

SECTION 8

WATER MAINS, FIRE LINES AND WATER SERVICE LATERALS

8.01 GENERAL

A. Scope. The purpose of this Section is to govern the furnishing of all materials, labor, equipment, tools, superintendence, and other services necessary to construct water mains, fire lines, and water service laterals complete with appurtenances, including extensions and relocations, at the locations shown on the Drawings, and in conformance with these specifications. References herein are to Topeka/Shawnee County Standard Technical Specifications, unless otherwise noted.

B. Warranty – One-Year Correction Period. All work specified herein is specifically identified as being subject to a one-year correction period. If any work is found to be defective, including settlement, within the one-year period from the Final Completion date, the Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions, either correct such defective work, or, if it has been rejected by Owner, remove it from the site and replace it with non-defective work. Any leaks which appear within the one-year period after the date of Final Completion shall be repaired at the expense of the Contractor. The Contractor shall furnish a performance bond in an amount equal to the contract price of the work, to remain in effect during the one-year correction period.

C. Traffic Control. The Contractor shall provide work zone traffic control, as specified in Subsection 4.24, Work Zone Traffic Control, for all water line work unless it is stated otherwise in the Project Contract Documents. Work zone traffic control shall be subsidiary to the water line work unless bid items for work zone traffic control are included in the Bid Form.

D. Excavation, Backfill, Compaction, and Pavement Restoration. All excavation, backfill and compaction for waterline work shall be as specified in Section 2, Trench and Structure Excavation, Backfill and Compaction. Unless otherwise indicated in the Project Contract Documents, all excavation, backfill and compaction for waterline work shall be subsidiary to other bid items.

Unless otherwise indicated in the Project Documents, the Contractor shall complete the removal, replacement and restoration of pavements as necessary to complete waterline work as specified in Subsection 4.06, Pavement Removal and Replacement for Trenches. This work shall be paid for as indicated in the project bid items.

E. Submittals. Prior to Pre-Construction Meeting and before the start of work, the Contractor shall submit electronic copies of the following information to the Engineer for review and approval as indicated in Subsection 1.05, Shop Drawings and Engineering Data. Contractor shall include transmittal listing materials included with each submittal and a statement that “Contractor has reviewed included material(s) documentation and that same conform fully to the Drawings and Project Manual requirements. Exceptions or proposed substitute materials are (list)”:

(1) Manufacturer's certification, representative test reports, and catalog-cuts (as appropriate) for each material type and category proposed to be incorporated into the work for: pipe; fittings; valves and lids; hydrants; backflow devices; air release valves; tracer wire; tapping sleeves; meter and backflow device vaults; manholes and vaults; bedding and backfill materials; and all other appurtenances and accessories supplied.

(2) Maintenance manuals for all mechanical equipment installed into the work as requested.

(3) Manufacturer's Warranty documents shall become effective as of Substantial Completion date and respective expiration dates shall be listed with Contractor's transmittal to Engineer.

(4) Pipe laying schedule prepared by the Manufacturer for all ductile iron water line 16 inches in diameter and larger. This schedule shall be a station-to-station summary of all relevant information (e.g. size, thickness/classification, joint types, etc.) for all pipe, fittings, valves, and any other appurtenances to be incorporated into the Project.

F. Coordination of Work. All work shall be fully coordinated with other work, and submittals must be checked and approved for each of the trades. Conflicts in the sequence of the work shall be coordinated through consultation with the Engineer.

G. Quality Assurance. Items submitted for approval in accordance with requirements shown on the Project Documents shall be of the manufacturer indicated, or an Engineer-approved equal, and in compliance with the approved Submittals in Subsection 8.01.E, Submittals, and as specified herein. All pipe, fittings, valves and boxes, and hydrants and appurtenances shall be manufactured in North America.

H. Pre-Construction Survey. Prior to start of any on-site construction activities, the Contractor and the Owner, or his authorized representative, shall make a joint condition survey, after which the Contractor shall prepare an electronic copy or three (3) copies of a report indicating on a layout plan the condition of any damaged property or improvements adjacent to the work site and any variances from the Drawings. The report shall also contain electronic pictures or color photographs, 3.5" x 5" or larger, of damaged areas noted, along with a sufficient number of photos showing the physical features of the existing route before construction begins. All property that is damaged by the Contractor during the construction work shall be repaired or replaced as directed by the Engineer to like-new condition regardless of its physical condition prior to the start of construction.

8.02 MATERIALS

A. Scope. This section governs materials for pipe 2 inches in diameter through 24 inches in diameter, in accordance with sizes and materials shown on the Drawings. Pipe 10 inches in diameter and 14 inches in diameter shall only be used in repair situations subject to approval of Engineer. Any visible defect or failure to meet the quality standards herein will be grounds for rejection of those items.

All pipe and appurtenances are subject to inspection at time of delivery. Neither inspection nor failure to provide inspection shall relieve the manufacturer of the responsibility to provide materials that fully conform to these Specifications and Project Manual. All materials found or identified to not conform to these requirements shall be made satisfactory or replaced.

B. Pipe Types. Pipe, joints and couplings (as applicable) shall be legibly and permanently marked with critical information, including: nominal pipe size, pressure class, dimension ratio, applicable conformance standards (e.g. ANSI/AWWA/ASTM), manufacturer's name, production record code, seal or mark of testing agency verifying suitability of pipe material for potable water service and for use in fire protection systems (e.g. UL/FM/NSF, as applicable).

DIP wall thickness shall be Class 51 for pipe 4 inches in diameter through 24-inches in diameter, unless greater wall thicknesses are indicated on the Drawings. All PVC and FPVC pipe shall be pressure class 235 unless greater wall thicknesses are indicated on the Drawings. All PVCO pipe shall be pressure class 305, unless otherwise indicated on the Drawings.

(1) Ductile Iron Pipe (DIP). DIP shall be used for all pipes larger than 12 inches in diameter unless alternate materials are shown on the Drawings, and may be used for pipe 12 inches in diameter and smaller, subject to approval of the Engineer. All pipe and pipe joints shall be bell-and-spigot, push-on type (e.g. American Fastite) or welded, boltless restrained-joint type (e.g. American Flex-Ring), and shall be AWWA C-151/ANSI A-21.51, as indicated in the Project Documents. Acceptable manufacturers are American, US Pipe and Clow or Engineer-approved equal.

Exterior coatings shall be bituminous coal tar base Not Less Than (NLT) 1 mil thick in accordance with AWWA C-151/ANSI A-21.4. Inside coatings for use under normal conditions shall be cement-mortar lining in accordance with AWWA C-104, unless otherwise specified, with a seal coat of bituminous coal tar base material in accordance with ANSI A-21.4. The finished bituminous coating shall be continuous and smooth, neither brittle when cold nor sticky when exposed to the sun in accordance with AWWA C-153, and shall be strongly adherent to the pipe. Rubber joint gaskets shall be in accordance with AWWA C-111/ANSI A-21.11. Joint lubricant must be labeled with manufacturer's name and conform to ANSI A21.11.

Normal laying length is 20-feet. Restrained joint pipe and welded thrust collar pipe shall be factory fabricated by only the pipe manufacturer.

(2) Polyvinyl Chloride Pipe (PVC). PVC may be used for all pipe 12 inches in diameter and smaller, in accordance with the Project Documents. All pipe shall be manufactured in accordance with AWWA C900. Pipe joints shall be bell-and-spigot, push-on type with integral elastomeric gasket, in conformance with ASTM D3139 and ASTM F477.

Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign material, blisters, and other visible deleterious faults. Pipe shall be manufactured from rigid polyvinyl chloride compound with cell classification 12454-B as defined in ASTM D-1784. Normal laying length is 20-feet.

(3) Fusible Polyvinyl Chloride Pipe (FPVC). FPVC may be used for all pipe 4 inches in diameter through 24 inches in diameter, in accordance with the Contract Documents and as approved by the Engineer. All pipe shall be manufactured in accordance with AWWA C-900 or C-905. The ends shall be extruded with plain ends and shall be square to the pipe and free of any bevel or chamfer.

Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters or other visible deleterious faults. Pipe shall be manufactured from rigid polyvinyl chloride compound with cell classification 12454-B as defined in ASTM D1784. Normal laying length is 40-feet.

(4) Molecularly Oriented Polyvinyl Chloride Pipe (PVCO). PVCO may be used for all pipe 6 inches in diameter through 12 inches in diameter, in accordance with the Project Documents and as approved by the Engineer. All pipe shall be manufactured in accordance with AWWA C-909. Pipe joints shall be bell-and-spigot, push-on type with integral elastomeric gaskets conforming to ASTM D-3139.

Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters or other visible deleterious faults. Pipe shall be manufactured from rigid polyvinyl chloride compound with cell classification 12454-B in accordance with ASTM D-1784. Normal laying length is 20-feet.

(5) Restrained Joint Polyvinyl Chloride Pipe (RJ-PVC). RJ-PVC may be used for pipe 12 inches in diameter and smaller, in accordance with the Project Documents and as approved by the Engineer. All pipe shall be manufactured in accordance with AWWA C900. Pipe joints can be non-metallic mechanically restrained elastomeric bell-and- spigot joints of either coupled or integral bell type in conformance with ASTM F-477 and AWWA C-900 or corrosion resistant steel.

Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters or other visible deleterious faults. Pipe shall be manufactured from rigid polyvinyl chloride compound with cell classification 12454-B as defined in ASTM D1784. Normal laying length is 20-feet.

(6) Mechanical Joint (MJ) Restraints. Ductile iron radial type bolt MJ restraints for mechanical joint applications designed for respective pipe material being used and for MJ fittings and valves. Split-ring restraints will not be permitted on new construction except under special circumstances. All restraint devices shall be of uniform thickness and utilize a standard MJ gasket and match standard MJ bolt circle, using 304/316 SS bolts and nuts (Teflon coated) required for installation.

The wedge screws shall be compressed to the outside wall of the pipe, after fully setting the joint, with twist-off torque calibrated bolts/nuts to ensure proper actuating of the MJ restraint. Coatings shall be petroleum asphalt per AWWA C-151/ANSI A-21.51 or with epoxy coating per AWWA C-550. Restraint device shall

be designed for a minimum working pressure of 350 psi. MJ Restraints are only required where noted on the Drawings, although for piping smaller than 12 inches in diameter, MJ Restraints may be used in locations where a restrained joint (RJ) is required. MJ Restraints are not an acceptable RJ for piping larger than 12 inches in diameters. Acceptable manufacturers include ROMAC Grip Rings and EBAA Iron Mega-Lugs or Engineer approved equal. For AWWA C-909 PVC pipe materials requires Engineer approval of proposed Restraint Glands.

C. Pipe Fittings. All tees, bends, crosses, plugs/caps, sleeves, and offset style fittings shall be ductile iron, mechanical joint style, pressure class 350 psi for fittings 24 inches in diameter and smaller, pressure class 250 psi for fittings larger than 24 inches in diameter. All fittings shall be manufactured in conformance with AWWA C-110/ANSI A-21.10 (full-body), A-21.11 and AWWA C-153/ANSI A-21.53 (compacts), as manufactured by American, Tyler Union, or Engineer approved equal. All fittings shall be lined and coated as specified for DIP. Fittings for pipe sizes smaller than 12 inches in diameter may be compact type with full body glands. Fittings 12 inches in diameter and larger shall be full body.

MJ swivel x solid adapter fittings shall be used between fittings and valves where called for on the Drawings or as needed to facilitate the Work, and 90-degree swivel x swivel adapter fittings may be used for installation of branch valves for hydrants. Fabricated swivel adapter fittings shall not be acceptable. All transition or reducing fittings in place of straight couplings, the sleeve and follower flange shall be of the same manufacturer.

All underground fitting, valve and hydrant joints shall be furnished with Type 304/316 SS bolts and nuts (Teflon coated) or with 316 SS T-head and all nuts shall be Teflon coated. When indicated on the Drawings or provided by the Contractor, tie-rods shall be 316 SS with Teflon coated nuts and duc-lugs, either all-thread or eye-bolt type.

D. Sleeves. Solid sleeve lengths shall be NLT 12-inches or longer in overall length, based on pipe size. The solid sleeve shall be capable of having two plain ends of pipe inserted into opposite ends of the sleeve. The sleeve is then to be sealed to the pipe by a mechanical joint at each end of the sleeve in accordance with AWWA C-111/ANSI A-21.11, with gaskets made of EPDM rubber. The follower retainer gland shall be manufactured from ductile iron at least ASTM A536, Grade 70-50-05 in accordance with AWWA C-111/ANSI A-21.11. All sleeves shall be manufactured of ductile iron, with lining and coatings as specified for DIP. Solid sleeves shall be manufactured in accordance with AWWA Standard C-153/ANSI A-21.53. All sleeves shall be rated for a minimum working pressure of 250 psi.

Special bolted compression couplings may be specified or used to connect new to existing mains of unknown OD using dedicated range, limited range or wide range couplings as approved by Engineer for sizes 2" – 24" nominal diameter in accordance with AWWA C-219. Acceptable suppliers include Hymax and Romac, or Engineer approved equal.

E. Tapping Sleeves. Tapping sleeves shall be Power Seal Pipeline Products Model 3490AS, Ford FTSS, Mueller H-304MJ, or Engineer approved equal. Tapping sleeves shall be stainless steel Grade 18-8, Type 304 per ASTM A-240, full circle gasket type. All nuts and bolts shall be stainless steel (type 304) and Teflon coated nuts per ASTM A-193 and A-194. Outlet shall be integral MJ.

F. Valves and Valve Boxes. Generally, and unless otherwise directed by the Engineer, MJ gate valves shall be used on all water mains smaller than 12 inches diameter. Generally, and unless otherwise directed by the Engineer, MJ butterfly valves shall be used on all water mains twelve (12) inches diameter and larger. Valves shall be NSF-61 certified and be for buried service. The size and location of valves shall be as shown on the Drawings. Valve ends shall be of the mechanical joint type, conforming to AWWA C-111/ANSI A21.11.

(1) Gate Valves. All gate valves shall be resilient-seated, pressure class 250 psi, MJ ductile iron body, bronze mounted with non-rising stems sealed with 3-O ring seals, clockwise to open, with 2-inch square operating nuts painted red. Gate valves shall conform to all applicable requirements of AWWA C-509, and shall be epoxy coated inside and outside with NLT 8-mils DFT conforming to AWWA C-550. All exposed valve bolts and nuts shall be 304/316 stainless steel with Teflon coated nuts conforming to ASTM 276.

The valve 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. All bolts and nuts in bonnet shall be stainless steel. Acceptable resilient wedge gate valve manufacturers include Mueller Series A-2360-20, American Series 2500 MM or Engineer approved equal.

(2) Butterfly Valves. All butterfly valves shall be minimum 200 psi, MJ cast or ductile iron body, configured with a horizontal valve shaft and a vertical actuator shaft with 2- inch square operating nuts painted red, clockwise to open. Butterfly valves shall be fitted with Buna-N seats, type 630 SS shaft, cast iron with hi-chrome edge disc, and nylon self-lubricating shaft bearings, conforming to AWWA C-504 Class 150B, and epoxy coated inside and outside conforming to AWWA C-550. Valve discs shall seat at 90 degree with the pipe axis.

Each valve shall be provided with an operator with a torque rating at least equal to the torques and turns-to-open listed in AWWA C504, Table 1. Operators shall be designed for buried service, totally enclosed, permanently lubricated link lever traveling nut type designed to hold the valve in any intermediate position between full-open and closed. Operator shall be provided with a stop-limiting device capable of withstanding input torque of 300 ft-lbs at extreme operator positions without damage to operator or valve.

The valve 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. All bolts and nuts in bonnet shall be stainless steel. All exposed valve bolts and nuts shall be 304–316 stainless steel. Valves shall be manufactured by the Henry Pratt Co., “Ground Hog”, Model to the City of Topeka standard, with no exceptions.

(3) Extension Stems. Extension stems shall be fabricated from solid steel shafting not smaller in diameter than the stem of the valve. All connections shall be non-pinned. Pipe couplings will not be acceptable.

Extension stems shall be provided for buried valves when the operating nut is more than five (5) feet below finished grade. Each extension stem for a buried valve shall extend to within one (1) foot of the finished ground surface, NO EXCEPTIONS WILL BE ALLOWED, and shall be provided with spacers, which will center the stem in the valve box, and shall be equipped with a 2-inch wrench nut painted Red.

(4) Valve Boxes, Bases, Lids and Covers. All buried valves shall be provided with valve boxes. Valve boxes shall be 6 inch, PVC AWWA C-900 Pressure Class 235 pipe. Lids outside the traveled roadway will be “mushroom” or “flat top” Clay & Bailey No. 2615-6 lid pattern with only “WATER” imprinted and shall be cast iron or steel Engineer approved equal.

Cast iron Lids and Covers in pavement and gravel shall be Clay & Bailey No. 2196 or Engineer approved equal. All parts of valve box extensions, lids, and covers shall be coated by dipping in bituminous ‘varnish’.

Valve boxes that need extensions must be extended by approved method. All risers need to be sealed to prevent debris and infiltration.

(5) Air Release and Combination Valves. When required on the Drawings, air release valves or combination air-release and vacuum-relief valves shall be installed with a 1- inch saddle tap and corporation valve on top centerline of pipe at highest elevation (2- inch on pipe 16-inch and larger sizes). The valve shall be set in a standard 36-inch diameter meter vault and poured concrete base, with Top being removable round cast frame/lid placed at 3-inches above finished grade if in turf. For pavement and gravel surfaces, valves shall be placed in 48-inch diameter manhole with Kor-N-Seal water tight boots and integral base and top of flat reinforced concrete slab with 30-inch round cast iron frame/lid placed at finished grade.

Air Release Valve shall be float operated and shall incorporate a simple lever mechanism to enable the valve to automatically release accumulated air from a fluid system while that system is pressurized and operating. The valve will normally be manually closed. The Air Release Valve shall close drop tight. All internal metal parts shall be of stainless steel, withstanding a test pressure of 1000 psig. The linkage/lever mechanism shall be designed to prevent jamming. The body and cover shall be of cast iron conforming to ASTM A126 Class B, shall be epoxy coated and shall be designed to withstand a test pressure of 450 psig.

All piping and isolation valves shall be brass except for the air outlet from the valve, which shall be brass or copper tubing. Each valve assembly shall be installed complete. Acceptable manufacturers include APCO Valve 143C/149C, G.A. Industries 945/960C, Val-Matic 201C/202C/204C or Engineer approved equal.

(6) Temporary Blow-off Valve Assemblies. Temporary blow-off assemblies for pressure testing and disinfection shall be provided for 1”, 1.5” or 2” sizes or as approved by the Engineer.

G. Dry-Barrel Fire Hydrants. The hydrant shall be furnished with a 6-inch MJ inlet, have two 2.5 inch NST hose nozzles and a 4.5 inch pumper nozzle with City of Topeka standard thread, be traffic model with breakaway flange or coupling and safety stem, and in accordance with AWWA C-502. All nozzles shall be of bronze, with outlet nozzle caps made of cast iron. A recess shall be provided at the inner back edge of cap threads to retain a replaceable gasket, with cap non-kinking chain securely attached, and with tapered operating/nozzle cap nuts per City of Topeka standard (7/8-inch square at base by 3/4-inch square at end, minimum 1-inch long).

Hydrants shall have compression type 5.25-inch main shut-off valve, close with pressure and be equipped with replaceable minimum dual O-ring shaft seals, and capable of 200 psi working pressure and 400 psi test pressure. The unit shall be fully bronze mounted with replaceable bronze seats, bronze cap nut and weather cap. Direction to OPEN shall be Clockwise, with an arrow and the word "OPEN" shall be cast in relief on the hydrant top to indicate direction of opening. Hydrants shall be furnished with all restrained type joint glands, Buna-N gaskets, Type 304/316 SS bolts and nuts (Teflon coated) required for installation.

Hydrant shall have standard minimum depth of bury of four (4) feet, with Contractor furnished and installed barrel extensions as required to fit final hydrant bury depth and finished grade requirements and as shown on the Project Documents. Extensions shall be in 6 inch increments with the least number of extensions practicable to conform to the final hydrant bury depth required; and whenever practicable, deeper bury hydrants will be ordered with depth of bury barrel lengths suited for the location shown on the Drawings.

Hydrant main valve assembly shall include an automatic drain system that consists of NLT two openings that are bronze or bronze lined in the valve seat that are force flushed each time hydrant is operated and when hydrant valve is closed, the water retained in the body during operation will drain to the gravel placed around hydrant base or shoe, and close when hydrant is flowing. Drain valve seals shall be long-life, non-metallic material that are mechanically secured by non-corrosive fasteners. The drain system shall be free of devices requiring field adjustment. All surfaces of drain channel shall be bronze or they shall be protected with factory applied epoxy coating per AWWA C-550.

Hydrant shall be painted with one-coat zinc-chromate primer (NLT 3-mils DFT) and two-coats premium enamel (each 3-mils DFT, 6-mils total). Buried portion shall have top coats black and brite hydrant red on exposed hydrant body. Pumper nozzle caps on all private hydrants, as designated by the Water Engineer, shall be painted Sherwin-Williams industrial yellow # B54- Y37.

Friction losses through hydrant shall not exceed 2.5 psi at 1,000 GPM through pumper nozzle when tested per AWWA C-502. Acceptable Fire Hydrant manufacturers include Mueller Type A-423 or American Darling Model B-84-B-5 or Engineer approved equal. All hydrants shall have manufacturer 5-year Warranty on materials and workmanship.

H. Tracer Wire. All water mains shall be installed with tracer wire for locating. Tracer wire for Open-Trench construction shall be minimum 12 AWG solid, steel core soft drawn tracer wire, average 250 lb. average tensile break load with Blue color 30- mil high molecular weight-high density polyethylene (HMW-HDPE) jacket complying with ASTM D-1248, 30-volt rating; For Horizontal Directional Drill (HDD) construction wire shall be minimum 12 AWG solid, steel core hard drawn extra high strength wire, average 1150 lb. ensile break load with Blue color 45-mil HMW-HDPE jacket complying with ASTM D-1248, 30-volt rating; For Pipe Bursting construction wire shall be minimum 7x17 stranded copper clad steel wire, average 4,700 lb. tensile break load with Blue color 45-mil HMW-HDPE jacket complying with ASTM D-1248, 30-volt rating and minimum of 21% conductivity as manufactured by Copperhead Industries, LLC, or Engineer approved equal. To make wire connections water-tight and to prevent corrosion or any deterioration of electrical conductivity in the future, the twisted bare ends shall be sealed using Copperhead Industries LLC Type 3WB-01, SCB-01SR or SCB-01 (as applicable) or Ideal Twister DB Plus wire connectors designed to be a water resistant connector for wet, damp or corrosive wiring conditions and intended for direct burial or Engineer approved equal. Tracer wire shall terminate at a SnakePit magnetized tracer box, as manufactured by Copperhead Industries, LLC, or Engineer approved equal. For off-pavement installations, use SnakePit model LD14*TP. For concrete and driveway installations, use SnakePit model CD14*TP. All boxes shall be equipped with a blue ABS cover.

I. Corrosion Protection. All ductile iron pipe, fittings and buried hydrant barrels shall be protected from corrosive soils and bury conditions by wrapping with NLT 8-mil thick blue polyethylene tubing or sheeting conforming to AWWA C-105 and sized for the pipe diameter being protected. Securing tape shall be 2-inch wide by 10-mil thick with one side adhesive and supplied with the poly-wrap by the supplier.

J. Bedding Aggregate. Bedding material for all direct buried pipe shall be crushed limestone (1/4" CHIP) and bedding shall fully encase the pipe from NLT four inches below bottom of pipe barrel to NLT six inches above top of pipe bell, and trench wall to trench wall. When pipe line trench is in shale or in rock, an additional six inches of bedding material shall be placed under the pipe barrel. Bedding aggregate shall have the following characteristics:

Retained on No. 4 Sieve	20%
Retained on No. 8 Sieve	94%
Retained on No. 100 Sieve (wash) not less than	98%
Deleterious Substances, (max)	5%

K. Poured Concrete. Concrete used for buttress, thrust blocking and anchorages shall be minimum 3,000 psi at 28-days and shall be made with either Type I or II cement. If 1 % calcium chloride is added to concrete mix, Type I cement shall be used with strength of 4,000 psi at 28-days. Slump shall not exceed 3-inches.

L. Water Services. All new water service piping shall have minimum 1-inch nominal diameter from the main to the meter/setter.

(1) Tapping Pipe Saddles. For 2-inch mains, saddle shall be style model Ford S90-xxx Style A fabricated with stainless steel band and bolts with Teflon coated nuts and epoxy coated saddle fitted with heavy duty EPDM gasket sized for the pipe line material. For 4-inch and larger mains with 1 - 1.5 - 2-inch tap sizes, saddle shall be 2-piece bolted style model Ford S90-xxx Style A, 202B-xxx or 202BS-xxx per AWWA C-800/ASTM B-62 & B-584, with AWWA tap threads and machined to rigid standards, with EPDM rubber gasket bonded in place per ASTM D-2000, with lower saddle of 18-8 type 304 stainless 3.25-inch wide band and with four 18-8 type 304 stainless 5/8-inch bolts welded to band and passivated to resist corrosion having coated SS hex nuts and SS washers.

(2) Corporation Stops. For Service pipe sizes 1 through 2-inch, corps shall be Ford Ballcorp model FB-1000-xx for flare copper designed to withstand working pressures up to 300 psi and AWWA “CC” inlet threads and Flare Copper outlet threads in conformance with AWWA C-800. In situations of a metal service line is installed (or existing) that is connected to a metal water main (installed or existing), a service insulator shall be installed for protection against service/main line electrolysis by using a Service Insulator.

(3) Adaptive Couplings. All copper and HDPE tubing couplings shall be Grip Joint Couplings and insert stiffeners, including copper gaskets when appropriate, as follows:

i. Straight Couplings:

Joint Coupling for copper or plastic tubing	Ford C44-xx
Male Iron Pipe for copper or plastic tubing	Ford C84-xx
Female Iron Pipe for copper or plastic tubing	Ford C14-xx
Female Copper Thread for copper or plastic tubing	Ford C04-xx

ii. Quarter Bends:

Pack Joint Ell Coupling x Copper or Plastic Tubing	Ford L44-xx
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iii. Ball Valve Curb Stop (when required):

Ball valve for copper or plastic tubing	Ford B44-xxx
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iv. Insert Stiffeners – stainless steel inserts:

304 tubular stainless steel insert (ASTM 240-92B)	INSERT-xx style
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(4) Service Pipe. Water service piping for 1 to 2-inch water services shall be either Type K soft copper or high density polyethylene (HDPE) DR-9 tubing with CTS size, conforming with AWWA C-153/ANSI A-21.53, with joints meeting AWWA C-111/ANSI A-21.11 standards. All HDPE tubing shall utilize solid 304 tubular stainless steel insert stiffeners, dimpled and flanged to retain placement within the service line. 4-inch and Larger Service Pipe. Water service piping, fittings and valves and appurtenances shall conform with Section 8.02 for respective components.

(5) Meter Setters, Meter Boxes/Pits, Rings and Covers, and Extension Rings, Meter and Meter Reading Unit. Shall be in conformance with the City of Topeka Water and Sewer Utilities Installation Standards.

M. Bid Items, Measurement and Payment.

(1) Bid Items:

- (*) **WATERLINE (size, class and material)** Unit: LINEAL FOOT (nearest L.F)
 - (*) **TEE AND BLOCK (size)** Unit: EACH
 - (*) **CROSS (size)** Unit: EACH
 - (*) **BEND AND BLOCK (size, degree bend)** Unit: EACH
 - (*) **REDUCER (size)** Unit: EACH
 - (*) **ANCHOR SPOOL FITTING (size and type)** Unit: EACH
 - (*) **CONCRETE THRUST COLLAR** Unit: EACH
 - (*) **SLEEVE (size)** Unit: EACH
 - (*) **TAPPING SLEEVE (size)** Unit: EACH
 - (*) **GATE VALVE & EXTENSION STEM (size)** Unit: EACH
 (TAPPING Sleeve VALVE to be bid per GATE Valve size)
 - (*) **BUTTERFLY VALVE & EXTENSION STEM (size)** Unit: EACH
 - (*) **VALVE BOX AND COVER (Turf)** Unit: EACH
 - (*) **VALVE BOX AND COVER (Pavement, etc)** Unit: EACH
 - (*) **AIR RELEASE VALVE / ENCLOSURE (by type)** Unit: EACH
 - (*) **TEMPORARY BLOW OFF VALVE ASSEMBLY** Unit: EACH
 - (*) **FIRE HYDRANT AND BLOCK** Unit: EACH
 (FIRE HYDRANT BRANCH VALVE to be bid per Gate Valve)
 (FIRE HYDRANT BRANCH PIPE to be bid per WATERLINE)
 - (*) **TAPPING SADDLE & CORPORATION STOP (by size)** Unit: EACH
 - (*) **SERVICE PIPE (Type K Copper or HDPE) (size)** Unit: LINEAL FOOT (nearest L.F.)
 (SERVICE CONNECTION PIPE > 2" to be bid per WATERLINE)
 - (*) **TAPPING SADDLE (by Main & Tap Sizes)** Unit: EACH
 - (*) **CORPORATION STOP VALVE (size)** Unit: EACH
 - (*) **METER BOX/PIT AND TOP (size and type)** Unit: EACH
 - (*) **METER AND METER READING UNIT (size and type)** Unit: EACH
 - (*) **CONNECTION AT STATION XX+XX (location)** Unit: LUMP SUM
- (*) = nominal diameter of pipe or fitting, etc. XX+XX = Plan location of connection

(2) Measurement. Waterlines shall be measured along the installed pipe to the nearest foot. Fittings, blocks, collars, sleeves, saddles, and valves shall be measured per each of the various sizes and types installed. Hydrants, valve boxes and covers shall be measured per each installed. Connections to existing water lines shall be measured by the lump sum at each of the various locations such connections are made.

(3) Payment. Payment for completed and accepted work shall be made at the Contract unit price, which payment shall be full compensation for all excavation, materials, dewatering, bedding, laying, testing, backfilling, compaction and grading as specified; and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

8.03 CONSTRUCTION/INSTALLATION REQUIREMENTS.

The Contractor shall investigate all conditions affecting the work, arrange work procedures and schedule accordingly, and have, on hand, such pipe, fittings, valves hydrants, accessories and bedding materials required and necessary for meet the project site conditions and provide a complete installation. Generally, construction and material installation shall conform to AWWA C-600, "Installation of Ductile Iron Water Mains and Their Appurtenances" and AWWA Manual M-23, "PVC Pipe Design and Installation".

All work shall be performed and materials installed by qualified, trained and competent workmen in strict accordance with the manufacturer's instructions and recommendations. Material suppliers shall have a responsibility to provide the Contractor services of a field representative to instruct and train the Contractor on proper handling and installation of water pipe line materials as outlined in this document.

The pipe line and components shall be laid to the elevations shown on the Drawings and shall have a minimum finished depth of cover over pipe bells/couplings/fittings of NLT forty-two (42) inches under (below) existing or proposed future finished (gravel or turf) grade, not including pavement thickness in pavement locations.

A. Pipe and Materials Handling. All pipe, fittings, valves, hydrants and accessories shall be checked by the Contractor immediately upon delivery to the work site for compliance with this Specification and conformance to Engineer Approved Submittals and for damaged or defective material(s). Improper handling of pipe, fittings, valves, hydrants and accessories resulting in damage to respective material item(s) will be grounds for rejection of said material(s). Any damaged or defective material(s) so identified shall be moved to separate nearby location and shall be removed from the work site within 24-hours of discovery.

Handling (equipment) procedures shall be in accordance with the approved manufacturer's recommendations/guidance for proper handling of his products to prevent harm to material(s) coatings and linings. Improper handling of pipe or materials which results in damage to interior lining, exterior coatings will be grounds for rejection of said items from installation. The Engineer will be the sole judge as to the acceptability of any material item as being acceptable or not for installation into the work. Hooks shall not be used. Under no circumstances shall pipe or accessories be dropped or dumped.

Cutting of ductile iron pipe is discouraged, and the Contractor is urged to plan his job to minimize the necessity for cutting. Cutting of ductile iron pipe that absolutely must be done for insertion of valves, fittings, or closure pieces shall be by use of manufacturer approved cutting equipment, such as abrasive pipe saw, rotary wheel-cutter, guillotine pipe saw, milling wheel saw, or roller-chain cutter. Cut ends and rough edges shall be ground smooth and true, and for push-on joint connections, the cut end shall be beveled by methods recommended by pipe manufacturer. Pipe cuts for push-on joints shall be field marked for proper insertion lengths. The work shall be done by workman trained and experienced in pipe cutting and shall be accomplished in such a manner so as to not damage the lining or coating of the pipe.

Prior to installation, and lastly while suspended for placement into the trench, each pipe and fitting shall be inspected for defects, cracks and other deficiencies. The interior of all pipes, fittings and valves shall be thoroughly cleaned of all foreign matter before installation and shall be kept clean thereafter until the line is placed into service. Any coating damaged by the Contractor shall be repaired or replaced before placement into the work. Damaged exterior coating shall be recoated to the satisfaction of the Engineer by applying coal-tar or other coating material as specified for the original coating for the protection of the materials being installed.

B. Grading and Excavation. Grading and excavation preparatory to pipeline and appurtenance construction shall be performed in accordance with Section 3, Earthwork and Grading. All trenching shall be performed in accordance with Section 2, Trench and Structure Excavation, Backfill and Compaction.

Grading and excavation shall be performed in a safe and proper manner with suitable precautions being taken against all hazards. The Contractor shall explore and expose any and all obstructions in advance of excavation so that minor changes in grade and alignment may be made by the Engineer when required by field conditions. In paralleling existing water, furnish temporary service to the consumers with minimum interruption until permanent service can be restored by the Contractor.

C. Trench Excavation. The Contractor shall not open more trenches in advance of pipe laying than is necessary to expedite the work. One block or 300 feet whichever is the shorter, shall be the maximum length of open trench ahead of pipe laying unless by written permission of the Engineer. Except where Tunneling-Boring and Jacking-HDD-Pipe Bursting is specified and shown on the Drawings, all trench excavations shall generally be open-cut.

The Contractor shall excavate the bottom of the trench to the line, grade and elevation as required on the Drawings and in this Specification. The excavation and the width of the trench shall be as specified in Standard Drawing Detail DT-007. If the water main is being installed in a location where pavement is not otherwise planned for removal or replacement as a part of the same project, pavement removal shall be as specified in Section 4.06.

No classification of excavated materials will be made unless otherwise indicated in the Project Documents or provided for on the bid form. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work regardless of the type, character, composition, or condition thereof. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

Any part of the trench excavated below required trench grade shall be corrected with placement of additional Bedding material by the Contractor at no cost to the Owner. Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen. Trench bottoms which are otherwise solid but which become mucky on top due to construction operations shall be reinforced with one or more layers of ¾" crushed stone as approved by the Engineer. Not more than ½-inch depth of mud or muck shall be allowed to remain on (stabilized) trench bottoms when the pipe bedding material is placed thereon.

The alignment and grade or elevation of the pipeline shall be as shown on the Drawings. The Contractor must maintain a constant check of the pipe alignment and trench depth (vertical pipe grade) and will be held responsible for any deviations there from. Unless otherwise shown or indicated on the Drawings or unless otherwise set forth by the Engineer, the horizontal and vertical alignment of the water main shall be maintained to within the following tolerances: Horizontal 3-inches; Vertical 1.5-inches with minimum 42" Depth of Cover as defined in Subsection 8.03 (general).

Except where otherwise shown, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe and as required in the Project Documents. Greater pipe cover depths may be necessary on existing pipe, conduits, drains, drainage structures, or other obstruction encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finish grade or pavement surface elevations.

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 as required on the Project Documents. The surface of pipe Bedding shall be graded to provide a uniform bearing and continuous support for each pipe at every point along its entire length.

Unless shown otherwise on the Drawings or noted in the Special Provisions, 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 Project Documents or a subsurface information report to determine the approximate location of soil types and depth of rock. Resistance to penetration was generally 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.

All rock excavation shall be carried to a minimum of 6-inches below the bottom of the standard trench bottom. Bedding 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, and remove any rock or boulders from being placed (accidentally or otherwise) within excavated trench to 2-feet above the pipe line.

D. 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 width below an elevation 6-inches above the top of the installed pipe shall be as described on Standard Detail Drawing DT- 007.

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

E. Removal of Water. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the work in accordance with Section 2.04 "Control of Ground & Surface Water".

All excavations for concrete structures or trenches which extend down to or below static groundwater elevations shall be dewatered by lowering and maintaining the groundwater surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment. Ground water shall be controlled as specified in Section 2.04, Control of Ground Water & Surface Water. Trench stabilization shall be as specified in Section 2.05 "Stabilizing Trench Bottoms" and 2.06 "Stabilizing Structure Subgrade". Removal of water is subsidiary.

F. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, or shored as necessary in accordance with Section 2.03 "Sheeting and Bracing". Trench Shoring and bracing is subsidiary. Trench sheeting shall not be pulled unless pipe strength is sufficient to carry trench loads based on trench width or disturb the design pipe line grade/alignment to the back of sheeting. Sheetting may not be pulled after backfilling, unless so directed by the Engineer. Where 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 as pipe embedment is being completed.

G. Bedding. The Contractor shall not place bedding material until the excavation has reached the required sub-grade. Bedding for PVC, PVCO and FPVC pipe shall be per AWWA Manual M-23. Bedding for pipe line materials shall be as shown in the Project Documents. Bedding shall be placed and compacted as specified for Type 'A' Compaction or as shown on the Drawings. Furnishing and placing Bedding material is subsidiary.

H. Laying of Pipe Line Materials. Every precaution shall be taken to prevent foreign material from entering the pipe line while materials are stored/stock-piled for use and while it is being placed. If the pipe laying crew cannot put the line into the trench without foreign material entering the pipe, the Engineer may require that the exposed end(s) of the pipe be enclosed in canvas bags configured with drawstrings so that the material cannot enter the exposed pipe. Pipe shall be placed in a flat bottom trench accurately graded to uniformly support the entire length of the barrel of the pipe with bell holes excavated for the joints.

At times when laying pipe is not in progress, the open ends of the pipe shall be "closed" or "covered" by use of plywood, plastic or inflatable plugs secured in such manner that debris and/or water due to trenching or water line leakage, rainfall or infiltration cannot occur. The Contractor shall ensure that all pipe, fittings and valves shall be thoroughly cleaned of all foreign matter before installation and shall be kept clean until the pipe line is put into service. 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. Such affected surfaces shall be wiped clean, and if necessary, wire brushed, and kept clean until jointing is completed.

Pipe shall not be laid in a wet trench. In the event surface or groundwater accumulates in the trench, the excavation shall be dewatered to permit the work to continue. At times when the pipe laying is not in progress and at the close of the days' work or for other reasons, such as rest breaks or meal periods, the open end(s) of the pipe shall be closed by watertight plug(s) secured so that no water from the trench may enter the pipe. Critter-proof plugs may be used when watertight plug(s) are not required. Sufficient backfill material shall also be placed over the pipe to prevent flotation.

If water accumulates in the trench, the watertight plug(s) shall remain in place until the trench is free of standing water and mud that may enter the pipe. Pipelines in place shall not be used for draining trenches. Dewatering of trenches is subsidiary.

Except where necessary for making connections with other lines, pipe shall be laid with the bells facing in the direction of progress. Except at closures, or when authorized by the Engineer, not more than two (2) lengths of pipe shall be in position ahead of each made-up joint. 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 appurtenances shall be rejected and marked as such and removed from the work site immediately.

For push on pipe, the spigot shall be inserted into the bell to the line on the spigot. The previously completed joints must be braced so the line does not become “stacked”, “over belled”, or inserted past the reference mark on the spigot for current or previously placed pipe(s). If the insertion mark is not visible after assembly, the joints shall be disassembled and re-done correctly. The gasket seat in the bell shall be wiped clean after which the gasket should be placed. A thick film of lubricant should be applied to the entire inner surface of the gasket and on the spigot end of the pipe. The lubricant and the gaskets shall be as recommended and supplied by the manufacturer of the pipe being used. The lubricant shall be odorless, tasteless, nontoxic, and suitable for use in potable water via NSF 61 approval. Field-cut pipe shall be beveled by filing or by mechanical means to remove any sharp or rough edges that might otherwise damage the gasket.

Restrained joints and anchoring joints shall be installed in strict accordance with the pipe manufacturer's recommendations and this Section

Alignment of pipe or runs intended to be straight shall be laid straight. For ductile iron pipe, changes in horizontal or vertical alignment may be achieved by deflection at the joints when so indicated on the Drawings. Joint deflection shall not exceed the values listed in Tables 2 and 3 of AWWA C600 for push-on-type joints and mechanical joints, respectively, or the pipe manufacturer’s published limits. For PVC and PVC-O pipe, changes in horizontal and vertical alignment may be achieved by longitudinal bending when so indicated on the Drawings. Longitudinal bending shall not result in a bending radius less than the minimum listed in Tables 2 and 3 of AWWA C605 for gasket-joint pipe and fused-joint pipe, respectively. When gasket-joint pipe is bent, the Contractor shall block or brace the pipe joints to ensure bending the pipe does not result in joint offset that exceeds the manufacturer’s published limits. Pipe shall be protected from lateral displacement by pipe embedment material when being placed as specified. Under no circumstances shall the pipe be laid in water, and no pipe shall be laid under unsuitable trench conditions.

I. Tracer Wire. Tracer wire shall be installed along all pipe and service lines and along all fire lines along the top 120-degree sector of each pipe line and on all service laterals to the meter (required to be connected with main line tracer wire). Tracer wire shall be taped to the top of the each pipe line at Not Greater Than (NGT) three (3) foot intervals to retain the wire over the central top area of the pipe.

Tracer wire shall be extended to the ground surface and terminated in a tracer box. Tracer boxes shall be installed at all fire hydrants located 12 inches from the barrel of the hydrant, and positioned 180 degrees from the 4.5-inch pumper nozzle. Tracer wire shall also be extended into pits/vaults and manholes with 2-foot pig-tail.

The Contractor shall prepare a continuity test on all tracer wire in the presence of the Engineer. If the tracer wire is found to be not continuous after testing, the Contractor shall repair or replace the failed segment of wire.

J. Corrosion Protection Wrap. The poly-wrap shall be wrapped as snugly as practicable without stretching or compromising wrap via soil/bedding compression or filling with bedding materials when backfilling trench. Any sections of wrap that are punctured or otherwise compromised in any manner during installation shall be either re-wrapped or the original wrap removed/discarded and new poly-wrap installed. The poly-wrap tubing on pipe line sections shall be folded in a reasonably snug manner along the pipe length and taped at NGT three (3) foot intervals along the pipe length, with end wrap overlaps of 1-foot at each end and with outer layer ends taped around the full circumference of pipe or valve or fitting or hydrant barrel NLT three (3) full turns with tape.

K. Bedding and Cover. Initial Bedding material shall be placed in finished excavated trench bottom as shown on the Drawings and in accordance with trench conditions. Bedding material shall be spread in a uniform manner to provide a consistent support for pipe and other accessories when placed. When the correct horizontal and vertical alignment is confirmed, additional Bedding material shall be “sprinkled” or “loosely spread” over the pipe and accessories in a fashion to assure material filling the space along the pipe haunches and so as not to displace alignment until material covers the pipe as required. Bedding material shall not be “dumped” into the trench or directly onto the pipe.

L. Fittings, Valves and Valve Boxes Installation. Fittings, valves, valve boxes and air release valves shall be installed at the locations shown on the Drawings. All valves and fittings shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded, or rolled. Valves shall be stored at all times in a safe manner to prevent damage and kept free of dirt, mud, or other foreign matter. All valve gaskets shall be stored and placed in a cool location, out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis. Gate valves and fittings shall be set and joined to new pipe in the manner specified herein for the placement, and joining of pipe. All butterfly valves operators shall be oriented on the north or west side.

Valves and Valve boxes shall be firmly supported, centered, and plumbed over the operating nut of the valve, with the top of the box brought flush with the finished grade. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped on each side of the box.

All connections requiring bolts shall be installed and tightened in strict accord with manufacturer’s installation instructions. Nuts-bolts shall not be over tightened, but shall meet the recommended torque tightness by manufacturer in accordance with Submittals.

M. Anchoring and Blocking. All bends, tees, crosses and plugs installed shall be provided with concrete blockings and restrained joint type connections. In all cases concrete shall conform to the dimension and neat lines detailed on the Drawings and shall be placed directly against undisturbed trench wall opposing the thrust of the pipeline. The trench wall is to act as a form for the concrete, which shall be vertical and shall be hand finished to a smooth, firm surface. If necessary for wall stabilization, the trench wall shall be given a “plaster” coat of cement mortar. No concrete or blocking shall be placed within 3 inches of the jointing area. All blocking shall have formed neat lines and smooth (troweled) surfaces.

All valves not spooled to fittings shall have a concrete thrust collar located on each side of the valve as shown on the Drawings. Fitting or provision of special pipe collar for thrust collar is subsidiary.

No concrete shall be placed until excavation has been approved by the Engineer. Should over- excavation occur, the Contractor shall fill the over-excavated areas with concrete at their sole expense. All steel clamps, tie rods, anchor bolts and other structural or anchorage shapes used in anchors and blocking, but not encased in concrete, shall be stainless steel 304-316.

Concrete Blocking shall not be backfilled over until 75% of the Type I concrete's design compressive strength is attained based upon cylinder breaks or until the concrete has cured for 7-days.

When concrete Type III cement is used, backfilling may be completed after the concrete has cured for 3-days.

If the blocking contains 1% calcium chloride, the pressure testing can begin 8 hours after the block has been poured.

N. Tapping Sleeves and Valves. When shown on the Drawings, the Contractor shall furnish and install the tapping sleeves and valves. The Water Division will make the actual wet tap and test the installation for leaks. After the tap is complete, the Contractor shall complete the piping connections and set the valve box and cover.

O. Fire Hydrants. Hydrants shall be installed at locations shown on the Drawings or as directed by Engineer, and shall include all necessary excavation, bedding, blocking and backfill to make the installation complete. Each hydrant shall be inspected before installation for direction of opening, nozzle sizes, threading, caps & chains, operating nut, tightness of pressure- containing bolting, cleanliness of inlet elbow and weep-hole openings and handling damage or cracks/chips. Defective hydrants shall be corrected or replaced timely.

Hydrants shall be set to a grade that allows their proper operation, and installed plumb and true. The weep holes of the hydrant shall be kept clear and free to drain. Traffic hydrants will be set with the break-away joint above the finished grade line. Hydrants behind curbs shall be placed with the hydrant centerline at least 36-inches from back-of-curb. The areas around each hydrant (and branch valve in turf/gravel) shall be thoroughly compacted to prevent settlement of these areas.

The Contractor shall "black bag" hydrant until operational and rotate the hydrant pumper nozzle for proper orientation following the system becoming operational. Temporary hydrants shall be cleaned and delivered to the Owner in sound condition and proper working order, with all normal components.

P. Backfill and Compaction. The Contractor shall not backfill over pipes before the Engineer approves pipes as being set on line/grade and properly joined. Backfill and compaction shall be completed as specified in Section 2.09 "Compaction" and 2.10 "Backfill". Backfill and compaction are subsidiary.

Q. Connection to Existing Mains. Water shall not be allowed to flow from the new pipe line into existing pipe lines until the new line has been thoroughly flushed, disinfected, tested and approved by the Engineer. Subsequent to approval, the Water Division will close the necessary valves and the Contractor shall make the connections at the locations indicated in the Project Documents using the types of fittings and lengths of straight pipe called-for or as may be required by field conditions. The Contractor shall excavate the main(s) to provide a safe working area of sufficient size for pipe removal and installation of new fitting(s), valve(s) and straight pipe.

The excavation shall extend below the pipeline to be removed to provide a minimum working space adequate to allow for pipe cutting, installation of fittings/valves, and collection/pumping of released water. For system interconnects, the Contractor shall place a four inch thick concrete 'working slab' a minimum of two and one-half feet below the new fitting(s) and valve(s) to be installed. This 'working slab' is to provide temporary support of the new and existing piping/fittings until final blocking, bedding and backfilling can be completed and will be considered subsidiary.

It may become necessary to test the new pipeline in segments, omitting the required testing of some connections with existing pipelines as specified for new construction. In either case, the methods of testing or sterilizing shall be approved by the Engineer. This work shall be subsidiary to fittings.

The Contractor shall employ the services of a mechanical contractor to air out any reconnected fire service or service line (4-inch diameter and larger) or make arrangements with the customer upon completion of the connection to the new main so that the customers personnel may air out the service. The mechanical contractor shall be duly experienced, licensed and permitted for this work. The cost of this work shall be subsidiary to the water line installation.

Connection to existing mains shall be so scheduled and timed as to cause the least possible interference with the operation of existing mains and service to existing customers, as approved by the Engineer. The fire line backflow device shall be tested and reported as required.

R. Temporary Blow-Off Assemblies. Temporary blow off assemblies shall be constructed at the locations and in the manner indicated in the Project Documents or as directed by the Engineer as necessary to pressure test and disinfect water pipes. Construction shall be as per the manufacturer's recommendations or as specified in the Project Documents. Blow-offs shall discharge at a location designated by the Engineer. Hosing may be required to convey blow-off to the desired point of discharge.

S. Conflicting Utilities. The Contractor shall excavate the utilities that are to be crossed by pot-holing a minimum distance of 150-feet in advance of the work-in-progress to allow the Engineer sufficient time to check the grades and to communicate with the owner(s) of those utilities reasonable time to relocate such conflicts, should that become necessary. Any delay resulting from the required relocation of a conflicting utility crossing or their appurtenances will not be grounds for additional payment to the Contractor.

T. Pavement Replacement. Unless otherwise indicated in the Project Documents, the Contractor shall replace pavement as specified in Subsection 4.06, Pavement Removal/Replacement.

U. Surface Restoration. In areas where turf is the required restoration, the top portion of the backfill beneath established finish grades shall be finished with not-less-than four inches of compacted viable topsoil, and shall be topsoil salvaged during the excavation and trenching operation whenever practicable and as directed by the Engineer. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by disking or scarifying to a depth of two inches to permit 'bonding' of the topsoil to the underlying soil surface.

Areas designated with "topsoil and seeding" shall have topsoil pulverized and smoothed, fertilized, seeded, rolled to press seed into soil and mulched. Areas designated to be "sodded" shall have topsoil pulverized and smoothed, designated variety of sod grass placed with tight joints and staked, followed by rolling of entire area to smooth, level and compact the sod and topsoil layers.

V. Stream Crossings. Stream crossings shall be made in accordance with these Specifications and as shown on the Drawings. The trench width shall be as required for proper pipe installation and the trench depth shall be sufficient for a minimum of 7 feet of cover over the top of pipe. Pipe encasement, where required, shall be in accordance with the Specifications and placed as indicated on the Drawings. All work performed and all operations of the Contractor, their employees, or his subcontractors within the limits of stream crossing shall be in conformity with all the requirements, regulations and be under the control (through the Engineer) of the authority owning or having jurisdiction over and control of the right-of-way.

Where the pipe is to be installed inside a casing pipe or tunnel liner, polyethylene casing spacers shall be strapped to each pipe before it is placed in the casing pipe or tunnel liner in accordance with these Specifications and as shown on the Drawings. The ends of each casing pipe or tunnel liner shall be closed with a minimum 1/8-inch neoprene rubber end seal with stainless steel bands or as shown on the Drawings. The closures for each casing pipe or tunnel line shall not be constructed until all testing of the line has been completed and accepted.

W. Highway and Railroad Crossings. The Contractor shall make highway and railroad crossing in accordance with these Specifications, the Special Provisions and as shown on the Drawings. All work performed and all operations of the Contractor, their employees, or their subcontractors within the limits of highway or railroad rights-of-way shall be in conformity with all the requirements, regulations and be under the control (through the Engineer) of the authority owning or having jurisdiction over and control of the right-of-way.

Where the pipe is to be installed inside a casing pipe or tunnel liner, the work shall be performed in accordance with Subsection 2.12, "Tunneling and Boring". The closures for each casing pipe or tunnel line shall not be constructed until all testing of the line has been completed and accepted.

X. Water Services.

(1) Service Connection Taps. The Contractor shall furnish/install saddle and corp; Water Division will make the actual wet tap. After the tap is complete, the Contractor shall complete the piping connections and set the meter setter, box and cover.

(2) Service Connection Pipe: 1", 1.5" and 2". Piping shall be P.C. 305 rated and CTS OD and be continuous from main to meter box with no intermediate couplings, unless approved by the Engineer. Polyethylene water service line must be laid with tracer wire using metal inserts with all fittings. NOTE that 3" PE or other type water service lines from main-to-meter shall not be permitted.

(3) Service Connection Pipe: 4" and larger. Pipe installation shall conform with mainline pipe of corresponding sizes and materials. All Service Pipe shall be laid with Tracer wire.

8.04 ABANDONMENT / SALVAGE OF UNUSED WATER MAINS - SERVICES:

A. Abandonment Requirements. All existing water mains, appurtenances or service lines that will not be re-used in the new construction, or re-used for reconstruction of existing building sites shall be abandoned in a manner pre-approved by the Engineer. All water main appurtenances (valves, hydrants, etc.) shall be abandoned by removal of subject appurtenances and installing a plug or cap, as appropriate, using type 304/316 SS bolts and nuts (Teflon coated).

Main, appurtenance and/or service abandonment at the street main shall be a condition of any site demolition permit(s) issued or in the case of duplication, service lines that will remain unused on new or reconstruction. All water service lines 2-inch diameter and smaller shall be abandoned by turning off the corporation tap stop valve, disconnecting and removing 2 – 3 feet of service line, removing corp valve and installing a standard brass plug on saddle. The brass cap (and plug) shall be Ford copper tube nut with FIP on the small end and MIP nut (part # C01.xy and C08.ab) or as approved by the Engineer. The remaining service line may remain abandoned in place.

B. Salvage Requirements. The Contractor shall carefully remove and salvage valves, fittings or other designated waterline appurtenances and transport them to a location designated by the Engineer. Removal shall include any concrete blocks interfering with the removal of the designated item or interfering with intended extension or modification of the waterline. No extra payment shall be made for the removal and disposal of concrete or blocks.

Removal of valves, fitting or other appurtenances shall be accomplished by unbolting the valve or fitting, if possible. If corrosion prevents removal by unbolting, the item shall be removed by neatly cutting or sawing the existing water line or appurtenance as close to the item as possible. Where the existing line is to remain in service, removal shall be accomplished in such a manner that rejoining of the water line can be accomplished with as few joints and/or sleeves as possible. Where the existing waterline is to be abandoned in place, it shall be plugged with concrete or another suitable device to provide a permanent watertight seal.

Items to be salvaged and removed shall be lifted and handled with care and in no case shall be dropped, thrown, skidded or rolled. The Contractor shall clean salvaged items to be free of dirt and debris prior to delivery to the Owner.

8.05 PRESSURE TESTING AND LEAKAGE ALLOWED

A. General. After installation, all newly installed mains shall be flushed and pressure/leakage tested and disinfected by chlorination prior to final acceptance. All flushing work shall be done in the presence of the Engineer's Representative. The Contractor shall notify the Engineer at least 24 hours in advance of the times and places at which flushing work is to be done and how. Water Services Division personnel will operate all existing system valving and contractor installed valves that control flow of potable water, with the Contractor manipulating the new water main valve(s) and hydrant(s) to slowly fill the new main and remove/expel all air from the section of water line being tested. When hydrants are in the test section, the test shall be made against closed hydrant valve(s); any service or fire line(s) installed shall be tested to their terminus.

Pipe and accessories to be tested shall be filled slowly with potable water at a maximum velocity of 1.0 ft per second while venting air. After filling, lines shall be flushed at blow-offs and dead-ends at a minimum velocity of at least 2.5 feet per second in the pipeline to be tested. Flushing shall be carried out until turbidity-free (< 5 NTU or system ambient values) water is obtained from all points along the main. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity and pigging of the main may be required.

A minimum of one (1) change (up to three changes without charge to Contractor for water volume usage) of treated water shall be used in the flushing operations. A special pipeline pig may be required when the required flushing velocity cannot be achieved or when needed to conserve water during water use restriction period or to remove caked deposits or to prevent erosion damage, nuisance or traffic interruption, as directed by the Engineer. The Contractor shall make provisions for launching and retrieving the pig at no additional charge or cost to Owner.

Valves shall be closed slowly to prevent excessive surges while maintaining positive pressure at all times throughout the pipeline section being tested. Flushing water shall be discharged without causing erosion damage, nuisance or interruption of traffic. Flushed water will be tested for Total Chlorine Residual, and if greater than 0.5 mg/L, then discharged water shall be de-chlorinated by the Contractor using Engineer approved method(s) as provided herein.

The Contractor shall provide the pressure gauges reading from 0 – 200 psig with intervals not exceeding 5 psi, measuring meter capable of reading to nearest 0.10 gallon increments, injection booster pump, pipe/hoses, connections and other necessary apparatus and the necessary labor to conduct the test. Prior to filling the pipeline test section(s) and prior to performing the actual test, the Contractor shall place sufficient backfill and thrust blocking or other types of restraining systems to prevent pipe movement, but before placement of final surfacing.

When existing water mains are used to supply test water, they should be protected from backflow contamination. Tests shall be performed only after the pipeline test section(s) have been properly filled, flushed and purged of air. After flushing and when hydrants are in the pressure test section, the test shall be made against the closed hydrant valve.

The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipeline in manner approved by Engineer. The test pressure shall not exceed the design pressure of the pipe, fittings, valves and hydrants and thrust restraints as herein provided. During tests, the system and exposed pipe, fittings, valves and hydrants shall be carefully inspected for leakage; visible leaks shall be stopped and defective elements shall be repaired or removed/replaced and the test repeated until the pressure test requirements have been met.

The Contractor shall perform hydrostatic test (pre-test) of the test segment at the specified test pressure(s). The pre-test shall continue until the Contractor has satisfied himself that the test segment will pass the hydrostatic test. In general, pressure and leakage testing shall conform to applicable sections of AWWA C-600 and C-605 and as required herein.

B. Test Duration. The duration of the final hydrostatic test shall be a minimum of two hours at the required pressures for the test section. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic test. This may require several cycles of pressurizing and bleeding trapped air prior to beginning the final test.

C. Test Pressure. The test pressure shall be no less than 150 psig for PVC, PVCO, FPVC, and DIP pipelines. The hydrostatic test pressure shall not be less than 1.25 times the stated sustained working pressure at the highest elevation along the test section, and not less than 1.5 times the stated sustained working pressure at the lowest elevation of the test section. In the event that the lowest and highest elevations of the section being tested exceeds 58.0 feet, the pipeline section to be pressure tested shall be reduced in length such that the segment to be tested conforms with the foregoing criteria and pressure requirements.

The hydrostatic test pressure shall not vary by more than +/- 5.0 psig for the duration of the test period. The test pressure shall be maintained within this tolerance by adding make-up water through the metered pressure test pump into the pipeline test segment. All make-up water added shall be accurately measured in gallons (and fractions thereof) by suitable methods. The total make-up water added during and at the conclusion of the test period to reach the required test pressure shall not exceed the calculated leakage allowance for the pipeline segment being hydrostatically being tested.

D. Testing Allowance: Leakage. No pipe installation will be acceptable if the leakage is greater than that determined by the following formulas for: PVC, PVCO, FPVC or DIP. When multiple pipe sizes are concurrently being tested, the allowable leakage shall be calculated based on the sum of leakages determined for each size of the tested segment. No pipe installation will be acceptable if the actual measured leakage is greater than that determined by following formula.

$$Q = \frac{L \times D \times P^{0.5}}{148,000}$$

where,

Q = allowable leakage, in gallons per hour

L = length of pipe tested (by size), in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, based upon high and low points within the segment size tested, in pounds per square inch

The above equation is based on a leakage rate of 10.5 gallons per day per mile per inch of nominal diameter of pipe. Leakage values determined by the above formula for 1000 feet of pipe are presented in Table 2, Section 7.3, AWWA C-605.

During the test(s), the new system and exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. Visible leaks shall be stopped. Defective elements shall be repaired or removed and replaced and the test repeated until the test requirements have been met.

A swift loss of water pressure in the main could be the result of a break in the line, major valve opening, loose mechanical joint bolts, missing or dislodged gasket, or inadequate thrust block. A slow loss of pressure in excess of allowable limits could be the result of minor problems such as a leaking valve or a corporation stop not completely shut off. In addition, air entrapped in the line can result in an apparent leakage in excess of the allowable limit.

Recommendations for avoiding minor leaks include the following:

- Vent all high points in the line by use of air release valves, corporation stops or hydrants.
- Check all mechanical joint bolted connections.
- Cure concrete thrust blocks before testing.
- Insure that exposed gasket grooves are properly cleaned before inserting gaskets.
- When inserting pipe into a mechanical joint or gasket joint, insure that the spigot end is squarely cut and beveled properly for the hub.

One approach for determining if the apparent leakage is the result of air entrapped in a line is to immediately repeat the leakage test (i.e., continue the test for another two hours) and determine the amount of make-up water required to fill the line a second time. If this amount is significantly less than the first filling, the difference in apparent leakage is probably the result of air being present in the line. If no significant difference in make-up water is recorded, a leak is probable.

8.06 DISINFECTION OF PIPELINE

A. General. While bacteriological testing in accordance with this subsection is used to verify that absence of coliform organisms and is generally accepted as verification that disinfection of the pipeline has been accomplished, coupled with adequate flushing of the line before disinfection, is necessary to ensure that the disinfected pipeline will be ready for connection to the water system. Failure to pass the bacteriological test requires that the flushing or disinfection process be repeated by the Contractor. It must be remembered that the final water quality test is not the primary means for certifying the sanitary condition of a main. The sanitary handling of materials, the practices during construction, and the continual inspection of the work are the primary means for ensuring the sanitary condition of the water main.

Of the three methods described in ANSI/AWWA C-651, only one method will generally be described herein for use: the continuous feed method. Of the three forms of chlorine that may be used in the disinfection operations, only two (2) forms will be acceptable for use: sodium hypochlorite solution and calcium hypochlorite granules mixed into solution conforming to ANSI/AWWA B-300.

Sodium Hypochlorite Solution contains between (+/-) 5 % and 15 % available chlorine and the storage conditions and time (age) must be controlled to minimize its deterioration. Note that available chlorine is usually expressed as a percent of Weight when the concentration is 5 % or less, and usually as a percent of Volume for higher concentrations. i.e. Percent x 10 = grams of available chlorine per liter of hypochlorite.

Calcium Hypochlorite is available in granular form and must contain about 65 % available chlorine by Weight. Prior to use, the material should be stored in a cool, dry and dark environment to minimize its deterioration. Note: Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

B. Basic Disinfection Procedure. The basic disinfection procedure consists of multiple steps and procedures to ensure successful disinfection of the pipeline.

- (1) Inspecting materials delivered to the work site and at the time of installation to ensure their integrity.
- (2) Preventing contaminating materials from entering the water main during storage, construction, or repair and noting potential contamination at the construction site.
- (3) Removing by flushing or other means, those materials that may have entered the water main or accessories.
- (4) Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
- (5) Protecting the existing distribution system from backflow caused by hydrostatic pressure test and/or disinfection procedures.

- (6) Documenting that an adequate level of chlorine contacted each pipe and accessory to provide disinfection.
- (7) Determining the bacteriological quality by laboratory test after disinfection procedures.
- (8) Final connection of the approved new water main to the active distribution system.

The continuous-feed method consists of mixing the Hypochlorite granules into a concentrated mixture to create a strong chlorine concentrated solution and feeding the solution into the pipeline to achieve an initial free chlorine concentration throughout the pipeline. The potable water and chlorine solution shall result in the entire pipeline and components being disinfected with a free chlorine residual of not less than 25 mg/L after a 24-hour holding period.

At a point not more than ten feet downstream from the beginning of the new main, water entering the main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 50 mg/L initial free chlorine in the pipeline. To ensure that this concentration is provided, measure the chlorine concentration at regular intervals in accordance with the procedures described in the current edition of Standard Methods for the Examination of Water and Wastewater, or AWWA Manual M-12, or using appropriate Serim Monitor for Chlorine free chlorine test strips as manufactured by www.SanitationTools.com. Solutions of one (1) percent free chlorine may be prepared with either type hypochlorite granule. For Calcium Hypochlorite solution requires one 10 lbs. of granule in eight (8) gallons of water.

Chlorine application shall not cease until the entire main and all included accessories are filled with heavily chlorinated water. The chlorinated water shall remain in the main for at least 24- hours, during which time valves, hydrants and service lines in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of this contact period, the treated water in all portions of the main shall have a residual of not less than 25 mg/L of free chlorine.

C. Final Flushing. After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with the pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself and appurtenances, the heavily chlorinated water shall be flushed from the main, fittings, valves, and all branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or that is acceptable for domestic use.

The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, the Contractor shall use a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine. State or local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

Chlorine residual of water being disposed shall be neutralized by treating with Ascorbic Acid. Periodic grab samples shall be taken after a travel distance of about 250 to 300-feet from the de-chlorination chemical addition point with chlorine residual being measured. De-chlorination chemical addition will be adjusted to achieve a chlorine residual of not more than 0.2 mg/L.

D. Bacteriological Samples and Testing. After the flushing and disinfection procedures have been accomplished, representative samples will be collected for each increment of 1200-feet or portion thereof and from the beginning and from the end of the line and on all branch lines by trained Water Division personnel. Sample(s) shall be analyzed promptly following collection by a State recognized water testing laboratory for: chlorine residual, Turbidity, pH and a standard heterotrophic plate count (HPC) test, including coliforms. Unless otherwise provided, the Water Treatment Plant Laboratory will perform bacteriological analyses of the first and second series of samples on each test segment without charge. A record or report of the bacteriological test results for each sample tested shall be provided to the Contractor and to Engineer's Representative for the Owner's project record files.

If sample results from the lab indicate a measured HPC greater than 500 colony-forming units per milliliter (cfu/ml), flushing should be resumed and another series of bacteriological samples collected and analyzed until no coliforms are present and the HPC is less than 500 cfu/ml. If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the main test segment may be re-flushed and shall be re-sampled. If check samples also fail to produce acceptable results, the main test segment shall be re-chlorinated by the continuous-feed method until satisfactory bacteriological results are obtained.

All additional flushing and/or disinfecting and for bacteriological sampling and analyses costs over and above a second series may be back-charged to the Contractor, including Engineer's Representative time.

E. Final Connections to Existing Mains. All water mains and appurtenances must be completely installed, flushed, disinfected, and satisfactory bacteriological results received prior to permanent connections being made to the active distribution system. Sanitary construction practices must be followed during installation of the final connection(s) so that there is no contamination of the new or existing water main with foreign material or trench /ground water.

Connections shall have all pipe-fittings-valves required for the connection sprayed with a minimum one to five (1 – 5) percent solution of chlorine just prior to being installed. During the time that the connection piping awaiting installation and after the spraying procedure, the ends of the piping must be covered with plastic wrap, watertight plug(s), cap(s) or means acceptable to Engineer.

8.07 SEPARATION OF WATER MAINS AND OTHER POLLUTION SOURCES

The Contractor shall notify the Engineer in accordance with requirements of the Kansas Department of Health and Environment (KDHE), if, during the performance of the work, the Contractor encounters or uncovers a known or unknown source of pollution. The Engineer will inspect the known or suspected point of pollution and advise the Contractor as to what course of action shall be taken prior to continuation of the installation of the water main or appurtenances.

A minimum horizontal distance of ten (10) feet shall be maintained between the barrel OD of new main and any sanitary or combined sewer, force main, sanitary or combined sewer manhole. When the new water main or appurtenance crosses below the sanitary sewer or is within two feet above the sanitary sewer, the sewer shall be encased in concrete or constructed of ductile iron pipe or DR-14 pressure class PVC type pipe with full pipe length centered over water pipeline, as detailed on the Drawings.

END OF
SECTION