F.3, “Safeguarding and Backfilling Open Holes.”

3.7. Installation of the Nonmetallic Pipe Detection System.

The nonmetallic pipe detection system is to be installed concurrently with the proposed pipe placement. Tracer wire shall be used for location purposes and taped directly to the pipe. The tracer wire shall be solid core (14 gauge insulated,) and shall be taper to the main in 10-in. increments. Wire shall also come up to the top of valve extensions and fire hydrant stems, as directed.

4. MEASUREMENT

This Item will be measured as follows: “8 SDR-18 C900 PVC Pipe,” “12 SDR-18 C900 PVC Pipe,” and “16 SDR-18 C900 PVC Pipe” for water pipe of the various sizes shown on the plans, will be measured by the horizontal linear foot as follows: From the centerline intersection of runs and branches of tees to the end of the valve of a dead-end run.

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

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

Carrier pipe used in bores and tunnels or backed into place will be measured by the linear foot of pipe installed from end to end of pipe to the limits shown on the plans.

Casing or liners used in bores and tunnels, where required by the plans, of the size and material required will be measured by the linear foot installed in accordance with plans.

"12-in. Gate Valve," "8-in. Gate Valve," and "16-in. Gate Valve" will be measured as each assembly of the various sizes installed to finished grade.

"Concrete Cap" and "Concrete Encasement" for pipe will be measured by the horizontal linear foot as dimensioned on the plans. Reinforcing, if required, will not be measured for payment.

"Fire Hydrant (Compl)" will be measured as each fire hydrant installed. Also included will be enough pipe, valve, fittings, fire hydrant lead line up to 100 feet, gate valve, paint, bends, and all other items shown on detail.

"2-in. Air Release Valve (Complete)" will be measured as each assembly of the size installed.

"Water (Trench Excavation Protection)" will be measured by the linear foot along the centerline of trench where the depth of trench exceeds 5-ft.

"Connect to Existing Water Line" will be measured as each connection.

"Hydrostatic Pressure Test" will not be measured for payment but is considered subsidiary.

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

"Flowable Backfill" will be measured by the cubic yard in accordance with Item 401, "Flowable Backfill," but not to exceed the minimum trench width specified in Section 3.A.2, "Width of Trench" or as shown on the plans.

"Ductile Iron Fittings" will be measured by the ton and will include bends, tee's, plugs, cross's, and reducer (all sizes.)

5. PAYMENT

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

Payment for "8 SDR-18 C900 PVC Pipe," "12 SDR-18 C900 PVC Pipe," and "16 SDR-18 C900 PVC Pipe" will be made at the unit price bid per foot of pipe of the various sizes installed by the open cut method. This payment is also to include selected bedding, excavation, backfill materials, polyethylene sleeve, all required fittings associated with the installation of the water main pipe of the various sizes, and hauling and disposition of surplus excavated materials.

Payment for “12-in. Gate Valve,” “8-in. Gate Valve,” and “16-in. Gate Valve” will be made at the unit price bid for each such assembly of the various sizes installed. This payment is also to include selected embedment material, anti-corrosion embedment when specified, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required. For butterfly valves only, such payment is also to include mechanical or transition couplings and coated and wrapped steel pipe nipples required to complete the connection.

Payment will be made at the unit price bid for “Concrete Encasement” and “Concrete Cap” by the linear foot of concrete placed. Reinforcing, if required, shall not be measured for payment.

Payment for “Fire Hydrant (Compl)” will be made at the unit prices bid for each such assemblies installed (includes all items shown on detail.)

Payment for “2-in. Air Release Valve (Complete)” will be made at the unit price bid for each assembly of the various sizes installed in accordance with the details shown on the plans. This payment is also to include selected embedment material, anti-corrosion embedment when specified, excavation and hauling and disposition of surplus excavated materials, blocking, and various sizes and types of meter boxes.

Payment for “Water (Trench Excavation Protection)” is to be made on the basis of the unit price bid for each linear foot of “Water (Trench Excavation Protection)” and “Joint Trench Excavation Protection” in place. Payment is to include all components of the trench protection system which can include, but not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering, or diversion of water to provide adequate drainage. Payment is also to include the additional excavation and backfill required, any jacking, jack removal, and removal of the trench support after completion and be full compensation for all other labor, materials, tools, equipment, and incidentals necessary to complete the work.

Payment for “Connect to Existing Water Line” will be made at the unit price bid for each connection.

Payment for all water line testing shall be considered subsidiary.

No direct payment will be made for concrete blocking of water mains; coating and wrapping pipe joints; trench excavation below specified limits; excavation and removal of unsuitable material at bottom of trench grade and restoration with approved material; supporting pipe or conduits of public utilities; abandonment of water mains and valves; resetting existing meters and meter boxes in proper configuration; salvaging fire hydrants, valve boxes, and meter boxes; flushing water mains; and disinfection of water mains. This work is to be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the nonmetallic pipe detection system. This work and materials are to be considered subsidiary to the various pay items. In addition, the Contractor is to ensure that the detection system is complete and operational to the satisfaction of the Engineer.

No direct payment will be made for furnishing and installing the pipe joint restraint system. This work and materials shall be considered subsidiary to the various bid items.

No direct payment will be made for furnishing and installing the Joint Restraint System for PVC C-905. This work and materials shall be considered subsidiary to the various pay items.

The work performed and materials furnished, in accordance with this Item and measured as provided under “Measurement,” will be paid for at the various unit prices. These prices are full compensation for furnishing materials and for equipment, labor, tools, and incidentals.