

Special Specification 7180

Water Systems



1. DESCRIPTION

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

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3. WATER MAINS

3.1. **Description.** Furnish all labor, materials, equipment and incidentals required to install water mains as shown on the plans and as specified, complete in place.

3.2. **Materials.**

3.2.1. **Polyvinyl Chloride (PVC) Pressure Pipe.** The following specifications cover the requirements for polyvinyl chloride (PVC) pressure plastic pipe materials and installation for potable water use and apply to PVC pipe, sizes 4 in through 12 in diameters.

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

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

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

3.2.1.2. **Submittals.** Furnish all necessary shop drawings, certificates, etc. for review and acceptance. A certification from the manufacturer must be furnished attesting compliance with appropriate ASTM Standards and ANSI/NSF Standard 61. Such compliance will be evidenced by an affidavit from the manufacturer or vendor. If the pipe does not presently conform to this standard, information from the manufacturer regarding action being taken to comply with this standard must be submitted. Failure to provide this information may result in rejection of pipeline material. Include documentation on pipe products, fittings, and related materials as may be required by the plans

or the Engineer. Review all submittals before submission. Submit it in a timely manner so as not to delay the project. Allow enough time for the Engineer's review and resubmission, if necessary. Include certifications from manufacturer that the product complies with appropriate ASTM standards

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

- ANSI/NSF 61 Drinking Water System Components - Health Effects
- ASTM F-477 Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- ASTM D-1784 Specifications for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
- ASTM D-2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
- ASTM D-2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
- ASTM D-3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- AWWA C-651 Standard for Disinfecting Water Mains
- AWWA C-900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-in through 12-in, for Water Distribution
- AWWA M-23 Manual: PVC Pipe - Design and Installation
- UNI-BELL-3 Polyvinyl Chloride (PVC) Pressure Pipe (Complying with AWWA Standard C-900)
- Texas Commission on Environmental Quality, Chapter 290 - Public Drinking Water

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

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

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

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

3.2.1.6. Joints. Furnish push-on flexible, elastomeric gasketed pipe joints. The pipe length must contain one bell-end or couple with a synthetic elastomeric gasket. Furnish restrained joint (RJ) connections if installed by jacking, boring, tunneling, or directional drilling. Only bell joint single gasket pipe will be allowed; no twin gasket collar joints will be allowed.

Gaskets and joints must meet the requirements of ASTM C443/C505/477. The bell will be an integral part of the pipe length, and have the same strength and DR as the pipe. The spigot pipe end will be beveled.

All push-on joint PVC pipe must have dual insertion marks on the spigot indicating proper penetration when the joint is assembled and only one mark remains visible. The sockets and/or spigot configurations for the fittings

and couplings will be compatible to the pipe. Socket configuration must prevent improper installation of gasket and will ensure that the gasket remains in place during joining operations.

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2.1.9.4. **Marking Tape.** Mark PVC pressure water pipe by installing the appropriate marking tape for detection purposes concurrently. Provide a high visibility blue detectable tape consisting of a 5.0 mil inert polyethylene plastic material with the standard warning and identification for potable water imprinted on the tape. Provide a minimum width of 6 in for all potable water lines and bury tape to a depth of 12 in, measured from above installed pipe. Use detecting tape manufactured by Empire, Lineguard, or approved equal.

3.2.1.9.5. **Deflection.** Maximum ring deflection (cross-sectional deflection) of installed PVC pressure pipe is 5 percent. Joint deflection (horizontal deflection) will not exceed manufacturer's recommendations for the particular pipe size.

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

3.2.1.9.7 **Connection to Existing Water Mains.** The work covered by this section of the specifications consists of furnishing all labor, equipment, appliances, and materials, and of performing all operations involving the connection of new water mains to existing water mains complete, in strict accordance with this section of the Specifications and Plans, and subject to the terms and conditions of the Contract. Connections to existing water mains must be done by use of tapping sleeves, tapping valves, and drilling machines or by main line installed tees with couplings. Approved methods as furnished by manufacturer must be used. State requirements must be followed for installation. Coordinate any required shut down of water supply with the Owner. Care should be taken to limit water supply down times to no more than 1 hour.

- **Tapping Sleeves** - Tapping sleeves must be Power Seal Model #3490AS, stainless steel or approved equal. Bolts to be stainless steel.
- **Tapping Valves** - Tapping valves must be resilient seated Mueller, M&H, American Darling, U.S. Pipe or approved equal unless otherwise noted on the Plans. Bolts to be stainless steel.
- **Main Line Tee** - Connections made with tees must be an approved mechanical joint type Cast Iron for use on cast iron or PVC pipe. Texlan coated "T" bolts must be used.

3.2.1.9.8 **Testing.**

■ After the distribution system is completely installed, with all meter bops, valves and fittings, but before installation of meters, a 24 hour hydrostatic test must be conducted in accordance with FmHA instruction 1942.18b15.

■ Allowable Leakage: The maximum allowable leakage for push-on joints is 10 gal/in dia./mile/24hrs.

■ Test Pressure: Minimum of 160 PSI or as directed.

■ Procedure:

- (1) Lines must be flushed to remove any foreign matter that may be in the lines. Lines must be clean before testing.
- (2) Fill pipe with water until air is exhausted.
- (3) Raise pressure to test pressure of pipe by means of pumping from a container.
- (4) Refill container and maintain pressure for a minimum of 4 hr.
- (5) Measure water required to refill container to pre-test level.
- (6) Before being placed into service, the entire system must be disinfected until two consecutive samples of chloride free water from each line is found to be free of organisms of the Coli-Aerogenes groups. The disinfection and submission of samples must be in accordance with

the requirements of the State Health Department or local authorities.

■ **Criteria for Test Failure**

- (1) Failure or inadequacy of test equipment.
- (2) Observed leakage in any element of the test section.
- (3) Presence of 5 psi drop in effective pressure at lowest point for more than 15 min.
- (4) Presence of a 15 psi drop in effective pressure at lowest point for any length of time.
- (5) Greater than the total allowable leakage.

■ **Criteria for Successful Test**

- (1) Occurrence of none of the items of Criteria for Test Failure.
- (2) Notify the Engineer and the Owner 24 hr in advance of any testing. Engineer's representative must be present during test. Forms will be furnished by the Engineer to the Contractor to record test data and results.

■ **Special Requirements**

- (1) The Engineer will furnish the Owner a signed certificate stating the pressure test(s) has been performed in accordance with these specifications. The certificate should contain the following, but not limited to:
 - a. Date tests were performed.
 - b. Name of people in attendance.
 - c. Brand names of pipe and pressure rating.
 - d. Test Pressure.
 - e. Number of leaks found during testing.
 - f. Comments.

3.3 STERILIZATION – Each unit of completed supply lines and distribution system must be sterilized with chlorine before acceptance for domestic operation.

3.3.1 Materials: The chlorinating material must conform to the requirements of Federal Specifications O-C-114, Type I, and AWWA Standard C601-81.

3.3.2 Method: The amount of chlorine applied must be such as to provide a dosage of not less than 50 mg/l. The chlorinating material must be introduced to the water lines and distribution systems in an approved manner. The chlorinated water must be retained in the main for at least 24 hr. At the end of this 24 hr period the treated water in all portions of the main must have a residual of not less than 10 mg/l free chlorine. If possible to do so, the lines must be thoroughly flushed with clean water until the residual chlorine content is not greater than 1.0 part per million. All valves in the lines being sterilized must be opened and closed several times during the contact period. State Health Department bacterial tests are required and approval of system subject to negative reports. Any items in this specification are subject to the most recent changes in the regulations of the Texas State Department of Health.

3.4 **CLEAN-UP** - Upon completion of the installation of the water lines, distribution systems and appurtenances, all debris and surplus materials resulting from the work must be removed.

3.3. **Measurement.**

3.3.1. **Water Main (PVC) (DR 18 C900).** This Item will be measured in place by the foot of PVC along the centerline of pipe as installed.

3.3.2. **Abandon and Fill Existing Water Pipe.** This Item will be measured by the foot of existing water main pipe that is abandoned in place for the size indicated

3.3.3. **Remove Existing Water Pipe.** This Item will be measured by the foot of existing water main pipe that is removed as identified on the plans.

3.5. **Payment.**

3.5.1. **Water Main (PVC) (DR 18 C900).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Water Main (PVC) (DR 18 C900)" of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, thrust restraint devices and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required.

All fittings and appurtenances which will be required for a complete installation of the proposed water main and are not listed on the plans or these specifications will not be paid for directly but will be subsidiary to the water pipe installation.

Trench excavation protection will not be paid directly but will be subsidiary to the water pipe installation.

3.5.2. **Abandon and Fill Existing Water Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "ABAND/FILL EXIST WATER PIPE" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited to the following items: coordination, traffic control, potholing, excavation, complete draining (dewatering) of pipe, flowable backfill, cutting, capping, complete filling with approved flowable backfill of water mains to be abandoned, removal of bonnet boxes from abandoned valves, and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal.

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

3.5.4. **Connect Existing Water Main to Proposed Water Main.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "CONNECT (size of proposed water main) WTR MAIN TO (size of existing water main) WTR MAIN" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited including all pipe, fittings and accessories; mechanical joint restraints; and all appurtenances defined herein to include, but not limited to the following items: concrete collars, end plugs, bends, tees, couplings, reducers, marking tape, concrete thrust blocks, thrust restraint devices and all other

items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required.

All fittings and appurtenances which will be required for a complete connection of the proposed water main to the existing water main not listed on the plans or these specifications will not be paid for directly but will be subsidiary to the water pipe installation.

Trench excavation protection will not be paid directly but will be subsidiary to the water pipe installation.

- 3.5.5. **Steel Casing Pipe.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "(STEEL)(24IN)(OPEN TRENCH)" of the size specified. This price is full compensation for furnishing all required materials, labor, and equipment, including but not limited including all pipe, fittings and accessories and all appurtenances defined herein to include, but not limited to the following items: concrete collars, end plugs, and all other items for the project not indicated as being covered under the other specific bid items shown on the proposal; furnishing all required labor, including coordination, traffic control, potholing, excavation, including hand-digging, if needed; embedment and backfilling; compaction and compaction testing; disinfection, pressure testing, dewatering of groundwater, where required.

Trench excavation protection will not be paid directly but will be subsidiary to the water pipe installation.

4. EXCAVATION, INSTALLATION, AND BACKFILL

- 4.1. **Pipe Installation.** Install pipes true to lines and grades as indicated on the plans. Inspect all pipe and fittings before placing in the trench. Clean all joint surfaces and soiled materials before connecting one another. As work progresses, maintain interior of pipes clean.
- 4.1.1. **Standard Cover.** Standard cover depends on the water main size and installation conditions and is generally
- 6 and 12 in diameter Main: Minimum of 4-foot cover from top of pipe to finished grade
 - Crossing under proposed storm sewer: Minimum of 2-foot cover from top of pipe to bottom of proposed storm sewer.
- 4.1.2. **Potholing.** Existing utilities shown on plans are for informational purposes only. Before new pipe installation, pothole all existing utilities and structures to confirm their location, depth, and size. If conflict or discrepancy affects the project design, notify the Engineer before proceeding with pipe installation to formulate a solution
- 4.1.3. **Pipe Zone Embedment.** Unless otherwise specified or shown on the plans, embed pipelines either Class I, II, or III material defined in this Article 6.2.4 and installed as described. Native or imported material for embedment may be used provided material conforms to this Specification.

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

Place bedding to provide uniform and adequate longitudinal support under the pipe. Place the first lift of bedding material from the bottom of the trench to slightly above the bottom of the pipe grade. Unless otherwise shown on the plans, provide a minimum bedding of 4 in in depth for pipe sizes 30 in and smaller, and 6 in for pipe sizes greater than 30 in.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.4. **Measurement**

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

- 4.4.2. **Cement Stabilized Backfill .** Unless shown on the plans as a pay item, quantities shown are for informational purposes. When specified as a pay item, this Item will be measured by the cubic yard as shown under Item 400, "Cement Sand".

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

5. VALVES AND FITTINGS

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

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

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

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

5.2.1. **Valves.**

5.2.1.1. **Tapping Valves.** Tapping valves must be resilient seated Mueller, M&H, American Darling, U.S. Pipe or approved equal unless otherwise noted on the Plans. Bolts must be stainless steel. Provide for the size specified. Acceptable manufacturers and models are listed:

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

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

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

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

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

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

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

Wedges. Equip double-disc gate valves with a free and positive-operating internal device that presses the disc seats firmly against the body seats when the valve is closed and releases the load before the discs begin to

move when the valve is opened. Provide a simple and rugged design with materials as specified in AWWA C-500. Iron to iron contact surface is not allowed.

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

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

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

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

5.2.1.2.

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

- American Darling
- M&H
- US Pipe

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

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

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

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

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

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

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

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

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

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

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

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

Standards. Comply with the following applicable requirements:

ANSI B16.1 "Cast Iron Pipe Flanges and Fittings"

AWWA C-104 "American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water"

AWWA C-105 "Standard for Polyethylene Encasement for Ductile Iron Pipe and Fittings"

AWWA C-110 "American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in, for Water and Other Liquids"

AWWA C-111 "Rubber-Gasket Joints"

AWWA C-153 "American National Standard for Ductile-Iron Compact Fittings, 3 in through 16 in, for Water and Other Liquids"

Minimum Requirements. Apply minimum requirements of shown Table 10 and Table 11 to the specified fittings.

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

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

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

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

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

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

Provide polyethylene wrapped fittings in accordance with AWWAC-105.:

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

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

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

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

Table 12.

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06-18
OTU

Bearing Surface Per Bend

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

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

5.4. **Construction.**

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

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

5.5. **Measurement.**

5.5.1. **Valves.** This Item will be measured in place per each installation of the sizes and types shown on the plans.

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

5.6. **Payment.**

5.6.1. **Valves.** The work performed and the materials furnished in accordance with this Item and measured as provided under "GATE VALVE & BOX" will be paid for individually complete in place. Valves of the sizes and types shown on the plans are per each installation and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all valves shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers instead of or in conjunction with concrete thrust blocking is not be considered for additional compensation.

5.6.2. **Fittings.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water mains pay items. All fittings shown on the plans, including fittings not shown on the plans as required for a complete installation of the proposed water main, are subsidiary to the different pay items for water mains and services and include all costs associated with coordination; excavation; disposal of excess material; backfill, compaction, compaction testing for utilities, all labor, equipment and materials required for furnishing and installing all fittings shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: thrust blocking, mechanical joint restrainers, concrete anchoring, polyethylene wrapping, and provisions for corrosion protection. Use of mechanical joint restrainers instead of or in conjunction with concrete thrust blocking will not be considered for additional compensation.

6. WATER SERVICE CONNECTIONS

6.1. **Description.** Furnish labor, materials, equipment and incidentals necessary to construct and install plastic meter boxes, water service connections, complete in place. The City must provide proposed water meter for the Contractor to install.

6.2. **Materials.**

General. Provide fittings and valves in contact with potable water in conformance to the latest revision of NSF/ANSI Standard 61 (Annex F) and the requirements of Article 7. Include certifications from manufacturers that the products comply with appropriate ASTM, AWWA and Utility Standards with required submittals. New water meters will be furnished by the department when required unless otherwise specified.

Quality Assurance. Fittings and valves in contact with potable water must conform to the latest revision of NSF/ANSI Standard 61 (Annex F). Such compliance must be evidenced by an affidavit from the manufacturer or vendor.

All fittings and valves must have the manufacturer's name or trademark permanently stamped or cast on it and "No Lead" brass allow, e.g. "NL" must be cast or stamped on the valves and fittings.

6.2.1.1. **Water Service Connections.**

Service Saddles. Provide double strap, epoxy coated, tapping saddle with cadmium plated bolts. Acceptable manufacturers are Smith-Blair No. 313 or approved equal.

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

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

Provide corporation stops manufactured by Mueller Model No. H-1500 (CC Thread x Compression (typ)), or approved equal and conform to the requirements of AWWA C800.

Provide Mueller Model No. B-25170 (Compression x FIPT) ball curb stop valve for single installation or Model No. B-20200 or B-20245 for double installation or approved equal .

6.3. **Service Pipe.** Provide copper Type "K" for service pipe sizes up to and including 2 in, meeting ASTM B-88 requirements with bronze fittings.

Construction.

6.3.1. **General.** Furnish and install service taps for 3/4 in (single service) to 1 in (double service) services with service saddle. Direct taps, i.e. without the saddle, are not allowed.

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

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

- 6.3.2. Existing Services. Where existing water services are indicated on the plans to be replaced, relocated, or reconnected to new water lines, make prior arrangements with each water customer as to the time and length of shutdown necessary. Notify the customer 24 hr before any connections are made. A maximum shut-off time of four (4) hr will be allowed for making connections, after which time supply the customer with potable water from an approved source at no additional cost to Department.
- 6.3.3. Meter Box Installation. Install in accordance with these specifications and Utility Standard Details to grade matching top of proposed surface.
- 6.3.4. Testing and Flushing Procedures. Pressure test all services for leakage by opening the corporation or service valve at the main service connection point, maintaining the meter angle valve closed, and visually observing all connections and piping for leaks. If no leaks are observed, then flush service line as follows. The ball curb stop valve is opened to "full" and then the corporation valve is slowly opened to full capacity. Water is allowed to flow until piping has been thoroughly flushed. Then the ball curb stop valve is slowly closed to prevent water hammer or shock pressure, which might rupture the main or adjacent water service connections. If no customer piping is currently connected to the meter outlet connection, use a fitted plug at the end of this connection to prevent the entrance of dirt or muddy water.
- 6.4. **Measurement.**
- 6.4.1. **New Water Service Installation.** This Item will be measured in place by each new service installed for the size and type indicated.
- 6.5. **Payment.**
- 6.5.1. **New Water Service Installation.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "NEW WATER SERVICE (3/4)" of the size and type specified. This price is full compensation for furnishing all required materials, including all costs associated with: furnishing labor, new materials, equipment, and incidentals to install new water services of the specific size and type (water service); complete restoration to its original condition, any disturbed area associated with the installation of new water services; coordination; and all appurtenances defined herein to include, but not limited to the following items: meter boxes, all fittings and valves in accordance with department requirements and as indicated on the plans. Water meter must be provided by the City and installed by the Contractor.

7. FIRE HYDRANTS

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

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

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

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

Provide center of the lowest nozzle a minimum ground clearance of 18 in. Supply with extension sections in multiples of 6 in with rod and coupling as required to increase barrel length.

The fire hydrant manufacturer must provide local representation and support services, through an established vendor. Acceptable manufacturers and models are:

- | | |
|--------------------|-----------------------|
| ■ American Darling | B84B |
| ■ U.S. Pipe | Metropolitan No. 250 |
| ■ M&H | Model 929 |
| ■ Mueller | Centurion Model A-423 |

Size. Provide a minimum inside barrel diameter of 7 in with a minimum diameter of the main valve opening of 5 and one-fourth (5-1/4") in.

7.2.2.

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

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

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

Main Valve. The main valve closure must be of the compression type, opening against the pressure and closing with the pressure. The main valve opening must not be less than 5-1/4" and be designed so that removal of seat, drain valve mechanism, internal rod and all working parts can be removed through top of hydrant. The bronze seat must be threaded into mating threads of bronze for easy field removal.

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

Inlet Connections. Six (6") in mechanical joint or as otherwise indicated in plans. All bolts used in mechanical joints must be pearlitic Malleable T-Head Bolts as manufactured by Texas Foundries, Inc. or approved equal. **Outlet and Pumper Nozzles.** Provide two hose outlets with 2-1/2 in nozzles with National Standard hose coupling screw threads. Provide outlet nozzles of the caulked type or mechanically connected into the barrel with an O-ring seal and a non-corrosive locking pin to lock the nozzle to the barrel.

Provide pumper Nozzle with an inner diameter of 4 and one-half (4-1/2") in with National Standard threads.

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

Hydrant Operator. The operating nut must be pentagon, one and one-half (1-1/2) in measured point to flat. The operating nut, main steam, coupling and main valve assembly must be capable of withstanding input torque of 200 ft/lbs, in opening or closing directions.

Attachment of the operator nut must not, in any way, hinder operating the hydrant with the wrench and must open by turning left (counterclockwise). Design hydrants with O-ring seals to prevent water from damaging the operating threads.

Painting. Safety red, with aluminum bonnet and caps. Exposed exterior surfaces below the ground line and exposed interior surfaces must be coated with two coats asphalt varnish, Federal Specifications TT-V-51 asphalt varnish or military Spec. Mil-C-450. The prime coat from the ground up must be Federal Spec. TT-P-86 (type M) Federal Spec. TT-P-636 or equal.

Interior surfaces above the main valve, except machined surfaces, must be coated with asphalt varnish or primer. The outside top section of the hydrant must be painted with a coat of primer and a coat of safety red paint on the fire hydrant body with aluminum paint on the bonnet and caps. Protective Coating. Epoxy coat all interior ferrous surfaces of shoe exposed to flow to a minimum dry thickness of 4 mils. Factory- apply epoxy coating by an electrostatic or thermosetting process in accordance with manufacturer's printed instructions. Epoxy materials must be 100 % powder epoxy or liquid epoxy conforming to AWWA C-550 and to the current requirements of the Food and Drug Administration and the EPA for potable water.

O-Rings: An internal housing with triple O-rings must be used to seal operating threads from the waterway and accommodate an anti-friction washer.

Construction. Install hydrants at locations shown on the plans or in approved standard locations. Fire hydrants and valves must be installed at points shown on the plans and at such other locations as directed. Changes to the plan must be approved by the Director of Utilities. A gate valve must be installed on each fire hydrant branch between the main line and the hydrant. Generally hydrants must be placed at intersections and must be installed at the end of the curb radius, with a minimum back of curb clearance of 1-1/2 ft measured from the steamer nozzle cap. Hydrants placed between blocks must be placed in line with a property line between individual lots. Fire hydrants must stand plumb, with the steamer nozzle facing the street. No hydrant must be installed more than 2" above the existing ground grade without prior approval. The Engineer will stake the location of each hydrant.

Each hydrant must be placed on a concrete slab 4 in thick and 15 in square. The side of the hydrant opposite the steamer nozzle must rest firmly against the face of the trench. Hydrants must be further restrained by retainer glands, with square head screws, restraining joints, or in unstable ground conditions bridle rods and collars must be required. If the Contractor makes excessive excavation around a fire hydrant location, he must furnish and install concrete backing behind the hydrant at no extra payment. Washed gravel consisting of 6 cu. ft. must be placed around the base of each hydrant to serve as a drain field when the hydrant is closed.

The length of the barrel of the hydrant must be enough for the depth of bury at the particular location in which the hydrant is to be installed. The joint between the upper and lower barrel sections must be at least 2 in above finished grade for each location. The standard bury of the fire hydrant is three and one-half (3-1/2) ft. The maximum bury permissible is six (6) ft. If fire hydrants are installed at points where the main pipeline is a greater depth than six (6) ft, offsets, bends and fittings are required to reduce the bury to no more than six (6) ft. No extra payment must be made for hydrants requiring barrels longer than three and one-half (3-1/2) ft bury.

All hydrants must be positively restrained, with use of retainer glands, long swivel hydrant adapters and swivel fittings or bridle rods and collars if unstable ground conditions are encountered.

The body of the fire hydrant above ground must be painted with two coats of perma-coat quick dry gloss enamel, safety red Gro-Co. No. 351-4009, or accepted equal. The bonnet and caps must be painted with two coats of silver chrome aluminum, Gro-Co. No. 358-0001, or approved equal.

Touch up paint damaged during installation. Disinfect hydrants with the connecting pipe in accordance with Article 10, "Cleaning, Disinfection and Testing of Water System" in this Specification. Ensure installed hydrants are left in good working order with control valve open.

7.3. Measurement.

7.3.1. **Fire Hydrant Assy.** This Item will be measured in place by each new fire hydrant connected to the new water main.

7.3.2. **Fire Hydrant (Remove and Salvage).** This Item will not be measured individually and is subsidiary to removal and abandonment of existing water mains.

7.4. Payment.

7.4.1. **Fire Hydrant Assy.** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "FIRE HYDRANT ASSY" as specified. This price is full compensation for furnishing all required materials, installation of new fire hydrant, spool extensions as needed, mechanical joint swivel tee with Texlan coated "T" bolts and fittings at the main, gate valve with bonnet box and lid, 6"x13" swivel by solid adapter with Texlan coated "t" bolts and fittings (ductile iron only), thrust blocking or mechanical joint restrainers and all fittings and appurtenances for a complete installation as shown on the plans.

7.4.2. **Fire Hydrant (Remove and Salvage).** The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be not paid for individually as it is considered subsidiary to the various water main removal and abandonment pay items.. This is for furnishing all required labor, materials, equipment, and incidentals to remove and salvage existing fire hydrants as indicated on the plans.

8. CLEANING, DISINFECTION, AND TESTING OF WATER SYSTEM

8.1. **Description.** Perform disinfection and testing of all water mains and related appurtenances.

8.2. Materials.

Standards. The chlorinating material must conform to the requirements of Federal Specifications O-C-114, Type I, and AWWA Standard C601-81. Water. Provide water required for filling, flushing and testing the line at such points along the pipeline as water is available from the existing distribution or supply systems. Do not waste water. Such action may require appropriate charges.

8.3. Construction.

General. After completion of all pipe line section, use the following procedure to clean, sterilize and pressure test the pipeline. Fill the pipeline and flush until all evidence of dirt or debris has been washed from the pipeline, then refill line, if necessary, introducing the chlorinating material. Perform pressure and leakage test at each valved section. After all sections have been approved, clean all valves and leave line full of sterilizing water. Each unit of completed supply lines and distribution system must be sterilized with chlorine before acceptance for domestic operation.

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

8.3.1.1. Sterilization. Before acceptance for operation, sterilize each unit of completed water system as specified below or as prescribed by AWWA Standard C-601-81 (Collect two consecutive sets of acceptable samples taken at least 24 hr apart from the new main.)

- Thoroughly flush with water the unit to be sterilized until all entrained dirt and mud have been removed before introducing the chlorinating material.
- Provide all chlorination material for sterilization and introduce the chlorinating material into the water line in an approved manner at a dosage of not less than 50 parts per million.
- Retain treated water in the pipe at least 25 hr to destroy all nonspore-forming bacteria except where a shorter period is approved. Retention time should produce not less than 10 ppm of chlorine at the extreme end of the line at the end of the retention period. State Health Department bacterial tests are required and approval of system subject to negative reports. Any items in this specification are subject to the most recent changes in the regulations of the Texas State Department of Health. If possible to do so, the lines must be thoroughly flushed with clean water until the residual chlorine content is not greater than 1.0 part per million.
- Open and close all valves on the lines being sterilized several times during the contact period.

8.3.1.2 Hydrostatic Pressure and Leakage Testing. After the distribution system is completely installed, with all meter bops, valves and fittings, but before installation of meters, a 24 hr hydrostatic test must be conducted in accordance with FmHA instruction 1942.18b15.

- **Allowable Leakage:** The maximum allowable leakage for push-on joints is 10 gal/in dia./mile/24hrs.
- **Test Pressure:** Minimum of 160 PSI or as directed.
- **Procedure:**
 - (1) Lines must be flushed to remove any foreign matter that may be in the lines. Lines must be clean before testing.
 - (2) Fill pipe with water until air is exhausted.
 - (3) Raise pressure to test pressure of pipe by means of pumping from a container.
 - (4) Refill container and maintain pressure for a minimum of 4 hr.
 - (5) Measure water required to refill container to pre-test level.
 - (6) Before being placed into service, the entire system must be disinfected until two consecutive samples of chloride free water from each line is found to be free of organisms of the Coli-Aerogenes groups. The disinfection and submission of samples must be in accordance with the requirements of the State Health Department or local authorities.
- **Criteria for Test Failure**

- (1) Failure or inadequacy of test equipment.
- (2) Observed leakage in any element of the test section.
- (3) Presence of 5 psi drop in effective pressure at lowest point for more than 15 min.
- (4) Presence of a 15 psi drop in effective pressure at lowest point for any length of time.
- (5) Greater than the total allowable leakage.

■ **Criteria for Successful Test**

- (1) Occurrence of none of the items of Criteria for Test Failure.
- (2) Notify the Engineer and the Owner 24 hr in advance of any testing. Engineer's representative must be present during test. Forms will be furnished by the Engineer to Contractor to record test data and results.

■ **Special Requirements**

- (1) The Engineer will furnish the Owner a signed certificate stating the pressure test(s) has been performed in accordance with these specifications. The certificate should contain the following, but not limited to:
 - a. Date tests were performed.
 - b. Name of people in attendance.
 - c. Brand names of pipe and pressure rating.
 - d. Test Pressure.
 - e. Number of leaks found during testing.
 - f. Comments.

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