

City of Lawrence
Construction and Material Specifications
Section 2900 – Waterlines

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SECTION 2901 GENERAL

- 2901.1 Description: Waterline construction shall consist of furnishing all labor, materials and equipment for the complete installation of pipelines and appurtenances in accordance with the contract documents, standard drawings, approved shop drawings, General Provisions and these specifications. These specifications govern materials for water mains having a diameter of two inches (50 mm) through 12 inches (300 mm).
- 2901.2 Specification Modifications: It is understood that throughout this section these Specifications may be modified by appropriate items in the Special Project Specifications or notes on the Contract Drawings.
- 2901.3 Revisions of Standards: When reference is made to a Standard Specification i.e. ASTM, ANSI, AWWA, MCIB the Specification referred to shall be understood to mean the latest revision of said specification as amended at the time of the Notice to Bidders, except as noted on the Plans or in the Special Project Specifications. The City may, at its option, update and revise these specifications periodically in response to changing technology and construction methodologies.
- 2901.4 Definitions: “Engineer” shall mean the Utilities Engineer or Utilities Engineer’s representative. “Design Engineer” shall mean the licensed individual or firm who developed, sealed, and signed the improvement plans. “Contractor” shall mean any employee, agent or subcontractor of the construction company responsible for completing the work. “Inspector” shall mean the City of Lawrence Utilities Department inspector assigned to the project or authorized representative thereof. “Special Project Specifications” shall mean specifications modified due to special or unusual project conditions identified by the Design Engineer that warrant deviation from the City of Lawrence Construction and Material Specifications Section 2900 – Waterlines, current edition.
- 2901.5 Contractor’s Warranty: During a period of one year from the date of final acceptance by the City, the Contractor is responsible for making any necessary repairs arising out of defective workmanship or materials. This includes, but is not limited to, trench settlement of water lines constructed as part of this project. The Contractor is responsible for repairing all trench settlement including removing and replacing sidewalks, streets, driveways, and entrance walks constructed since the project was accepted by the City. Representatives from the City and the Contractor shall conduct an inspection of this project 11 months after the project has been accepted by the City to determine what repairs need to be made.

SECTION 2902 MATERIALS

2902.1 Scope: This section governs materials that may be required to complete pipeline construction as shown on the Plans and/or as provided for in the Special Project Specifications.

1. Requirements: Furnish pipe of materials, joint types, sizes, and strength classes indicated or specified. Higher strengths may be furnished at the Contractor's option at no additional cost to the project.
2. Manufacturer: The manufacturer shall be experienced in the design, manufacture and commercial supplying of the specific material.
3. Inspection and Testing: Inspection and testing shall be performed by the Manufacturer's quality control personnel in conformance with applicable standards. Testing may be witnessed by Design Engineer, Engineer or approved independent testing laboratory. The Contractor shall provide one (1) copy of certified test reports indicating the materials conform to the specifications to the Inspector.
4. Handling: Handling of materials used in pipeline construction shall conform with section 2903.2 of these specifications. Damage to materials that cause reasonable doubt as to their structural strength or water-tightness will cause that material to be rejected.

2902.2 Pipe and Fittings:

1. Ductile Iron Pipe and Fittings: Unless indicated otherwise on the plans all ductile iron pipe shall be Class 50 conforming to ANSI A21.51, AWWA C151, ASTM A536, and shall be of Grade 64-42-10.

All ductile iron fittings shall be mechanical joint fittings, class 350, meeting all applicable requirements of ANSI A21.10 and A21.11 and AWWA C153 and C111. Fittings shall be supplied with all necessary appurtenances to accomplish installation as shown on the plans. All fittings to be provided with stainless steel grade 304 or better nuts, bolts, and washers.

- a. Joints: Unless otherwise specified, shall be of the push-on type conforming to ANSI A21.11/AWWA C111, except gaskets shall be neoprene or synthetic rubber. Natural rubber gaskets will not be acceptable. Mechanical joints shall conform to ANSI A21.11. Restrained joints shall be Griffin Snap-Lok or approved equal.
- b. Lining: All ductile iron pipe shall be cement mortar lined, conforming to ANSI A21.4 and AWWA C104. All ductile iron fittings shall be lined with a fusion bonded epoxy conforming to ANSI 21.16 and AWWA C116.

2. Coating: All ductile iron pipe shall be bituminous coated per AWWA C151. All ductile iron fittings shall be shop coated with a fusion bonded epoxy inside and outside conforming to ANSI A21.16 and AWWA C116. Anchor couplings shall be shop coated with asphalt varnish tar.
3. Polyvinyl Chloride Pipe (PVC) and Fittings: PVC shall meet the requirements of ASTM D1784, cell classification 12454-B, for PVC compounds, and AWWA C900 with cast iron pipe O.D., for PVC pipe. Materials from which the pipe is manufactured shall have been tested and approved for conveying potable water by the National Sanitation Foundation. The NSF stamp of approval shall appear on the pipe. PVC pipe shall be blue in color and pressured rated at 200 psi with a dimension ratio (D.R.) of 14 as defined in AWWA C900.

All fittings shall be ductile iron and shall be mechanical joint fittings, class 350, meeting all applicable requirements of ANSI A21.10 and A21.11 and AWWA C153 and C111. Fittings shall be supplied with all necessary appurtenances to accomplish installation as shown on the plans. All fittings to be provided with stainless steel grade 304 or better nuts, bolts, and washers.

- a. Joints: Joints for PVC pipe shall be slip on type with integral bell and spigot pipe, or pipe with extruded type couplings, meeting the requirements of ASTM D3139, except flexible elastomeric gaskets meeting the requirements of ASTM F477, shall be synthetic rubber. Natural rubber will not be acceptable. Restrained joints shall be Certa-Lok or approved equal.
 - b. Lining: All ductile iron fittings shall be lined in conformance with Section 2902.2.1.b of these specifications.
 - c. Coating: All ductile iron fittings shall be coated in conformance with Section 2902.2.1.c of these specifications.
4. Copper Pipe: Copper pipe and brass fittings shall be American made Type “K” soft copper, unless rigid is required, and shall be supplied in accordance with ASTM Specification B-88-62.
 5. Polyethylene Tubing: Polyethylene Tubing for service connections sizes ½” to 2” shall be of cell classification PE 3608, a minimum of SDR-9 and shall conform to all applicable requirements of AWWA C901

2902.3 Valves and Valve Boxes:

1. Gate Valves: The type, size and location of valves shall be as shown on the Plans. All gate valves 3 inch and larger in pipe lines, except as modified herein, shall be 200 psi, ductile iron body, gate valves with non-rising stems. Gate valves shall be resilient seated conforming with all applicable requirements of AWWA C515. All gate valves shall have stainless steel grade 304 or greater nuts, bolts, and washers.

All 2 inch and smaller valves shall be ball valve type brass curb stops and shall conform to the requirements of Section 2902.3.4 of these specifications.

2. Butterfly Valves: All butterfly valves 4" and larger shall be Henry Pratt Groundhog Buried Rubber Seated Butterfly Valve or approved equal. All butterfly valves shall conform to AWWA C504 and be rubber seated.
3. Hose Valves: Hose valves shall be Nibco No. 63 or Tanner No. 906.
4. Curb Stops: Curb stops shall be brass, ball valve type with a T-head for operation. End connections shall be either iron pipe threads or compression type depending upon application and with the approval of the Engineer or authorized representative. Curb stops shall be Ford Meter Box Company, Inc. ball valve curb stop.
5. Corporation Stops: Corporation stops shall be brass construction, tee head type Ford FB-1000. All corporation stops shall be furnished with AWWA taper thread on inlets.
6. Valve Ends: Valve ends shall be of the mechanical joint type, conforming to ANSI A21.11/AWWA C111 except where flanged ends are required on the plans.

The end flanges of flanged gate valves shall conform in dimensions and drilling to ANSI B16.10 for cast-iron flanges and flanged fittings, Class 125, unless explicitly provided otherwise on the Plans and Special Project Specifications. The laying lengths of the flanged valves shall conform to the dimensions of ANSI B16.10.

7. Bonnet Thrust Plates: The bonnet shall have a removable thrust plate to permit the removal and replacement of the valve stem and "O" ring seal while the valve is in service.
8. Tapping Valves: The size and location of the tapping valves shall be as shown on the plans. The valves shall be 200 psi, ductile iron body, resilient seat gate valves with non-rising stems conforming with all applicable requirements of ANSI/AWWA C515 except that the outlet end shall be standard mechanical joint end conforming to ANSI A21.11/AWWA C111 and the inlet shall have a raised male face, conforming to MSS-SP60, to ensure true alignment of valve and tapping sleeve.

9. Stem Seals and Coatings:
 - a. All valves shall be provided with stem seals of the “O” ring type. Two “O” rings shall be used with at least one “O” ring inserted above the thrust collar. The packing plate shall be attached to the valve bonnet by not less than two (2) bolts and one “O” ring below the thrust collar.
 - b. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop coated with a fusion bonded epoxy for corrosion protection. The valve manufacturer’s standard epoxy coating will be acceptable.
10. Valve Operation: All valves shall be equipped with a 2 inch square wrench nut and the direction of rotation to open the valve shall be counterclockwise. Each valve body shall have the word “OPEN” and an arrow indicating the direction to open the valve cast thereon. Wrench nuts shall comply with AWWA C515.
11. Extension Stems: When the distance from the top of the valve cover to the valve operating nut exceeds 3 feet, an extension stem to bring the valve stem to within 3 feet of the top of the valve cover shall be provided.
12. Valve Boxes, Lids and Covers: All valve boxes, lids, and covers shall be coated in bituminous varnish.
 - a. Valve Boxes: All buried valves shall be provided with valve boxes.
 1. Valve box shall be cast iron screw type within paved areas.
 2. Valve box shall be 6” IPS SDR-26 PVC cut to depth required in turf areas.
 3. All valve boxes shall be set plumb and placed directly over the valve it serves.
 - b. Lids and Covers:
 1. Lid and cover shall be Clay and Bailey #2194 or Star Pipe Products VB-0045 for turf areas.
 2. All lids shall have “Water” cast in the lid.
 3. All lids shall be flush with finished grade.
 - c. Valve box adapters:
 1. Valve box adapters shall be Clay and Bailey #P-1080 with drop type lid or approved equal.

2902.4 Fire Hydrants:

1. General: Fire hydrants shall be open right, dry barrel, standard compression, two-piece standpipe, break-away design conforming to AWWA C502 and shall comply with the following:
 - a. Fire hydrants shall be supplied with one 4 ½” pumper nozzle, two 2 ½” hose nozzles, 5 ¼” minimum mechanical valve opening with bronze to bronze seating.
 - b. Hydrant shall be equipped with a 6” mechanical joint shoe connection with all joint accessories furnished.
 - c. Hydrant shoe shall be epoxy coated internally and externally and all below grade bolts except those on the mechanical joint shoe connection shall be stainless steel.
 - d. Hydrants shall be Waterous WB-67, U.S or Mueller “Super Centurion”, or AVK Model 2700 or 2780with traffic safety flanges.
2. Fire hydrants shall be painted Federal Safety Yellow to the ground line.
3. Nut Dimensions: Operating stem and nozzle cap nuts shall be 1 ½” point to flat pentagon.
4. Nozzle Threads and Caps: Hydrant nozzles shall meet NFPA standard thread requirements. All hydrant threads shall be oil lubricated by means of an oil reservoir.

2902.5 Specials

1. General: Vaults which, by their special nature, must be cast in place shall conform to the plans and concrete specifications in Section 2902.8.
2. Pressure Reducing Valves: Pressure reducing valves shall be designed to provide tight shutoff under conditions of no flow and shall not “hunt” under ordinary flow conditions. Pressure reducing valves shall be installed as shown on the Plans, and selected and sized as recommended by the valve manufacturer. Pressure reducing valves shall be as suitable for operation under the pressure and flow conditions as shown on the Plans.
3. Air Release Valves: Air release valves shall be installed at the locations indicated on the Plans. Valves shall be designed for a working pressure of 125 psi and shall have floats and all working parts constructed of stainless steel, or other non-corroding material. Each valve assembly shall be installed complete with all appurtenant piping as shown on the Standard Drawings and shall be APCO No. 200 or approved equal. Orifice size shall be determined by the manufacturer with a 3/16” diameter, minimum.

4. Check Valves: Check valves in air release piping shall be wafer style designed for installation between two pipe flanges and shall be Center Line “Center Check” or Mission “Style B Duo-Check Fig. 12 HMP” Each check valve shall conform to AWWA C550, have a ductile iron body per ASTM A536, stainless steel plates, stainless steel springs, and standard trim materials for IBBM construction. The coating shall be electrostatically applied fusion bonded epoxy.
5. Blow-Off Assemblies: Blow-off assemblies shall be installed at the locations indicated on the Plans. Blow-off assemblies shall be installed with all appurtenant piping, valves, etc. as indicated on the Plans and/or Standard Drawings. All piping shall be 2 inch diameter brass or galvanized steel as indicated on the Standard Drawings.
6. Tapping Saddles:
 - a. Tapping saddles used on PVC pipe for 2 inch and smaller services shall be solid brass Ford S-90 series or Mueller H-13000 series.
 - b. Tapping saddles used on ductile iron pipe for 2 inch and smaller services shall be solid brass Ford 202B double strap series or Mueller BR2B series.
 - c. All tapping saddles shall be furnished with AWWA threads.
7. Tapping Sleeves: Tapping sleeve body, flange, bolts, and nuts shall be grade 304 stainless steel. Tapping sleeves shall be either mechanical joint or flanged for a true tapping valve per MSS-SP60 and shall be provided with a complete full circle rubber gasket permanently attached to the body.
 - a. Size on size tapping will not be permitted for mechanical joint tapping sleeves.
 - b. All tapping sleeves shall have a ¾” NPT test plug for pressure testing and be capable of withstanding a working pressure of 150 psi.
 - c. Tapping sleeves shall be Ford FAST, Romac SST, Powerseal 3480, Powerseal 3480MJ, JCM 432, JCM 439, or Mueller H304SS.

8. Meter Assembly: Meter assemblies shall be removed, reset, reconnected, or replaced as shown on the Plans.
 - a. Meter Setter: Meter setter shall be Ford VB-81W for 5/8" meters, Ford VB-84W for 1" meters, VBH76-18-44-66 for 1 1/2" meters, and VBH77-18-44-77 for 2" meters. Vertical brace eye shall be specified for 1" and smaller meter setters when polyethylene tubing (PE pipe) is specified for use
 - b. Meters larger than 2" shall require individual vault designs. The Design Engineer shall submit plans for the vault design to the Engineer for review and approval on a case by case basis.
 - c. Meter Box: Contractor shall furnish and install 18"x30" meter boxes for 3/4" services, 20"x30" meter boxes for 1" services, and 36"x42" meter boxes for 1 1/2" and 2" services. 18" meter boxes shall be ADS 1805AAH (30" cut length) 18050012H (12' uncut length) or Hancor MP-NL1-18-002 (30" cut length) MP-PL1-18-012 (12' uncut length). 20" meter boxes shall be Oldcastle 00202013. 36" meter boxes shall be corrugated galvanized steel pipe, ADS or Hancor N-12 HDPE pipe, or Contech A2000 PVC.
 - d. Meter Box Covers: The Contractor shall furnish and install a meter box cover as specified on the Plans. Meter box covers shall be as follows:

<u>Condition</u>	<u>Meter Pit Size</u>	<u>Meter Box Cover</u>
Unpaved Area	18-inch	Ford C-32
	20-inch	Ford C-53
	36-inch	Ford MC-36
Paved Area	18-inch	Ford A-32
	20-inch	Ford A-53
	36-inch	Ford MC-36H

9. Service Line Fittings: Service line fittings shall be Ford Meter Box Company, Inc. CTS pack joint fittings. Insert stiffeners for polyethylene tubing (PE pipe) shall be Ford Meter Box Company, Inc. 50 series.

2902.6 Bedding Material:

1. Pipe Embedment: Embedment for pipe shall be in accordance with these specifications.
 - a. Pipe embedment shall be sand both above and below the pipe. Sand embedment shall be a minimum of 6 inches and a maximum of 12 inches both above and below the pipe. Trench width shall conform to the Standard Drawings and Section 2903.1.12 of these specifications.

2902.7 Location Wire and Tape: Location wire and marking tape shall be buried above all waterlines in accordance with the following:

1. Location Wire:
 - a. Location wire shall be installed to enable the detection of all plastic, ductile iron, and copper pipe. Location wire shall be No. 12 THHN annealed soft copper wire (solid) with blue thermal plastic insulation for open trench installations or No. 12 copper clad steel (CCS), minimum break load of 1150 lbs. with blue 45 mil HDPE jacket for directional drill installation.
 - b. The location wire shall be placed no further than 6 inches to the side or above the waterline.
 - c. The location wire shall be accessible at valve box test stations at least every 500 feet. The location wire shall be installed on the outside of the valve box with a 3/16" hole drilled three inches from the top of the valve box for the location wire to pass through.
 - d. Splicing of location wire shall be accomplished by the use of Copperhead Industries LLC Locking SnakeBite Wire Connector.
 - e. Anodes shall be one pound bare magnesium or zinc. Anodes shall be placed at the beginning and end of the waterline and at every valve box test station and/or at least every 500 feet.
2. Marking Tape:
 - a. Underground marker tape shall be installed 18 inches above plastic or ductile iron pipe.
 - b. The marking tape shall be at least 3 inches in width, blue in color, and shall have black lettering stating "Caution Buried Waterline Below". Lettering shall be printed on the tape at 20 to 30 inch intervals.

2902.8 Concrete: All concrete shall conform to the requirements of the City of Lawrence Technical Specifications Section 2000, Concrete.

2902.9 Flowable Mortar: All flowable mortar shall conform to the requirements of the City of Lawrence Technical Specifications Section 1100, Grading.

2902.10 Casing Pipe: Casing pipe for bored, jacked or open cut construction shall be steel pipe conforming to ASTM A 139 with a minimum diameter as shown on the Plans.

1. Minimum wall thickness shall be in accordance with the following table:

Diameter of Casing - Inches	Nominal Wall Thickness - Inches	
	Under Railroads	All other Uses
14 and under	0.188	0.188
16	0.281	0.188
18	0.312	0.250
20	0.344	0.250
24	0.375	0.281

2. Steel shall be a minimum of Grade A unless a higher standard is required by the responsible agency.
3. Steel pipe shall have welded joints in accordance with AWWA C 206.
4. Casing Spacers shall be CCI stainless steel casing spacers or approved equal.
5. The end seals shall be Advance Products & Systems (APS) model AW or approved equal.
6. The annular space between lining and carrier pipe shall be not be filled.
7. Cathodic and corrosion protection shall be provided for all casing conduits. One 32 lb sacrificial anode package per 100 feet of casing pipe shall be provided at each end of the casing. Sacrificial, magnesium anodes shall be attached to the encasement pipe by a #12 A.W.G. grounding wire at each end of the casing. For casing pipes less than 100 feet in length sacrificial anodes shall be provided at a rate of 0.50lb/ft of casing with a minimum anode size of 5 lbs. required.

SECTION 2903 CONSTRUCTION DETAILS

2903.1 Grading and Excavation:

1. Scope: Excavation and trenching work shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary of required; protection of adjacent property; and other appurtenant work.
2. General: The terms “excavation” and “trenching” shall mean the removal and subsequent handling of all material required to perform the work.
 - a. All pipeline excavation work shall be accomplished under supervision of a person experienced with the materials and procedures, which will provide protection to existing improvements, including utilities and the proposed pipeline. A currently certified competent person shall be present during all excavation operations according to OSHA regulations.
 - b. Contractor shall have a trench safety plan for the trench conditions to be encountered on the project. The trench safety plan shall be available on the job site at all times it shall be designed by a licensed professional engineer should conditions warrant.
 - c. When pipe is to be installed in embankment or fill, the embankment shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the trench.
 - d. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction. All open trenches shall be adequately protected and shall conform with OSHA safety standards.
 - e. In the event hazardous wastes as defined by the Resource Conservation and Recovery Act of 1976 (PL94-580) are encountered, work shall be halted and the Engineer shall be notified. Work shall be resumed only after the Contractor has notified the proper authorities and permission has been given by the governing authority to resume construction activities. Regulation of removal, handling and disposal of hazardous wastes is the responsibility of Federal and State agencies.
 - f. Except where tunneling or boring and jacking is specified and shown on the Plans, all trench excavation shall be open cut from the surface.
3. Unclassified Excavation: Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material excavated will be considered as Unclassified Excavation.

4. De-Watering: The Contractor shall remove any water that may accumulate or be found in the trenches and other excavations made under the Contract.

The Contractor shall form all dams, flumes or other works necessary to keep the excavation clear of water while the waterlines, and other appurtenant works, are being constructed. All water shall be removed from such excavation in a manner that will not damage property.

5. Blasting: When blasting is permitted by Lawrence-Douglas County Fire and Medical Services, the Contractor shall use the utmost care to protect life and property. The Contractor shall comply with all laws, ordinances, and the applicable safety code requirements and regulations relative to the handling, storage and use of explosives and protection of life and property, and he shall be responsible for all damage thereto caused by his or his subcontractor's operations.

The Contractor shall provide insurance as required by the General Provisions and Covenants and Special Project Specifications before performing any blasting. The governing agency shall be notified at least 24 hours before blasting operations begin.

6. No Blasting Areas: No blasting of any kind for rock excavations or any other purpose will be allowed within areas noted as such on the Plans.

7. Open-Cut Method (Trenching):

- a. Scope: This item establishes the requirements to be followed for pipeline excavation performed by the open-cut method (trenching).
- b. General: Excavations for pipelines shall be accomplished by the open-cut method (trenching) except as specified or approved by the Engineer. Trenching shall be with a minimum inconvenience and disturbance to the general public.

The Contractor shall sort and stockpile the excavated material so the proper material is available for backfill.

- c. Trench bottoms which become soft, mucky, or otherwise unstable during construction operations shall be stabilized, by and at the expense of the Contractor, with one or more layers of crushed rock or other suitable material, where and as necessary to provide a firm and stable base for granular fill pipe foundation material to be placed thereon. Not more than one-half inch (1/2") depth of mud or muck shall be allowed to remain on the stabilized trench bottom when the granular fill pipe foundation material is installed.
- d. Trench Depths: All trenches shall be excavated to depths required for proper pipe embedment. Overdepth excavation shall be required when the subgrade is unstable. Overdepth excavations shall be backfilled with pipe embedment material unless otherwise directed by the Engineer.
- e. Trench Walls: Undercutting of trench walls is not permitted.

- f. Trench Sheeting: Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced and shored, as necessary, to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled before backfilling unless the pipe strength is sufficient, in the opinion of the Design Engineer, to carry trench loads based on trench width to the back of sheeting; nor shall sheeting be pulled after backfilling. When ordered by the Design Engineer, sheeting shall be left permanently in the trench. Payment for such sheeting will be made in accordance with the contract provisions for extra work.

When trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

- g. Limiting Trench Width: Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths below an elevation 6 inches above the top of the installed pipe shall be as follows:

Limiting Trench Widths			
Pipe Size	Minimum Trench Width	Minimum Clearance	Maximum Trench Width
2	14	4	18
4	16	6	20
6	18	6	22
8	20	6	24
12	24	6	36
16	28	6	40

Minimum clearances listed are not minimum average clearances, but are minimum clear distances which will be required.

Where necessary to reduce earth load on trench banks to prevent backsliding and caving, banks may be cut back on slopes which shall not extend lower than one foot above the top of the pipe.

- h. Unauthorized Trench Widths: When, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing tables, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor.

8. Directional Boring: The contractor shall have the option of installing proposed piping by means of directional boring throughout the project at no additional expense to the project.
 - a. The City shall have the option to stop directional boring if surface upheaval problems are experienced. The contractor shall attempt to address the problems which caused the stop in construction activity. In the event that the problems cannot be remedied, the contractor shall finish installation activities by conventional open cut trenching and auger bore installation methods as shown in the construction plans.
 - b. All pipe installed by directional boring shall be restrained joint pipe. The pipe material shall be as specified in the plans and shall conform to Section 2902.2 of these specifications.
 - c. Directional Boring Installation Requirements:
 1. Trenching and backfilling shall be in conformance with Section 2903.1 of these specifications.
 2. All open trenches and excavations shall be backfilled within forty-eight (48) hours after work is completed or as directed by the Engineer.
 3. The contractor shall install carrier piping at planned locations at required depth and length as noted on the approved plans, along with any fittings, valves, fire hydrants and tracer wire.
 4. All carrier pipe installed by directional boring shall be pressure tested for integrity by the prescribed method as outlined in section 2903.9 of these specifications.
 5. The contractor shall dispose of drilling fluids in accordance with any local, state or federal regulations. Restoration of damage to any surface or structure caused by escaping drilling fluid, or directional drilling operation, shall be the responsibility of the contractor.
 6. Precautions shall be taken to keep drilling fluid out of streets, manholes, sanitary and storm sewers and other drainage systems, including streams and rivers. The contractor shall make every effort to minimize spills during construction and shall act promptly to clean up any drilling mud overflows or spills if experienced.
 7. The contractor shall be responsible for the restoration of all areas uplifted (pavement or sidewalk heaving, etc.) and/or settlement resulting from directional drilling construction activities.
 8. The proposed pipe shall not be installed with more than 5 feet (60 inches) of cover unless attaining depth to clear utilities.

9. The contractor shall expose (pothole) all utilities in advance of directional boring activities. Utilities shall remain exposed during drilling activities to prevent damage to existing utilities due to increased soil pressure resulting from construction activities.

9. Minimum and Maximum Cover: Trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of pipe of 42 inches, and with a maximum depth of backfill cover over the top of the pipe of 60 inches, except where connections to existing pipelines are made. Depth of cover shall be measured from the top of pipe to the finished grade or pavement surface elevation. Greater depths of cover may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipeline grades. When greater depths of cover are necessary, measures shall be taken to bring the pipe back to the proper depth as quickly as possible utilizing either allowable pipe deflection or pipe fittings in accordance with Section 2902.2 of these specifications.

10. Trench Bottom in Earth: The trench in earth shall have a flat bottom the full width of the trench and shall be excavated to the grade to which the pipe is to be laid. The surface shall be graded to provide uniform bearing and continuous support for each pipe at every point along its entire length.

11. Trench Bottoms in Rock: All rock excavation shall be carried to a minimum of 6 inches below the bottom of the pipe. Pipe embedment material shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length. Care shall be exercised to prevent any portion of the pipe from coming to bear on solid rock or boulders.

12. Pipe Embedment: Embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

13. Rock Exploration: Unless shown otherwise on the plans or noted in the Special Project Specifications, no rock exploration has been made. On those projects where rock exploration has been made, test holes have been drilled at locations and intervals as shown on the Plans or subsurface information report to determine the approximate location and depth of rock. Resistance to penetration was assumed to be "solid rock". This information is furnished for general reference purposes only.

The Contractor must form his own opinion as to the character of materials which will be encountered from an inspection in the ground, from his own investigation of the test hole information, or from such other investigations as he may desire.

14. Mechanical Excavation: The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, alternate excavating methods shall be used

Mechanical equipment used for trench excavation shall be of the type, design, and construction and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from the bottom of the trench, and that trench alignment will be centered in the trench with adequate clearance between the pipe and the sidewalls of the trench. Undercutting the trench to obtain sidewall clearance will not be permitted.

All mechanical trenching equipment, its operating conditions, and the manner of its operations shall be subject at all times to the approval of the Engineer.

15. Stream Crossings: Stream crossings shall be made in accordance with these specifications and as shown on the Plans.

The trench width shall be as required for proper pipe installation and the trench depth shall be as required to give minimum cover shown on the Plans. Pipe encasement, where required, shall be in accordance with the specifications and placed as indicated on the Plans.

16. Highway and Railroad Crossings: The Contractor shall make highway and railroad crossings in accordance with these specifications, the Special Project Specifications and as shown on the Plans.

All construction or work performed and all operations of the Contractor, his employees, or subcontractors within the limits of highway or railroad right-of-ways shall be in conformance with all the requirements and regulations of the authority having jurisdiction of said right-of-ways.

The Contractor shall pay all fees and obtain all permits to make the crossings unless otherwise directed.

2903.2 Installation:

1. General: Laying of ductile iron pipe and polyvinyl chloride pipe; installation of valves, and hydrants; and embedment and backfill shall conform to the following specifications.
 - a. Unless otherwise specified herein or as shown on the plans, the water mains shall be laid to have a minimum cover of 42 inches measured from the top of pipe to the finished grade or top of pavement.
 - b. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug which will prevent trench water from entering the pipe.
2. Polyvinyl Chloride Pipe (PVC)
 - a. Handling: Pipe, fittings, and accessories shall be handled in a manner that will insure installation in sound, undamaged condition. Equipment, tools, and methods used in reloading, hauling, and laying pipe and fittings shall be such that the pipe and fittings are not damaged. Hooks inserted in ends of pipe shall have broad, well padded contact surfaces.
 - b. Cutting Pipe: All pipe shall be cut with a saw or special cutting tool. Cutting shall be done in a neat manner without damage to the pipe. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed and beveled. Beveling shall be done with a specifically designed beveling tool. Hand beveling will not be allowed. When cutting pipe with couplings, mark the field cut pipe end the same distance in as the mark appeared on the original full length pipe section.
 - c. Cleaning: The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted.
 - d. Inspection: PVC pipe shall be installed in strict accordance with the requirements and instructions of the pipe manufacturer. It shall be protected from lateral displacement and deflection by pipe embedment material installed per section 2903.8 of these specifications and as shown on the Standard Drawings. No pipe shall be laid under unsuitable trench conditions.
 - e. Alignment: Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in AWWA C600.
 - f. Laying Pipe: Pipe shall be protected from lateral displacement by pipe embedment material installed as specified. Under no circumstances shall the pipe be laid in water, and no pipe shall be laid under unsuitable trench conditions.

3. Ductile Iron Pipe:

- a. Handling: Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in a sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that pipe, pipe coating, and fittings are not damaged. Hooks shall not be used. Under no circumstances shall pipe or accessories be dropped or dumped. Pipe and fittings on which the cement lining has been broken or loosened shall be replaced by the Contractor at his sole expense. Where damaged areas are small and readily accessible, the Contractor may be permitted to repair the lining.

All pipe coating which has been damaged shall be repaired by the Contractor prior to installing the pipe.

- b. Cutting pipe: Ductile iron pipe shall be cut with either a saw or an abrasive wheel. Cutting of existing cast iron pipe shall be done with either a saw or abrasive wheel, or when there is a free end, with mechanical pipe cutters. The cutting of pipe with a torch will not be permitted.

Cutting shall be done in a neat manner without damage to the pipe, or the cement lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.

- c. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter prior to installation and shall be kept clean until the work has been accepted. Such surfaces shall be wire brushed, if necessary, wiped clean, and kept clean until jointing is completed.
- d. Inspection: Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective, damaged, or unsound pipe and fittings shall be rejected and marked as such and removed from the site of work.
- e. Alignment: Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in AWWA C600.
- f. Laying Pipe: Pipe shall be protected from lateral displacement by pipe embedment material installed per section 2903.8 of these specifications. Under no circumstances shall the pipe be laid in water, and no pipe shall be laid under unsuitable trench conditions.

2903.3 Jointing:

1. Push-on Joints: All instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations, shall be followed by the Contractor. All joint surfaces shall be lubricated immediately before the joint is completed.

The lubricant and the gaskets shall be as recommended and supplied by the pipe manufacturer. The lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

Field cut pipe and each spigot end shall be suitably beveled to facilitate installation.

2. Mechanical Joints: Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained the joint shall be disassembled, thoroughly cleaned, and reassembled. Under no circumstance will over-tightening of bolts be permitted.
3. Flanged Joints: When bolting flanged joints, care shall be taken to ensure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell and Spigot joints shall not be packed or assembled until all flanged joints affected thereby have been tightened. Bolts shall be tightened gradually and at a uniform rate so that gasket compression is uniform.
4. Restrained Joints: Restrained joints and anchoring joints shall be installed in strict accordance with the pipe manufacturer's recommendations.

2903.4 Connection to Existing Mains: The Contractor shall furnish and install all fittings necessary to join the existing and new water mains as shown on the plans.

The Department of Utilities shall be given at least 24 hours notice prior to turning off any water supply mains. The Contractor shall coordinate tie-ins with the Department of Utilities to minimize down time.

Connections shall be made using suitable fittings for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will minimize any disruption in service. Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing pipe. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and swabbed with, or dipped in, chlorine solution having a chlorine content of 200 ppm.

2903.5 Polyethylene Encasements:

1. General: Polyethylene encasement, minimum 8 mil thickness, shall be installed on all ductile iron pipe and fittings.
2. All ductile iron pipe water mains shall be polyethylene encased and shall conform to ASTM A674.
3. Polyethylene Film. Tubular or sheet form without tears, breaks, or defects, conforming to the following requirements shall be used to encase the DIP. Linear low-density film manufactured from virgin polyethylene material conforming to ANSI/AWWA C105/A21.5-99.
4. Polyethylene Tape. Provide 1-1/2-inch wide, plastic-backed, adhesive tape. Acceptable tapes are Fulton No. 355, Polyken No 900 or Scotchwrap No 50. Fulton Tie Strips are an approved alternative to tape. Duct tape or other tape not specified shall not be used. Installation shall be as described in detail in ASTM 674-05.
5. Repairs. Repair any cuts, tears, punctures, or damage to polyethylene with adhesive tape or short length of polyethylene sheet or cut open tube, wrapped around pipe to cover damaged area, and secured in place.
6. Backfill. Prevent damage to film by assuring that backfill material is free from cinders, refuse, boulders, rocks, stones, or other material that could damage the film. Follow AWWA C600 for backfilling.
7. Certification. The Contractor shall provide written certification that he has furnished polyethylene material that meets the ANSI/AWWA C105/A21.5-99 specification and written certification that he has installed this material according to ASTM 674-05. This certification shall be provided in duplicate to the City Inspector.

2903.6 Setting Valves, Fittings, and Hydrants

1. Valves and Fittings: All valves, fittings, plugs, and caps shall be set and joined to the pipe in the manner heretofore specified for cleaning, laying and joining pipe, except that large valves may require special support so that the pipe will not be required to support the valve weight.

Each valve shall be inspected before installation to ensure that all foreign substances have been removed from within the valve body, and shall be opened and closed to see that all parts are in a new working condition. Gate valves shall be set vertical in the horizontal pipeline. Valves and pipe shall be supported in such a manner as to prevent stress in either with no deflection in the valve/pipe joint.

Valve boxes and lids shall be installed at each valve and shall be supported and maintained centered and plumb over the operating nut of the valve. The valve box shaft shall not transmit shock or stress to the valve. Install valve box covers flush with the surface of the finished grade or as directed by the Engineer.

All bends and tees shall be provided with thrust blocks as specified. All dead ends on new mains shall be closed with plugs or caps suitably restrained to prevent blowing off under test pressure.

2. Hydrants: All new hydrant installations shall be as shown on the Plans or Standard Drawings and shall include all necessary excavation and backfill to make the installation complete.

Each hydrant shall be inspected before installation for direction opening, nozzle size and threading, nozzle caps and chains, operating nut, and cap nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow and weep hole openings, and handling damage and cracks. Defective hydrants shall be corrected or replaced.

All hydrants shall stand plumb. The weep holes of the hydrant shall be kept clear and free to drain and shall be covered with three (3) cubic feet of $\frac{3}{4}$ " wash rock. The areas around each hydrant and hydrant valve shall be thoroughly compacted to prevent settlement of these areas.

Hydrants shall be set to a grade that allows their proper operation. Traffic hydrants with breakaway joint must be set with the joint above the ground line. Hydrants shall be placed with the hydrant centerline a minimum of four (4) feet and a maximum of twelve (12) feet from the back of curb line. Hydrants shall be rotated so as to have the pumper nozzle facing the street or rotated to face any direction as required by the Engineer.

Hydrants shall be repainted upon completion of installation.

2903.7 Thrust Restraint:

1. Hydrants: The back of the base elbow of each hydrant shall be braced against a sufficient area of unexcavated earth or rock with a concrete thrust block and be restrained by suitable restrained joints as shown on the Plans or Standard Drawings.
2. Fittings: All plugs, caps, tees, bends, and other fittings, unless otherwise specified, shall be provided with reaction blocking or suitable restrained joints as shown on the Plans or Standard Drawings.
3. Thrust Blocks: Vertical and Horizontal reaction blocking shall be concrete conforming with Section 2902.8 of these specifications. Thrust blocks shall be installed between solid ground and the fitting to be restrained. Concrete shall be located to contain the resultant force and permit access to pipe and fitting joints for repairs.
4. Restrained Joints: Restrained push-on or mechanical joints, mechanical joint anchor fittings, and mechanical joints utilizing set screw ductile iron retainer glands may be used in lieu of concrete thrust blocking if so indicated on the plans or approved by the Engineer.

2903.8 Embedment and Backfilling: Embedment and backfill shall be accomplished in accordance with the laying condition as specified and as shown on the Plans and Standard Drawings.

1. Pipe Embedment: Embedment for pipe shall be in accordance with Section 2902.6 of these specifications and details of the laying condition as indicated on the Plans.
2. Trench Backfill: Backfill for the entire length of the pipeline shall be compacted full depth of the trench above the embedment.
 - a. Compacted backfill shall be finely divided job excavated material free from debris, organic material, frozen materials, and stones larger than three (3) inches in greatest dimension. Masses of moist, stiff clay shall not be used.
 - b. Select Backfill Material: Select backfill material shall be equivalent to the Kansas Department of Transportation Standard Specifications for AB-3.
 - c. Trench backfill shall be flowable mortar, conforming to Section 2902.9 of these specifications, for all trenches crossing existing or proposed streets or alleys from two (2) feet beyond the edge of pavement, and for all portions of trenches running parallel to and within two (2) feet of the back of curb. All other trench backfill shall be either flowable mortar or compacted earth as indicated on the drawings and standard details, or as specified in the Special Project Specifications.

- d. Earth backfill material to be placed above pipe embedment shall be free of brush, roots more than two (2) inches in diameter, debris, cinders, or other corrosive material, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. No backfill material containing rocks, or rock excavation detritus material, shall be placed within two (2) feet of final surface. No rock greater than six (6) inches in its largest axis shall be placed in any trench excavation as backfill.
 - e. Structure Backfill: Backfill around structures shall be compacted to the extent necessary to prevent future settlement, by tamping or other means acceptable to the Engineer.
 - f. Whenever, in the opinion of the Engineer, the material excavated from the trenches is not suitable for backfilling, or there is a deficiency of material suitable for backfilling, the Contractor shall provide suitable material. The Contractor shall remove all excess excavated materials and shall dispose of them at locations provided by the Contractor.
3. Placement and Compaction:
- a. Job excavated materials shall be placed in lifts not to exceed 8 inches in depth. Each lift shall be compacted to the required density prior to the next lift being placed. Increased layer thickness may be permitted for noncohesive material if the Contractor demonstrates to the satisfaction of the Engineer that the specified compacted density will be obtained. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.
 - b. Select backfill placement shall be in lifts of not more than 6 inches in compacted thickness, which shall be compacted by means of mechanical tampers to a density of at least 95 percent of maximum as determined from ASTM D698.
 - c. Flowable mortar shall be discharged from the mixer by a reasonable means into the trench area to be filled. Flowable mortar shall be placed to the bottom of existing or future pavement.
 - d. Trench backfill, unless otherwise specified, shall be compacted to a minimum of 95% of the standard proctor maximum density for the material used as determined by ASTM D698
4. Testing: All laboratory tests required ensuring compliance of embedment and backfill with specified requirements herein shall be paid for directly by the Contractor. Copies of test results shall be submitted to and approved by the Engineer.

2903.9 Disinfection and Testing:

1. General: All water mains constructed shall be disinfected and tested as specified herein.
 - a. All hydrostatic testing shall be done in the presence of the Engineer, Inspector or authorized representative.
 - b. All water sampling shall be performed by the Engineer, Inspector or authorized representative.
 - c. Bacteriological testing shall be performed by the City of Lawrence Utilities Department Laboratory.
 - d. The Contractor shall notify the Engineer 72 hours in advance of the times and places at which testing work is to be done.
 - e. Temporary discharge piping shall be provided for disposing of test water. Test water shall be disposed of without damage to public or private property.
2. Disinfection: After installation, the entire main shall be flushed and disinfected by chlorination per AWWA C651-05. The Contractor shall disinfect the main or prepare the main for disinfection by the owning authority when so noted in the Special Project Specifications.
 - a. Flushing shall be carried out until water free of visual turbidity is obtained from all points along the main.
 - b. Disinfection may be performed concurrently with pressure and leakage testing if acceptable to the Inspector, or after pressure and leakage testing is completed.
 - c. Disinfection of newly constructed pipelines shall be accomplished by the introduction of a chlorinated solution of not less than 25mg/L into the lines. The contact period shall not be less than 24 hours and the free chlorine residual at the end of the contact period shall not be less than 10mg/L. Following chlorination, all treated water shall be flushed from the system. Treated water to be flushed from the system shall be de-chlorinated as environmental conditions warrant per Section 4.5.2 of AWWA C651-05. Type and application of neutralizing chemicals shall conform to Appendix C, Table C.1 of AWWA C651-05.
 - d. All existing mains which require a section to be removed for connection work shall be disinfected. The interior of all pipe and fittings used in making the connection shall be swabbed with a 5-10% hypochlorite solution immediately prior to their installation in the system. When the assembly is completed, the existing main shall be thoroughly flushed.

- e. Two consecutive sets of acceptable samples taken at least 24 hours apart, shall be collected from the new main. If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the new main may be flushed and shall be resampled. If check samples also fail to produce acceptable results, the main shall be rechlorinated until satisfactory results are obtained—that being two consecutive sets of acceptable samples taken 24 hr apart.
 - f. Each water main tested shall be allowed two disinfection tests. Should the main fail to produce satisfactory results and additional testing is required, the contractor will be charged a fee of \$500 per test for inspection and testing.
3. Hydrostatic Testing: The Contractor shall perform hydrostatic pressure testing in accordance with AWWA C600 procedures. Where practicable, pipelines shall be tested in lengths between line valves or plugs of no more than 1500 feet in length.
- a. General:
 1. All pipelines shall be subjected to hydrostatic testing. All shutoff valves shall be open during pressure testing. Anchored or blocked test plugs shall be placed as necessary to limit testing length as specified above.
 2. The Contractor shall provide all necessary pumping equipment, piping connections, pressure gauges, anchored or blocked test plugs, and all other equipment, materials, and facilities for the testing.
 3. The contractor shall replace materials, repair pipelines, and repeat testing as necessary should the initial testing fail to yield satisfactory results. Testing shall be repeated until satisfactory results are obtained.
 - b. Hydrostatic Pressure Testing:
 1. The test pressure at any point in the pipeline shall be 2.5 times the operating pressure not to exceed 200 psi.
 2. The test pressure shall be maintained for a minimum of 30 minutes or whatever period is necessary for the Inspector to inspect the pipeline. Under no circumstance shall the Inspector be permitted to leave the project site during pressure testing activities.
 3. Any drop in pressure across the tested section of the pipeline shall constitute failure of the pressure test.
 4. All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed immediately and replaced with new and acceptable material, by and at the expense of the Contractor.
 5. Pressure testing shall be repeated until the line and all parts thereof withstand the test pressure in a satisfactory manner.

2903.10 Surface Restoration: This section covers restoration of asphalt pavement, gravel surfacing, sidewalks, driveways, curbs, and other surface construction removed or damaged during the progress of the work.

1. All surface restoration work shall comply with City of Lawrence Technical Specifications, current edition, and Kansas Department of Transportation Standard Specifications for State Road and Bridge Construction, 1990 edition.
2. All restoration work shall be subject to acceptance by the Engineer, owner, and agency having jurisdiction thereof. All materials utilized for surface restoration work shall be new unless otherwise specified on the Plans, Special Project Specifications, or as approved by the Engineer.

2903.11 Separation:

1. Horizontal Separation:
 - a. A minimum of ten (10) feet horizontal separation, as measured from the outside edge to outside edge, shall be required between a potable waterline and a sanitary sewer main or manhole.
 - b. Under no circumstance shall potable waterline and sanitary sewer be placed in the same trench.
 - c. Potable waterlines shall meet the minimum separation requirements from all pollution sources as set forth by the appropriate reviewing agency.
 - d. When waterlines and other utilities are laid parallel to each other the separation distance shall be determined based on geotechnical considerations. A minimum of three (3) feet of undisturbed earth separating the trenches shall be required. Under no circumstance shall waterlines and other utilities be installed in the same trench.
2. Vertical Separation:
 - a. A minimum of two (2) feet vertical separation, as measured from the outside walls of the pipe, shall be required between a sanitary sewer main and potable waterline.
 - b. In general potable waterlines shall be located above sanitary sewer lines.
 - c. Potable waterlines shall maintain a minimum of two (2) feet of vertical separation, as measured from the outside walls of the pipe, and shall always cross above any sewer force main.

3. Protective Measures: When potable waterlines and gravity sanitary sewers cross with less than two (2) feet of vertical clearance, and in all cases where the potable waterline is located below the gravity sanitary sewer, additional measures must be employed to protect the potable waterline.

Acceptable measures include:

- a. Construction of the sanitary sewer line using one of the following materials:
 1. Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.52 with a minimum thickness class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.
 2. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3212.
 3. Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Install a minimum twenty (20) foot length of sanitary sewer pipe on the crossing to maximize the joint spacing to a minimum of ten (10) feet from the crossing.

- b. Provide concrete encasement of the sanitary sewer line a minimum of six (6) inches in thickness for a minimum distance of ten (10) feet either side of the pipeline crossing.
- c. Sanitary sewer service lines may be constructed using schedule 40 PVC pipe with solvent welded joints. Pipe joints shall be located a minimum of ten (10) feet either side of the pipeline crossing.

SECTION 2904 MEASUREMENT AND PAYMENT

- 2904.1 Scope: This section covers the methods of measurement, and the basis of payment, for the furnishing of all labor, equipment, tools and materials and for the performance of all related work necessary to complete any construction covered in Section 2900.
- 2904.2 General: The methods of measurement and payment shall be in accordance with City of Lawrence Technical Specifications Section 0010: General Technical Provisions, as specified herein, and as listed in the Proposal.
- 2904.3 Items not listed in the Proposal: There will be no measurement or separate payment for any items of work not specifically identified and listed in the Proposal and all costs pertaining thereto will be included in the Lump Sum Proposal or Contract Unit Prices for other items listed in the Proposal.
- 2904.4 Basis of Payment: Payment will be made of the respective unit at the unit or lump-sum price listed in the proposal and shall be full compensation for all labor, materials, and equipment necessary to complete the respective unit in place. There will be no separate measurement or payment for any item of work not specifically identified and listed in the proposal, and all such work shall be considered a subsidiary item with all costs pertaining thereto included in the prices for other items listed in the proposal. At the Engineer's option, partial payment may be made for any lump sum item listed in the proposal, providing that the Contractor is diligently and satisfactorily pursuing full completion of such partially complete item in accordance with the approved job progress schedule.
- 2904.5 Standard Bid Items: The following is a list of standard bid times and quantity units for waterline projects. Project-specific or special items shall be added to the list where appropriate. Lack of inclusion of a specific item from the Standard Bid Items List will not be justification for non-performance. All work must meet City Standards.

<u>Bid Item</u>	<u>Quantity Unit</u>
__-inch Waterline	LF
__-inch Gate Valve	EA
__-inch Bend and Block	EA
__-inch Fitting (Tee, Cross, Reducer, Sleeves)	EA
Connect to Existing Waterline	EA
Water Meter Removal and Abandonment	EA
Water Meter Installation or Relocation	EA
Fire Hydrant Assembly	EA
Valve Lid Adjustment	EA
Air Release Valves	EA
Seed, Fertilize, and Mulch	LS
Erosion Control	LS
Construction Staking	LS
Traffic Control	LS