

Special Specification 7214

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 60 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 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-605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- AWWA C-651 Standard for Disinfecting Water Mains
- AWWA C-900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in. through 60-in.
- 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 60 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 36 in. diameters and a minimum pressure class of 165 psi (DR 25) for 42 in. through 60 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 F-477. The bell will be an integral part of the pipe length, and have the same strength and DR as the pipe. The spigot pipe end will be beveled.

All push-on joint PVC pipe must have dual insertion marks on the spigot indicating proper penetration when the joint is assembled and only one mark remains visible. The sockets and/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 in mating, machined grooves in the pipe and coupling to provide full 360° restraint.

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

3.2.1.7. Fittings. Provide DI, cement lined fittings in accordance with Article 5 of this specification. Provide mechanical joint (MJ) pipe fittings unless otherwise specified.

3.2.1.8. Provisions for Thrust. Provide thrust joint restraint in accordance with Article 5.3 of this specification.

3.2.1.9. Steel Casing Pipe. Encasement pipe must conform to all requirements set forth in ASTM A139 for welded steel pipe, Grade A and be of the diameter and wall thickness as specified on the Plans. Any variation of diameter and wall thickness, as required for various types of carrier pipe, must be approved by the Engineer before installation. Casing spacers must be Raci type or approved equal as shown on the Plans. End seals must be minimum 1/8" thick synthetic rubber with stainless steel bands. Other methods of sealing the end of the encasement pipe must be constructed only upon pre-approval by the Engineer. Carrier pipes must conform to all requirements set forth in this specification and be of the diameter and as specified on the Plans.

3.2.1.10. Underground Utility Locator System.

Tracer Wire: Tracer wire must be 12 gauge minimum solid copper clad steel with minimum 30 mil HDPE thermoplastic insulation recommended for direct burial. Tracer wire will have a minimum break load of 380 pounds. THNN Nylon Thermoplastic insulated solid or stranded copper wire is **NOT** permitted. Tracer wire for open ditch installations must be Copperhead HS-CCS HDPE 30 MIL or approved equal. Tracer wire for boring installations must be Copperhead SoloShot EHS-CCS HDPE 45 MIL or approved equal.

Wire Connectors: Wire connectors will be Copperhead Snakebite, or approved equal, suitable for underground service and must be watertight to provide electrical continuity. Electrical wire nut connectors or taped twisted wire splices are **NOT** permitted.

Fiberglass Utility Markers: Fiberglass utility markers must be Carsonite CRM, or approved equal.

Construction.

- Tracer wire must be installed on all waterlines. The wire must be installed in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.
- Tracer wire must be installed in the same trench and inside bored holes and casing with pipe during installation. It must be secured to the pipe as required to ensure that the wire remains adjacent to the pipe. The tracer wire must be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity and it must be accessible at all tracer wire access points.

- At the point of connection between ductile iron water mains and non-iron water mains, the tracer wire will be properly connected to the ductile iron water main with a cad weld of approved equivalent. Tracer wire welds must be completely sealed through the use of an approved mastic type sealer specifically manufactured for underground use. Mastic will be applied in a thick coat a minimum of 2 in. thick and must be protected from contamination by the backfill material with the use of a plastic membrane.
- Tracer wire must be laid flat and securely affixed to the pipe at 10 ft. intervals at the springline of the pipe. The wire must be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation will be permitted. At water service saddles, the tracer wire will not be allowed to be placed between the saddle and the water main.
- Except for approved splice-in connections, tracer wire should be continuous and without splices from each tracer wire access point.
- At all utility main end caps, a minimum of 6 ft. of tracer wire must be installed beyond the end of the pipe, coiled and secured for future connections.
- Spliced connections between the main line tracer wire and branch connection tracer wire will only be allowed at tees, crosses or at iron or copper services where a portion of the branch connection or service is replaced with a non-iron or non-copper material. The branch connection tracer wire must be a single tracer wire properly connected to the main line tracer wire without cutting the main line tracer wire by means of a Copperhead DryConn Direct Bury Lug or approved equal. Where the existing branch connection is neither iron nor copper, then the new branch connection tracer wire should be properly spliced to the existing tracer wire on the branch connection using approved connectors as noted above.
- Fiberglass utility markers must be installed at all mainline valves, air valves, and flush valves, and at all horizontal bends. Markers will also be placed at each end of all road and railroad crossings. Each marker will have a label in accordance with the plan details.

3.2.1.11. Pipe Trenching, Installation and Backfill. Pipe trenching, installation, and backfill must be in accordance with Article 4 of this specification.

3.2.1.12. 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.

3.2.1.13. **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), (DR 18 C900 RJ), or Uncased Bore.** This Item will be measured in place by the foot of PVC or steel casing pipe 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.

3.4. **Payment.**

3.4.1. **Water Main (PVC) (DR 18 C900), (DR 18 C900 RJ), or Uncased Bore.** 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)(Size)", "Water Main (PVC) (DR 18 C900 RJ)(Size)", or "Uncased Bore(Size)" of the type and size specified. This price is full compensation for furnishing all required materials, including all pipe (including RJ, which is restrained joint), 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, fiberglass markers, tracer wire, 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, or uncased bore (as required and shown) 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.

3.4.2. **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.

3.4.3. **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.

- 3.4.4. **Connect to Existing 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 TO EXISTING WATER MAIN (size of existing water 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; valves and boxes; 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.

- 3.4.5. **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 "CASING (STEEL) (OPEN CUT) (SIZE)" and "CASING (STEEL) (BY DRY BORE) (SIZE)" 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: casing spacers, end seals, 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, equipment, labor and material necessary for installation of dry bore (as shown in plans) where required.

Trench excavation protection will not be paid directly but will be subsidiary to the casing 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. Except as noted, Pipe Trenching, Installation and Backfill for PVC Pressure Pipe will be in accordance with AWWA M-23, C-605, and conforming to "Excavation and Backfill for Structures" Item 400 and details shown on construction plans.
- 4.1.1. **Standard Cover and Location.** Standard cover and location depends on the water main size and installation conditions and is generally
- 6 and 12 in. diameter Main: Minimum of 4-ft. cover from top of pipe to finished grade
 - Crossing under proposed storm sewer: Minimum of 2-ft. cover from top of pipe to bottom of proposed storm sewer.
 - Location and cover with respect to existing and/or proposed sanitary sewer lines must be in accordance with 30 TAC 290.44. (e).
- 4.1.2. **Trench Width.** Provide a minimum trench clear width of 1 ft. greater than the outside diameter of the pipe and a maximum clear width at a point 1 ft. above the top of the pipe equal to the pipe outside diameter plus 2 ft. If the maximum recommended trench width is exceeded or if the pipe is installed in a compacted embankment, compact pipe embedment to a minimum point of 2 1/2 pipe diameters from the side of the pipe or to the trench walls.

4.1.3. 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

4.1.4. Pipe Zone Embedment. Unless otherwise specified or shown on the plans, embed pipelines either Class I, II, or III material defined in this Article 4.1.6 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 Class I 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 4.1.7, and lay pipe to indicated grade.

Place a second lift, and if required, subsequent lifts, of Class I 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 of Class II or Class III material 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.

4.1.5. 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 Tyvar 3401, or approved equal.

4.1.6. 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.

- 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.

- 4.1.7. 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.

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

- 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.

- 4.1.11. **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.

4.2. Measurement

- 4.2.1. **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.
- 4.2.2. **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".
- 4.3. **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, and 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 s.

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.** Provide NRS tapping valves that are resilient seated, 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 Supply Service" and AWWA C-550 "Protective Interior 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. Flange bolts for attachment to tapping sleeve must be stainless steel. Provide NRS Gate Valves of the size specified. Acceptable manufacturers are listed:

- American Darling
- M&H
- US Pipe
- Mueller

Submittals. Provide submittals for approval. Provide records of all tests performed in accordance with Section 5.1 of AWWA Standard C-509 along with an affidavit and certificate of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-509.

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. Valve inlet end will be flanged to match the outlet flange of the tapping sleeve. Valve outlet should be mechanical joint 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 ASTM A-126 Class B Cast Iron, ASTM A-395/A-536 Ductile Iron, or ASTM B-763 Copper Alloy No. C99500. Resilient seats should be bonded or mechanically attached to the gate.

Body- Seating Surfaces. Resilient seats must seal against a corrosion resistant surface. The surface may be either metallic or non-metallic, applied in a manner to withstand the action of the line fluids and the operation the sealing gate during long-term service. The body seating surface must be coated in accordance with 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%. Minimum number of turns to open is three times the valve diameter.

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 seated, 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 Supply Service" and AWWA C-550 "Protective Interior 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 records of all tests performed in accordance with Section 5.1 of AWWA Standard C-509 along with an affidavit and certificate of testing for the valve assembly as outlined in Section 6.3 of AWWA Standard C-509.

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.

Gate. Manufacture in ASTM A-126 Class B Cast Iron, ASTM A-395/A-536 Ductile Iron, or ASTM B-763 Copper Alloy No. C99500. Resilient seats should be bonded or mechanically attached to the gate.

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

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 inch 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.

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

Combination Air Valves (CAV). Provide heavy-duty air and vacuum valves with air release designed to release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled and by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Also design CAV to permit large volumes of air to enter the pipeline during pipeline drainage. Provide CAV that are APCO Model 143C or Engineer approved equal.

Submittals. Provide submittals for approval. Provide manufacturer's affidavit stating that the valve and all materials used in its construction conform to the applicable requirements of AWWA C-512 and these

specifications. When required, the manufacturer should provide an affidavit stating that the valve has been tested and is in compliance with the requirements specified in Section 5.1 of AWWA C-512.

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

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

Float. Provide stainless steel float that is baffled to prevent air from blowing valve closed until air is exhausted. Design valve body, float, etc., for a working pressure equal to that of the system in which it is installed. Floats for valves with inlet sizes less than 4in. must be capable of withstanding a collapse pressure of 1000 psig. For larger inlet sizes, floats must be capable of withstanding a collapse pressure of 750 psig.

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

Installation. Install AR and AV valves within valve vaults, or manhole, in accordance with Utility Standard Details 263-1, 263-2, 263-3, 263-4 and plans.

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

- 5.2.2. **Valve Boxes.** Provide a cast-iron valve box for all underground valves. The boxes should be cast-iron, tow piece screw type with a shaft diameter of not less than 5-1/4 inches and must have the word "WATER" stamped on the lid.

Provide extension stem for all buried valves terminating in a standard 2-in. square AWWA nut within four feet of valve box cover.

The valve box should not transmit shock or stress to the valve and should be centered over the operating nut of the valve. The box cover should be set flush with the surface of the finished area or other such level as directed by the Engineer.

- 5.2.3. **Tapping Sleeves.** Provide stainless steel tapping-sleeve bodies and flanges in accordance with AWWA C-223 "Fabricated Steel and Stainless Steel Tapping Sleeves". The flange must be ASTM A240 Stainless Steel, Type 304, ANSI 150 pound drilling. Gaskets must be full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water service. The tapping sleeve body and all bolts and nuts must be Type 304 stainless steel.

- 5.2.4. **Fittings.** Provide ductile iron (DI) 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/C-153. 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 "Cement-Mortar Lining for Ductile-Iron Pipe and Fittings"

AWWA C-105 "Polyethylene Encasement for Ductile Iron Pipe Systems"

AWWA C-110 "Ductile-Iron and Gray-Iron Fittings"

AWWA C-111 "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings "

AWWA C-153 "Ductile-Iron Compact Fittings"

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
Mechanical (Rubber Gasket/C-111)	30-48 in.	250 psi	DI
Flanged	4-48 in.	250 psi	DI

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

TYPE OF JOINT	DIAMETER	RATED WORKING PRESSURE	MATERIAL
Mechanical (Rubber Gasket/C-111)	4-24 in.	350 psi	DI
Mechanical (Rubber Gasket/C-111)	30-48 in.	250 psi	DI
Flanged	4-48 in.	250 psi	DI

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

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 "Thrust Restraint Design for Ductile Iron Pipe" published by the Ductile 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 A 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. The information in Table 12 is based upon internal test pressure of 100 psi and soil bearing capacity of 1,000 psf. Concrete should not be placed in a manner that interferes with the removal of any joint accessories.

Table 12.
Bearing Surface Per Bend

PIPE SIZE	TEE, DEAD END, 90 DEGREE BEND	45 AND 22-1/2 DEGREE BEND	TEES AND PLUGS
6 In.	6 sq. ft.	3 sq. ft.	3.9375 sq. ft.
8 In.	9.625 sq. ft.	5 sq. ft.	6.5 sq. ft.
10 In.	13.75 sq. ft.	7.5 sq. ft.	10 sq. ft.
12 In.	19.5 sq. ft.	11 sq. ft.	14.625 sq. ft.

Install mechanical joint restrainers as specified that are manufactured by EBAA Iron, 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.

- 5.4. **Construction.**
- 5.4.1. **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.
- 5.4.2. **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.
- 5.4.3. **Fitting Installation.** Polyethylene-wrap fittings in accordance with AWWA C-105, unless otherwise specified. Provide thrust blocking as specified.
- 5.4.4. **Tapping Sleeve and Valve Installation.** Install sleeve so valve is in horizontally level position unless otherwise indicated on the Plans. Clean sleeve and before installation. Make tap with sharp, shell cutter and remove coupon and flush cuttings from newly made tap. Furnish coupon to Engineer upon removal. If asbestos cement (AC) pipe is encountered, notify the Engineer and follow the protocol below in addition to any other regulatory requirements:

- Mechanically excavate no more than 6-in. of AC pipe. Carefully uncover the remainder of the pipe by hand or with shovel
- Keep pipe adequately wet before and during work.
- Locate tap a minimum of 2-ft. away from existing AC collars.
- Use of power tools is prohibited.
- Remove waste AC pipe coupon and dispose of in accordance with all regulatory requirements.

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

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

5.5.4. **Tapping Sleeve and Tapping Valve.** This Item will be measured in place per each installation of the sizes and types shown on the plans.

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 (SIZE)" 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. **Air Release Valves.** The work performed and the materials furnished in accordance with this Item and measured as provided under "AIR RELEASE VALVE" will be paid for individually complete in place. Combination Air Release 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 air release valves shown on the plans to include those required as part of the different pay items, complete in place, including but not limited to: tapping saddle, combination air release valve, 4' diameter concrete manhole with manhole frame and cover, all required valves, piping and fittings, complete in place.

5.6.3. **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.

- 5.6.4. **Tapping Sleeve and Tapping Valve.** The work performed and the materials furnished in accordance with this Item and measured as provided under "TAPPING SLEEVE AND VALVE (SIZE)" will be paid for individually complete in place. Tapping sleeves and tapping 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 tapping sleeves and 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.

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. 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. 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. **Water Service Connections.**

Service Saddles. Provide double strap, epoxy coated, and 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 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 (SIZE)" 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. The City of Nacogdoches will supply all water meters and will program them on site at the time of installation. The Contractor must provide and set a meter box (typical D1200 with an AMR lid). Upon notification, the City will dispatch a crew and assist the Contractor with the meter install and programming for each location.

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 m-94 No. 250 |
| ■ M&H | Model 929 |
| ■ Mueller | Super 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 inch square nut, gaskets and non-kinking chains. Provide operating nut and nozzle cap nuts that have one, 1 inch square at the base and tapered to 7/8 in. square at the end and not less than 1 inch 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 percent 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) feet, 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 8, "Cleaning, Testing, and Disinfection 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 be measured by each fire hydrant salvaged, removed and delivered to Contractor storage yard (on-site) for the City of Nacogdoches to pick-up.

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 ASSEMBLY" 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 paid for at the unit price bid for "REMOVE AND SALVAGE FIRE HYDRANT". 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 fire hydrant, to Contractor storage yard (on-site) for the City of Nacogdoches to pick-up, and all other items not indicated as being covered under the other specific bid items.

8. CLEANING, TESTING, AND DISINFECTION OF WATER SYSTEM

8.1. **Description.** Perform cleaning, filling, flushing, hydrostatic testing, and disinfection of all water mains and related appurtenances. Cleaning, filling, flushing, and hydrostatic testing must be in accordance with AWWA C-605 and disinfection must be in accordance with AWWA C-651.

8.2. **Materials.**

The Contractor will furnish pump, pipe connections and all necessary apparatus (including gauges and meters) to clean, hydrostatically test, and disinfect the water lines in accordance with this specification.

Chlorine for Disinfection. The chlorinating material must conform to the requirements of AWWA Standard C-651 "Disinfecting Water Mains.

Water. Provide water required for filling, flushing and testing the line at such points along the pipeline as water is available from the existing distribution or supply systems. Do not waste water. Such action may require appropriate charges.

8.3. Construction.

8.3.1. Cleaning. After the distribution system is completely installed, with all meter bops, valves, fittings, and fire hydrants, but before installation of meters, the Contractor must ensure that the water line is clean accordance with AWWA C-651. The line should be flushed until the discharge turbidity drops below 5 ntu, using the procedures described in AWWA Manual M12. 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.

8.3.2. Filling and Flushing. After the line has been properly cleaned, it must be filled slowly with potable water at a maximum velocity of 1 ft/sec while venting air. Precautions should be taken to prevent entrapping air in the lines as this will affect testing. After filling, the lines must be flushed at blowoffs, hydrants, and dead ends at a minimum of 3 ft/sec to cause a minimum of three changes of potable water in the water line. Flushing water must be discharged without causing erosion damage, nuisance, or disruption of traffic. Discharge of potable water must comply with the requirements of all regulatory authorities.

8.3.3. Hydrostatic Testing. After the distribution system is completely installed, with all meter bops, valves and fittings, but before installation of meters, a minimum 2 hour hydrostatic test must be conducted in accordance with AWWA C-605 "Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings".

Test Pressure: For PVC pipe conforming to AWWA C900 the test pressure must not be less than 1.25 times the working pressure at the highest elevation along the test section and not less than 1.5 times the working pressure at the lowest elevation of the test section. However, in no case should the test pressure exceed the rated working pressure limit for any joint, thrust restraint, valve, fitting or other connected appurtenance of the test section. Minimum test pressure must be 160 PSI.

Testing Allowance: The testing allowance will be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within ± 5 psi of the specified hydrostatic test pressure. No installation will be accepted if the quantity of makeup water is greater than that determined by the following formula:

$$Q = (LD\sqrt{P})/148,000$$

Where:

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

This formula is based on a testing allowance of 10.5 gal. per day per mile of pipe per inch of nominal diameter at a pressure of 150 psi. The duration of the test will be a minimum of 2 hr.

Any line segment being tested that fails to meet the allowable pressure loss or leakage requirements established herein and by the AWWA C-605 Specification will be rejected. The Contractor must repair any rejected segment, re-disinfect the segment and retest the segment at no additional costs. **The Engineer or approved Engineer's representative will be present during any and all tests.**

- 8.3.4. Disinfection. After the water lines have passed hydrostatic testing, and before acceptance for operation, disinfect each unit of completed water system as prescribed by AWWA Standard C-651.

The Contractor may use any of the four methods of chlorination described in AWWA C-651 (tablet, continuous feed, slug, and spray). The Contractor must submit their proposed method to the Engineer for review before initiating disinfecting procedures. Disinfection of water mains must include disinfection of all fire hydrant leads.

All new mains must be thoroughly disinfected, then flushed and sampled before being placed in service. Samples must be collected for microbiological analysis to check the effectiveness of the disinfection procedure which will be repeated if contamination persists. A minimum of one sample for each 1,000 ft. of complete water line will be required or at the next available sampling point beyond 1,000 ft. as designated by the Engineer. If in the opinion of the Engineer, any segments of the lines are not properly disinfected, the Contractor must properly disinfect the lines to the satisfaction of the Engineer without additional cost.

The environment to which the chlorinated water is to be discharged must be inspected. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent will be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

- 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.