

Special Specification 7178

Water Mains and Service Lines



1. DESCRIPTION

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

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

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

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

2. MATERIALS

All materials used in this project are to be new and unused unless otherwise specified on the plans, specifications or the proposal.

2.1 Concrete:

- 2.1.1 All concrete used must have a minimum compressive strength of 3000 PSI, Class "A" and conform to Item 421 "Hydraulic Cement Concrete".

2.2 Bedding Sand For Encasement:

- 2.2.1 Sand must be granular soil of low plasticity such that 100% pass a #4 sieve and no more than 10% pass a #200 sieve and the PI will not to exceed 6. Soils with a Unified Classification of SW and SP, or AASHTO Classification of A3, and some A2 soils will be required.
- 2.2.2 Bank sand should be free of organic matter, foreign materials and mud balls. Bank sand must have a maximum Plasticity Index of 6 with not more than 10% passing a No. 200 sieve, 100% should pass the No. 4 sieve.
- 2.2.3 Select material should be a mixture of sand and clay or other suitable granular material. The material must be free from vegetation, debris and clay lumps. That portion of the select material passing a 40-mesh sieve must have a liquid limit of 45 maximum, a plasticity index range from 6 to 13, and a calculated linear shrinkage of 8.5 maximum.

2.3 Ductile Iron Pipe and Fittings:

- 2.3.1 General: All ductile iron pipe will conform to AWWA C151. The interior of pipe and fittings must be lined with enameled cement mortar in accordance with AWWA C104. The exterior of pipe and fittings will have a coating of coal tar enamel of approximately 1 mil thick or as specified in A.W.W.A. C-105. Ductile iron pipe must be wrapped in two plys of 8 mil polyethylene in accordance with Section 3.9.

2.3.2 **Fittings:** All fittings will be either gray cast iron or ductile iron and in accordance with AWWA C110 or C153. Fittings must have a pressure rating of 250 p.s.i for sizes through 12" and 150 p.s.i for 14" and larger sizes, unless shown differently on drawings. Unless noted otherwise on drawings, Mechanical Joints must be used.

2.3.3 **Joints:** Joints for pipe must be mechanical type; joints for fittings must be mechanical joints, unless shown otherwise on drawings. Mechanical joints must conform to AWWA C111 and/or C153. Mechanical joints must be furnished complete with joint material, Cor-ten nuts, Cor-ten bolts, glands and gaskets.

When restrained joints are indicated on the drawings, restrained joints for pipe and fittings of 12" diameter and less should be mechanical joint with retainer gland Series 1100 by EBA Iron or approved equal with a minimum of 250 psi rated working pressure. Restrained joints for pipe and fittings over 12" in diameter should be push on type with a retainer ring as LOK-RING by American Ductile Iron Pipe or TR FLEX by U.S. Pipe, or approved equal. Gaskets must be of synthetic rubber. An analysis of the material used in each size gasket showing the type of synthetic rubber and that no natural rubber is present will be supplied.

2.3.4 **Pipe:**

2.3.4.1 Pressure class ductile iron pipe requirements:

Diameter (Inches)	Pressure Class (psi)	Wall Thickness (Inches)	Range of Maximum Allowable Depth Cover	
			feet	feet
			A-B*	
4#	350	0.25	60+	
6	350	0.25	30-65	
8	350	0.25	20-50	
10#	350	0.26	15-45	
12	350	0.28	15-44	
14#	300	0.30	13-42	
16	300	0.32	13-39	
18	300	0.34	13-36	
20	300	0.36	13-35	
24	250	0.37	11-29	
24+	x	x	x	

* Range of maximum allowable depth of pipe where:

A = Ground water, or unstable bottom, or quick condition.

B = Ideal trench conditions, and sand encasement is at an average density in excess of 90% Standard Proctor.

Pipe sizes not typically specified on City projects, but shown for reference.

x Requires special evaluation.

The face of bells must be plainly marked by color coding for classes so as to be readily identified in the field.

2.3.5 **Certifications:** A certification must accompany each order of pipe and fittings furnished to job site. Certification must include the following items: indicate that pipe complies with Part 3 of this specification; indicate that fittings and joints comply with Part 4 of this specification (it should be noted that the supplier should furnish sufficient technical material for the Engineer to determine whether or not push-on joints can comply with the "or equal" clause); and a copy of a lab analysis of the material used in each size gasket showing the type of synthetic rubber and that no natural rubber is present.

2.4 **Polyvinyl Chloride Pipe:**

2.4.1 All PVC pipe must be made of Class 1245-A or Class 1245-B virgin compounds, as defined in ASTM D1784 with an established hydrostatic-design-basis of 4000 psi for water at 73.4° F.

2.4.2 **Dimensions:** Pipe should be manufactured to cast iron pipe equivalent outside diameters.

- 2.4.3 **Joint:** Pipe must have a gasket bell end with a thickened wall section integral with the pipe barrel. The use of solvent weld pipe will not be allowed.
- 2.4.4 **Gaskets:** Gaskets for jointing pipe must be in accordance with ASTM F477. (High Head).
- 2.4.5 **Pipe Pressure Class and Dimension Ratio:** Unless indicated otherwise on the drawings pipe must have a dimension ratio (DR) of 18 and in accordance with:
 Pipe Size Designation
 4" to 12" AWWA C900
 Over 12" AWWA C905
- 2.4.6 **Cause for Rejection:** Pipe should be clearly marked in accordance with AWWA Requirements. Unmarked or scratched pipe must be rejected.
- 2.4.7 **Certification:** The contractor should furnish in duplicate to the Engineer a copy of the manufacturer's affidavit of compliance with this specification, to include gaskets. Certification should accompany each delivery of materials.

2.5 **Water Service Lines:**

- 2.5.1 All service fittings must have a minimum of 150 psi working pressure rating, unless indicated otherwise. Fittings and materials must be in accordance with the applicable provisions of AWWA C-800. All service connections must require service clamps.
- 2.5.2 **Service Clamps** should be brass saddle with two silicone bronze straps with I.P. thread and have a minimum working pressure rating of 200 psi. The saddle and nuts must be of 85-5-5-5 brass alloy per ASTM B-62 and AWWA C800. The Nuts must have unitized washers. Straps will be 5/8" high quality silicone bronze flattened and contoured to provide a wider bearing surface against pipe. Clamps should be comparable to: Ford 202B, Smith Blair 323, Rockwell 323
- 2.5.3 **Corporation Stops** will be of brass with I.P. thread inlet and Muller 110 Compression connection outlet designed for type K copper pipe and be comparable in design to the following: Muller H-15028 for 1" sizes; Muller H-15023 for 12" & 2" sizes
- 2.5.4 **Angle Meter Stops** should have a Teflon coated bronze ball which rotates within two Buna-N rubber seats. Inlet should be packed joint for Type K copper and be comparable in design to the following: Ford BA43-342 for 1" Service Line with 5/8" x 3/4" or 3/4" meter size Brass gate valve req. for 12" and 2" sizes
- 2.5.5 **Service Lines** from service tap to meter must be of type K copper tube. Service line from meter to tie-in house connection should be schedule 40 PVC. Other products of comparable featured and equal quality may be substituted for the above items with approval of the Engineer.

2.6 **Tapping Sleeves and Valves:**

- 2.6.1 All tapping sleeves should have a Class 125 ANSI B16.1 outlet flange of cast iron, ductile iron or stainless steel. Sleeves must be of ductile iron or 304 or 316 stainless steel. Lugs, bolts, washers and nuts should be of 304 or 316 stainless steel. Iron sleeves should be of the mechanical joint or caulked joint type as manufactured by Mueller, Clow, or approved equal. Stainless steel sleeves should be of the compression gasket type capable of providing full support of the tapped pipe, as manufactured by Ford, Smith Blair, Romac, or approved equal. Gasket materials should be of material suitable for potable water systems.

Tapping sleeves must be sized for the type and size of pipe to be tapped. The class of asbestos cement pipe that will most likely be encountered in the water will be Class 200 for pipes 6 in in diameter and smaller, and Class 150 for larger pipes. It should be understood that existing pipes to be tapped may not be of the type of material and/or size that is shown on the drawings. The proper size and type of tapping sleeve should be provided and installed regardless of what is encountered.

Tapping valves must conform to AWWA Standards and Section 2.7.1 "Gate Valves for Waterlines". Valve boxes should be as described in Section 2.7.2 "Cast Iron Valve Boxes".

2.7 Gate Valves for Waterlines:

2.7.1 Gate Valves: All valves must meet the following requirements. Gate valves will conform to AWWA Standard C500 of AWWA Standard C-509 except for changes or additions as follows: (Note: Valves manufactured by the Mueller Co., Eddy-Iowa Division of James B. Clow & Son., Darling Valve & Manufacturing Co., and the Rensselaer Valve Company are acceptable provided they comply with these specifications.)

2.7.1.1 The gate valves should be double disc with parallel or tapered seats (C500) or resilient wedge (C-509) and non-rising stems.

2.7.1.2 Valve ends should be flanged or mechanical joint type or a combination of these as indicated or specified. A complete set of joint materials should be furnished with each valve, except for bell ends and flanges.

2.7.1.3 Valves 16" and larger must be furnished for horizontal installation.

2.7.1.4 May be equipped with stuffing boxes.

2.7.1.5 Valves should open left (counter clockwise). Valves over 18" must have the main valve stem furnished with a combination hand wheel and operating nut.

2.7.1.6 Tapping valves to be used with tapping saddles should have one end mechanical joint.

2.7.1.7 The minimum number of turns to open as applied to the operating nut for valves through 12" must be as set out in Table 3 (AWWA C500) and for valves 16" and larger as follows:

- 16 in - 96 turns to open
- 20 in - 128 turns to open
- 24 in - 152 turns to open
- 30 in - 186 turns to open
- 36 in - 222 turns to open

2.7.1.8 All valves must be equipped with bronze hooks or wedge pins. All valves 16 in in diameter and above must be equipped with bevel gears, bronze rollers, bronze tracks, bronze scrapers and bronze hooks or wedge pins.

2.7.1.9 All gears must be in oil filled extended type gear cases.

2.7.1.10 No position indicator will be required.

2.7.1.11 Bypass valves must be installed on valves 20" in diameter and larger.

2.7.1.12 Within 30 days after award of contract, the Contractor should submit in triplicate, for approval, the following:

1. Certified drawings of each size and type of valve 16" and larger showing principal dimensions, construction details, and materials used.
2. On all size valves, the composition of bronze to be offered for various parts of the valve, complete with minimum tensile strength in psi, the minimum yield strength in psi, and the minimum elongation in 2%.

2.7.2 Cast Iron Valve Boxes: Cast iron valve boxes should be provided over all operating nuts of gate valves 12" and smaller. The word "WATER" will be cast in the top cover. The boxes should be hemispherical in shape and should fit the particular valve size. The boxes and lids should be given a coat of hot tar dip.

Valve boxes must be hemispherical in shape and should measure 10-1/4" at the bottom diameter. The valve box must have 1" wide by 1/2" thick rim around the middle 4" from the top. It shall have a 6" inside diameter bell type top extension with a 7-1/2" by 7-1/8" in tapered bell of 1" in depth. The vertical distance from the bottom of the extension to the top of the bell must be 11" in. The casting should be free of defects with all mold marks and defects ground off. The valve box should have 1 coat of hot tar dip. The extension pipe of the valve box described above should be eight 8" plastic (SDR 35).

2.8 **Fire Hydrants:**

- 2.8.1 **Concrete:** Concrete must have a minimum compressive strength of 3000 psi at 28 days.
- 2.8.2 **Fire Hydrants:** The fire hydrants must conform to AWWA C502-64 standard specifications for fire hydrants for ordinary water works service, except for changes, additions and supplementary details specifically outlined herein: Hydrants should be of the traffic model type equipped with a safety flange or collar on both the hydrant barrel and stem.
- 2.8.3 **Type of Shutoff:** The shutoff should be of the compression type only.
- 2.8.4 **Inlet Connection:** The inlet shall be ASA A-21.11 1964 mechanical joint for six (6") inch, Class 150 ductile iron pipe. A complete set of joint material must be furnished with each hydrant.
- 2.8.5 **Delivery Classifications:** Each hydrant should have two hose nozzles and one pumper nozzle.
- 2.8.6 **Bury Length:** The hydrants will be furnished in the bury length as indicated on drawings.
- 2.8.7 **Diameter (Nominal Inside) of Hose and Pumper Nozzles:** The hose nozzles must be two and one-half (2 1/2") in inside diameter and the pumper nozzle shall be four (4") inches inside diameter.
- 2.8.8 **Hose and Pumper Nozzle Threads:** The hose nozzles must have had two and one-half (2 1/2") inches National Standard thread (7 1/2" threads per in). The pumper nozzle must have size 96) threads per inch with an outside diameter of 4.658 in, pitch diameter of 4.543 in, and a root diameter of 4.406 in.
- 2.8.9 **Nozzle Cap Gaskets:** Required.
- 2.8.10 **Drain Openings:** Required.
- 2.8.11 **Tapping of Drain Opening:** Tapping of the drain opening for pipe threads is not required.
- 2.8.12 **Direction to Open:** The hydrants must open left (counter clockwise).
- 2.8.13 **Color of Finish Above Ground Line:** That portion of the hydrant above the ground line shall be painted chrome yellow.
- 2.8.14 **Shape and Size of Operating and Cap Nuts:** The operating and cap nuts shall be tapered pentagon one and one-fourth (1 1/4") in point to face at base and one and one-eighth (1 1/8") in point to face at top of nut.
- 2.8.15 **Nozzle Cap Chains:** Hydrants shall be furnished without nozzle cap chains.
- 2.8.16 **Size of Fire Hydrant:** The main valve opening should not be less than five and one-quarter (5 1/4") inches inside diameter.
- 2.8.17 **Valve Facing:** The main valve facing of the hydrant should be rubber with 90+ Durometer hardness. When the main valve lower washer and stem nut are not an integral casting then the bottom stem threads must be protected with a bronze cap nut and a bronze lock nut.
- 2.8.18 **Barrel Sections:** The hydrant should be made in two or more barrel sections with flanges connecting the barrel to the elbow and to the packing plate.
- 2.8.19 **Breakable Coupling:** Hydrants will be equipped with a breakable coupling on both the barrel section and the stem. The couplings should be so designed that in case of traffic collision the barrel and stem collar will break before any other part of the hydrant breaks.
- 2.8.20 **Hydrant Adjustment:** The hydrant must be designed as to permit its extension without excavating after the hydrant is completely installed.

- 2.8.21 **Breakable Collars, Barrel and Stem:** Weakened steel or weakened cast iron bolts that are used in the breakable barrel couplings will not be acceptable.
- 2.8.22 **Operating Stem:** Stems that have operating thread located in the waterway should be made of manganese bronze, everdure, or other high quality non-corrodible metal. Stems that do not have operating threads located in the waterway must be sealed by a packing gland or "O" ring seal located between the stem threads and waterway. Iron or steel stems shall be constructed with a bronze sleeve extending through the packing or "O" ring seal area. The sleeve must be of sufficient length to be in the packing gland "O" ring seal in both open and closed positions of the main valve.
- The sleeve must be secured to the steel stem so as to prevent water leakage between the two when subjected to 300lb hydrostatic test pressure.
- 2.8.23 **Drain Valve Mechanism:** Drain valves operating through springs or gravity are not acceptable.
- 2.8.24 **Operating Stem Nut:** The operating stem nut must be designed to prevent seepage or rain, sleet and the accumulation of dust between the operating nut and the hydrant top.
- 2.8.25 **Packing Gland or "O" Ring Seal:** Fire hydrants having the threaded part of the stem at the hydrant top must be equipped with a packing gland or an "O" ring seal immediately below the threaded section of the stem.

2.9 **Waterline Riser Assembly:**

- 2.9.1 Riser Assemblies for 2" water line will consist of (in order):
 2" Straight Coupling Compression Fitting for copper tube with male iron pipe thread and setscrew; Ford C84-77 or approved equal
 2" x 6" Galvanized Nipple
 2" Galvanized 90 Bend
 2" x 3' Galvanized Nipple
 2" Straight Coupling
 2" x 3' Galvanized Nipple
 2" Brass Gate Valve
- 2.9.2 Riser assemblies for 4" and up water line will consist of (in order):
 M. J. Plug or Cap, drilled and tapped (2")
 2" x 6" Galvanized Nipple
 2" Galvanized 90 Bend
 2" x 3' Galvanized Nipple
 2" Straight Coupling
 2" x 3' Galvanized Nipple
 2" Brass Gate Valve

2.10 **Hydrostatic Testing:**

- 2.10.1 Water for filling the line and making tests should be furnished by the Contractor through a standard meter connection. A meter and gauges for testing should be supplied by the Contractor. A test pump with appropriate connector points as approved by the Water Superintendent for the installation of meter and gauge shall be furnished by the Contractor. The meter must be directly connected to the main or pipe being tested by the use of copper tubing or an approved reinforced hose. The meter should be protected against extreme pressures by the use of a one inch (1") safety relief valve set at the test pressure plus ten pounds per square inch and furnished by the Contractor.

3. CONSTRUCTION

3.1 Site Clearing and Striping:

3.1.1 The site must be cleared of all trees, stumps, brush, roots, vegetation, rubbish and other objectionable matter as indicated on the drawings and/or as directed by the Engineer or his designated representative. Tree stumps and roots should be grubbed to a minimum depth of 2 ft below natural ground or 2 ft below base of subgrade, whichever is lower. Areas that underlie compacted backfill must be stripped of all vegetation, humus and other objectionable matter encountered within the top six (6) inches of the soil. All material removed from the site under this operation will become the Contractor's responsibility. The material must be disposed of either at a disposal site indicated on the drawings or at a disposal site obtained by the Contractor.

3.2 Waterlines:

3.2.1 **Handling Materials:** The Contractor will be responsible for the safe storage of all material furnished to, or by him, and accepted by him, until it has been incorporated in the completed project. All material found during the progress of the work to have cracks, flaws or other defects will be rejected, and the Contractor will remove such defective material from the site of work.

3.3 Unloading and Distribution of Materials at Work Site:

3.3.1 Pipe and other materials shall be unloaded at point of delivery, hauled to and distributed at the job site by the Contractor. Materials should at all times be handled with care and in accordance with manufacturer's recommendations. Care must be taken not to scratch PVC pipe. Excessive scratching should be considered cause for rejection of PVC pipe. Materials may be unloaded opposite or near the place where it is to be installed provided that it is to be incorporated into the work within 10 days. The Contractor will not distribute material in such a manner as to cause undue inconvenience to the public.

3.4 Storing Materials:

3.4.1 Materials that are not to be incorporated into the work within 10 days will be stored on platforms. The interior of pipes and accessories will be kept free from dirt and foreign matter.

3.5 Alignment and Grade:

3.5.1 All pipes should be laid and maintained to the required lines and grades. Fittings, valves and hydrants shall be at the required locations with joints centered, spigots home and all valve and hydrant stems plumb.

Temporary support and adequate protection of all underground and surface utility structures encountered in the progress of the work should be furnished by the Contractor. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, connections to sewers or drains, the obstruction should be permanently supported, relocated, removed, or reconstructed by the Contractor at the Contractor's expense, in cooperation with the owners of such utility structures.

3.6 Deviation from Drawings:

3.6.1 No deviation from the line and grade shown on plans may be made without the written consent of the Engineer.

3.7 Depth of Cover:

3.7.1 Depth of cover will be measured from the established street grade or the surface of the permanent improvement, or from finished grade to the top of the pipe barrel. Unless otherwise shown on drawings, the minimum depth of cover must be 36 inches.

3.8 **Trench Excavation and Backfill:**

- 3.8.1 Unless otherwise specified on the plans or permitted by the Engineer, all sewers, pipe, and conduit shall be constructed in open cut trenches with vertical sides. Trenches should be sheathed and braced as necessary throughout the construction period. Sheathing and bracing will be the responsibility of the Contractor and must be performed in accordance with OSHA Standards and Interpretations, 29 CFR 1926, Subpart P, "Expectations". Trenches shall have a maximum width of one foot beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto on each side unless otherwise specified.

The Contractor shall not have more the 200 feet of open trench left behind the trenching operation and no more then 500 feet of ditch behind the ditching machine that is not compacted as required by the plans and specification. No trench or excavation will remain open after working hours. For all utility conduit and sewer pipe to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than one foot above the top of the pipe or conduit after which excavation for the pipe or conduit shall be made.

If quicksand, muck, or similar unstable material develop or is encountered during the excavation, the following procedure shall be used unless other methods are called for on the plans. If the unstable condition is a result of ground water, the Contractor, prior to additional excavation shall control it.

After stable conditions have been achieved, unstable soil should be removed or stabilized to a depth of 2 ft below the bottom of pipe for pipes 2 ft or more in height; and to a depth equal to the height of pipe, 6 inch minimum, for pipe less than 2 ft in height. Such excavation must be carried at least 1 ft beyond the horizontal limits of the structure on all sides.

All unstable soil so removed shall be replaced with suitable stable material, placed in uniform layers of suitable depth as directed by the Engineer, and each layer should be wetted, if necessary, and compacted by mechanical tamping as required to provide a stable condition. For unstable trench conditions requiring outside forms, seals, sheathing, and bracing, any additional excavation and backfill required shall be done at the contractor's expense.

- 3.8.2 **Shaping of Trench Bottom:** The trench bottom must be undercut a minimum depth sufficient to accommodate the class of bedding indicated in the plans and specification.
- 3.8.3. **Dewatering Trench:** Pipe or conduit must not be constructed or laid in a trench in the presence of water. All water must be removed from the trench sufficiently prior to the pipe or conduit planing operation insure a relatively dry (no standing water), firm bed. The trench should be maintained in such dewatered condition until the trench has been backfilled to a height at lease one-foot above the top of pipe. Removal of water may be accomplished by bailing, pumping, or by a well-points installation as conditions warrant. Removal of well-points shall be at rate of 1/3 per 24 hours (every third well-point).
- 3.8.4 **Excavation in Streets:** Excavation in streets, together with the maintenance of traffic where specified, and the restoration of the pavement riding surface shall be in accordance with plan detail, or as required by other applicable specifications.
- 3.8.5 **Removing Old Structures:** When old masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of 1-foot below the bottom of the trench. When old inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new utility, such manholes and inlets shall be removed completely to a depth 1-foot below the bottom of the trench. In each instance, the bottom to the trench shall be restored to grade by backfilling and compacting by the methods provided hereinafter for backfill. Where the trench cuts through storm or sanitary sewers which are known to be

abandoned, these sewers shall be cut flush with sides of the trench and blocked with a concrete plug in a manner satisfactory to the Engineer.

- 3.8.7 **Protection of Utilities:** The Contractor should conduct his work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of water and gas lines. Such lines, if broken, shall be restored promptly by the Contractor. When active sanitary sewer lines are cut in the trenching operations, temporary flumes should be provided across the trench, while open, and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours, or to make other adjustments to utility lines in order that the Contractor may proceed with his work with a minimum of delay. The Contractor should not hold the City or TxDOT liable for any expense due to delay or additional work because of utility adjustments or conflicts.

- 3.8.8 **Excess Excavated Material:** All materials from excavation not required for backfilling the trench shall be removed, by the Contractor, from the job site promptly following the completion of work involved.

- 3.8.9 **Backfill:**

3.8.9.1 **Backfill Procedure Around Pipe:** All trenches and excavation will be backfilled as soon as is practical after the pipes or conduits are properly laid. In addition to the specified pipe bedding material, the backfill around the pipe as applicable, shall be select material as described in Section 2.2.3. The backfill must be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench, in layers not to exceed six (6) inches (loose measurement), wetted if required to obtain proper compaction, and thoroughly compacted by mechanical tampers. A thoroughly compacted material should be in place between the external wall of the pipe and the undisturbed sides of the trench and to a level twelve (12) inches above the top of the pipe.

3.8.9.2 **Backfill Over One Foot Above Pipe:** The backfill for that portion of trench over (1) foot above the pipe or conduit shall be selected excavated material free of hard lumps, rock fragments, or other debris, placed in layers not more than 6 inches in depth (loose measurement), wetted if required and thoroughly compacted by use of mechanical tampers to the natural bank density and not less than 95% Std. Proctor. Flooding of backfill is not allowed. Jetting of backfill will be allowed in sandy soils and in soils otherwise approved by the Engineer. Regardless of backfill method, no lift should exceed six in and the material shall be brought to the wet side of optimum moisture content density and must not be less than 95% Std. Proctor.

A period of not less than twenty-four (24) hr shall lapse between the time of jetting and the placing of the top four (4) ft of backfill.

When indicated on the plans or at utility line crossings that are under pavements, trenches shall be backfilled to the road base with "Hasty Backfill" cement-stabilized sand containing a minimum of 1½ sacks of standard Type I Portland cement per cubic yard of sand.

- 3.10 **Polyethylene Wrapping:** All ductile or cast iron pipe, valve and fittings, except pipe or valves which are laid in encasement pipe or in concrete valve boxes, shall be wrapped in polyethylene.

The polyethylene material should have a thickness of 8 mils and may be either clear or black. The wrapping shall be lapped in such manner that all surfaces of pipe valves and fittings, including joints, shall have a double thickness of polyethylene. If a single longitudinal lap is made, using a double thickness of polyethylene, it shall be lapped a

minimum of 18 in and the lap should be placed in the lower quadrant of the pipe and in such manner that backfill material cannot fall into the lap.

The polyethylene shall be secured in place with binder twine at no more than 6-ft intervals. If wrapping is applied before the pipe placed in the trench, then special care shall be taken in handling the pipe so that the wrapping will not be damaged. Care should also be exercised in backfilling around the pipe and fittings and in blocking fittings so as not to damage the wrapping. Any wrapping that may be damaged must be repaired in a manner satisfactory to the Engineer and so as to form the best protection to the pipes.

- 3.11 **Sand Encasement:** All pipe and fittings that are not enclosed in concrete valve boxes, or laid in encasement pipe shall be completely encased with a minimum of eight inches of sand. This encasement includes the bottom, sides and top of pipe and fittings including bells, so that all portions will be encased with a minimum of eight inches of sand to insulate the pipe from the natural ground and from the backfill. The sand should be compacted to a minimum of 90% Standard Proctor.

Sand should be placed in a manner that will not injure the polyethylene wrapping and shall be compacted under, around the side, and over the pipe in a manner that will reduce settlement to a minimum and as approved by the Engineer.

In order to reduce the amount of sand required, the trench bottom may be excavated in a rounded manner so as to maintain at least a minimum of eight inches of sand between the excavation and the pipe.

Mechanical Tamping: Place bank sand backfill at optimum moisture content in layers not exceeding 12" measured loose. Compact with mechanical tamps to at least 95% Standard Proctor Density or as shown on details on the Plans.

- 3.12 **Lowering Pipe and Accessories in the Trench:** The trench shall be excavated true and parallel to the pipe center line with a minimum clearance of eight inches below the pipe bottom and with a like clearance from the bottom of the bell to the bottom of the bell hole. The trench will then be refilled to the proper grade with sand as specified. The placing of the encasing material must be done in such a manner so as to be free of all natural soil rock or other foreign matter.

After final grading in the trench of the encasing material, bell holes should be excavated at each joint.

Proper implements, tools and facilities satisfactory to the Engineer should be provided and used by the Contractor for the safe and efficient execution of the work.

All pipe, fittings, valves, hydrants and accessories shall be carefully lowered into the trench by means of a derrick, ropes, or other suitable equipment, in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Inspection of Pipe and Accessories: The pipe and accessories must be inspected for defects prior to lowering in the trench. Any defective damage or unsound pipe shall be replaced.

Clean Pipe: All foreign matter, or dirt, should be removed from the interior of the pipe prior to lowering into the trench. Pipe should be kept clean both in and out of the trench at all times during the laying.

- 3.13 **Joining Pipes:** All pipes must be made up in accordance with manufacturer's recommendation. Pipe deflection shall not exceed 75% of the maximum amount recommended by the manufacturer.

- 3.14 **Temporary Concrete Thrust Blocks:** Temporary thrust blocks, or other means of carrying thrust loads generated by hydrostatic testing shall be provided at all ends of lines to be tested. Details of the end connections and method of temporary blocking

shall be submitted to the Engineer for approval. After satisfactory completion of the hydrostatic test, this temporary blocking must be removed so that connections may be made with existing lines. This work is subsidiary to waterline installation and no separate payment will be made for it.

- 3.15 **Metal Harness:** Metal harness, tie rods and clamps, or swivel fittings will be used to prevent movement when soil conditions would not withstand thrust blocking. Steel rods and clamps should be galvanized, or otherwise rust proofed or coated with hot coal tar enamel, then wrapped with two layers of polyethylene wrapping.
- 3.16 **Sterilization:**
- 3.16.1 **Fittings:** Valves, hydrants and fittings must be stored on timbers and kept clean. Where soil or other substance has come in contact with the water surfaces of the fittings, the interior shall be washed and sterilized with 2% solution of calcium hypochlorite.
- 3.16.2 **Pipe:** As each joint of pipe is laid, the Contractor, unless otherwise specified by the Engineer, must throw powdered calcium hypochlorite (70%) through the length of the joint (One pound for each 1,680 gallons of water to give 50 ppm). When the line is complete, and before testing, same shall be slowly filled with water between valves and allowed to stand for 48 hours. After sterilization period is completed, lines shall be flushed by the Contractor under the direct supervision of a representative of the City. The City will take same test two hours after refilling. If the sample does not pass State Health Department purification standards, the procedure shall be repeated. The entire procedure should be coordinated under the supervision of the City.
- During sterilization process, valves will be operated only under the supervision of the City. There should be a base fee of \$100 paid by the Contractor to the City for each retest that is required.
- 3.17 **Fire Hydrant:**
- 3.17.1 **Fire hydrants** shall be installed as shown on drawings. Minimum burial length shall be 3 feet. Breakable couplings shall be located at least 2 inches and less than 6 inches above finish grade.
- Hydrants and fittings shall be stored on timber and kept clean. The interior surfaces of hydrants and fittings shall be washed and sterilized with approved sterilized agent, if requested by the Engineer at time of installation.
- 3.17.2 **Certification:** The manufacturer must furnish to the Engineer two (2) certified sets of prints showing complete details and dimensions of the hydrant.
- The manufacturer must furnish to the Engineer one (1) certified copy of the physical tests of all metals used in the manufacture of the fire hydrant that is normally manufactured and that will meet these specifications.
- 3.18 **Water Service Lines:** Service lined shall be placed by the Contractor as indicated on the drawing and as directed by the Engineer.
- 3.19 **Cast Iron Valve Boxes:** Valve boxes must be installed as indicated on the drawings. When valves are in the street ROW, the top box should be set flush with the pavement or surrounding ground. In cultivated areas, the top of box shall be set 12" below natural ground and long enough to be raised to natural ground at a future date.
- 3.20 **Waterline Riser Assembly:** The Contractor should install riser assemblies on each end of water lines to be tested. Note that this includes all 2" service connections. The assembly must be wrapped in polyethylene, and concrete thrust blocking shall be applied at the base.

After the line is tested and ready for connection to the existing water system, the Contractor shall remove the riser assembly. The riser assemblies will remain the property of the Contractor.

3.21 Hydrostatic Testing:

3.21.1 **Test Procedure:** Tests must be made only after completion of backfill as specified, and not until at least thirty-six (36) hours after the last concrete thrust block has been cast.

Each section of pipeline should be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied. During the filling of the pipe, and before applying the specified test pressure, all air shall be expelled from the pipeline.

During the test, all exposed pipe, fittings, valves, hydrants, and joints will be carefully examined. If found to be leaking, they shall be corrected immediately by the Contractor. If the leaking is due to cracked or defective material, the defective material must be removed and replaced by the Contractor with sound material.

All pipes shall be subjected to two hydrostatic tests. The first hydrostatic test should be a two-hour test at a pressure of 120 P.S.I. Hydrostatic test pressures and durations shall be as indicated on the plans. The maximum allowable leakage shall be as follows:

Ductile Iron Pipe, AWWA C600 N/A

$$L = \frac{SD\sqrt{P}}{133,200} \quad \text{or} \quad L = \frac{ND\sqrt{P}}{7,400}$$

Asbestos - Cement Pipe, AWWA C603 N/A

$$L = \frac{ND\sqrt{P}}{4,000}$$

PVC Pipe - Uni-bell equation 99

$$L = \frac{ND\sqrt{P}}{7,400}$$

WHERE

L = Maximum Allowable Leakage (Gal./Hr.)

S = Length of Pipe Tested (Feet)

N = Number of Joints in Tested Line (Pipe & Fittings)

D = Nominal Diameter of Pipe (In.)

P = Average Test Pressure (P.S.I.)

If the pressure system fails to meet the leakage requirements, the Contractor must make the required repairs to the system and the system should be retested. This procedure must be repeated until the system complies with leakage requirements.

4. MEASUREMENT

"Bank Sand Bedding and Backfill" will not be measured for payment but is to be considered subsidiary to the items for which it is required.

"Site Clearing and Grubbing" will be measured by lump sum if item is required.

This Item will be measured as follows: "Pipe Water Main (PVC)," "Pipe Water Main (PVC Casing) (Open Cut)," and "Pipe Water Main (Steel Casing) (Open Cut)" for water pipe of the various sizes shown on the

plans, will be measured by the linear foot as follows: From the centerline intersection of runs and branches of tees to the end of the valve of a dead-end run.

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

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

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

"Gate Valve and Box (Complete)" will be measured as each assembly of the various sizes installed to finished grade.

"Tapping Sleeve, Valve and Box (Complete)" will be measured as each assembly of the various sizes installed.

"Cut-in Tee (Complete)" will be measured as each assembly of the various sizes of cast-iron tees cut-in to the existing water main.

"Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars" for pipe and reinforcing if required will not be measured for payment but considered subsidiary to the bid item in which it is needed for.

"Fire Hydrant with 6 in. Valve and Box" will be measured as each fire hydrant installed. Also included will be sufficient pipe, valve and fittings.

"Trench Excavation Protection" and "Joint Trench Excavation Protection" will be measured by the linear foot along the centerline of trench.

"Tie-In (Complete)" will be measured as each of the various sizes and types completed.

"Service Section" will be measured as each of the various sizes and types of new service lines installed.

"Full Depth Pavement Repair" will be measured by the square yard of surface area of the asphalt pavement cut and replaced, but not to exceed the minimum trench width and in accordance with Item 351.

"Hydrostatic Pressure Test" will not be measured for payment, but is to be considered subsidiary to the various related bid items.

"Excavation" will not be measured for payment, but is to be considered subsidiary to items for which the excavation is required.

"Installation of the Nonmetallic Pipe Detection System" will not be measured for payment, but is to be considered subsidiary to the pipe installation.

"Ductile Iron and Gray Iron Fittings" will be measured as each assembly of the various sizes of fittings installed.

"Ductile Iron Fitting-Tee" will be measured as each assembly of the various sizes of fittings installed.

"Ductile Iron Fitting-45 degree bend" will be measured as each assembly of the various sizes of fittings installed.

"Ductile Iron Fitting-22.5 degree bend" will be measured as each assembly of the various sizes of fittings installed.

"Ductile Iron Fitting-Cap" will be measured as each assembly of the various sizes of fittings installed

5. PAYMENT

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

Payment for "Pipe Water Main (DI)", "Pipe Water Main (PVC)", "Pipe Water Main (PVC Casing) (Open Cut)", and "Pipe Water Main (Steel Casing) (Open Cut)" will be made at the unit price bid per foot of pipe of the various sizes installed by the open cut method. This payment is also to include selected bedding, excavation, backfill materials (except for cement stabilized backfill), polyethylene sleeve, and hauling and disposition of surplus excavated materials.

Casings or liners used in bores or tunnels will be paid for at the contract unit price bid for "Casing or Liner for Jacking, Boring or Tunneling" per linear foot of casing or liner installed and measured as prescribed above.

Payment for "Gate Valve and Box (Complete)" and "Tapping Sleeve, Valve and Box (Complete)" will be made at the unit price bid for each such assembly of the various sizes installed.

This payment is also to include but not be limited to, furnishing and installing the valves complete in place including joint materials, cast iron valve box, box extension, cover, concrete collar, and all other related item such as bottling, wrapping, cement stabilized sand encasing, backfilling and compacting; and shall be full compensation for all labor, material, tolls, equipment and incidentals required to properly install the valves as indicated and specified selected embedment material, anti-corrosion embedment when specified, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast-iron boot, packing, tarpaper, concrete grout, concrete reaction blocking, asphaltic material for bolts, nuts and ferrous surfaces, polyethylene sleeve, hauling and disposition of excavated surplus material and backfill where required. For butterfly valves only, such payment is also to include mechanical or transition couplings, and coated and wrapped steel pipe nipples required to complete the connection.

Payment for "Cut-in Gate Valve and Box (Complete)" will be made at the unit price bid for each such assembly of the various sizes installed. This payment is to include backfill, installation of valve, valve box assembly, all pipe cut and used to complete cut-in, reaction blocking, and polyethylene sleeve where required.

Payment for "Cut-in Tee (Complete)" will be made at the unit price bid for each of the various sizes of cast iron tees cut-in to ductile and cast iron mains. This payment is also to include necessary tie-ins, protective coating for bolts, nuts, ferrous surfaces, selected embedment material, anti-corrosion embedment when specified, backfill, pipe, fittings, polyethylene sleeve when required, concrete reaction blocking, and site restoration.

Payment for "Fire Hydrant Connection with 6 in Valve and Box" will be made at the unit prices bid for each such assemblies installed. These payments are to include backfill, selected material, anti-corrosion embedment when specified, branch line pipe, fittings exclusive of the tee from the main line pipe, polyethylene sleeve.

Payment for "Gray Iron Fittings" and "Ductile Iron Fittings" will be made at the unit price bid for each fitting of all sizes and types installed. Such payment will also include excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking.

Payment for "Ductile Iron Fitting - Tee" will be made at the unit price bid for each fitting of all sizes and types installed. Such payment will also include excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking.

Payment for "Ductile Iron Fitting -45 degree bend" will be made at the unit price bid for each fitting of all sizes and types installed. Such payment will also include excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve,

asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking.

Payment for "Ductile Iron Fitting -22.5 degree bend" will be made at the unit price bid for each fitting of all sizes and types installed. Such payment will also include excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking.

Payment for "Ductile Iron Fitting - Cap" will be made at the unit price bid for each fitting of all sizes and types installed. Such payment will also include excavation, selected embedment material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, polyethylene sleeve, asphaltic material for ferrous surfaces, all glands, nuts, bolts, gaskets and concrete reaction and thrust blocking.

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

Payment for "Tie-In (Complete)" will be made at the unit price bid for each tie-in of the various sizes and types completed. This payment is to include shutdown and isolation of the existing main to which the tie is to be made, cutting pipe for connection, de-watering the excavation, and customer notification of service interruption where required. Connections between new and existing mains which are made with tapping sleeves and valves by cutting-in tees will be as a no-separate pay item.

Payment for "Connection Service" will be made at the unit price bid for each new service line of the various sizes and types installed. This payment is to include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and Customer valve. Such payment will also include excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type fittings of the various sizes used in the service line relay and copper tubing or ductile iron pipe (4 in. and larger).

No direct payment will be made for "Hydrostatic Pressure Test". Such test includes all materials and equipment required to conduct the test. This work and materials will be considered subsidiary to the various related bid items.

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

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

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

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