SECTION 501 - WATER SYSTEM PIPELINES

1. GENERAL

Pipelines for water systems shall conform to the following specifications and shall be installed at the locations indicated on the drawings.

2. TRENCH AND BACKFILL

Trench excavation and backfill shall conform to the requirements of the Section 101, entitled "Trench and Backfill." Minimum depth of cover for ductile iron, PVC, and HDPE pipeline shall be fifty-four inches (54”) below the finished grade. The minimum depth of cover for water service lines shall be forty-two inches (42”) below the finished grade.

3. DUCTILE IRON PIPE

Ductile iron pipe (DIP) shall conform to AWWA Specification C-151. All pipe shall have standard tar coating exterior and cement lined interior AWWA Specification C-104. Ductile iron pipe shall conform to NSF 372, Reduction of Lead in Drinking Water Act (2014), as applicable. All pipe shall have a minimum bursting tensile strength of 21,000 p.s.i. and 45,000 p.s.i. modulus of rupture. Thickness design is based on Laying Condition "A" or "Type I," unless otherwise noted. The pipe thickness classification shall be Class 50.

Prior to the installation of any pipe on the project, the Contractor shall be required to furnish in writing, proper certification from the manufacturer or a recognized testing agency, that the pipe fulfills every requirement of the specifications set forth above.

4. POLYVINYL-CHLORIDE PIPE

Polyvinyl chloride pipe shall conform to AWWA Specification C900 "Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 60-inch for Water", unless otherwise designated on the plans or special provisions. The pipe shall be Class 200 (cast iron O.D.) suited for a working pressure of 200 p.s.i. at 73ºF and shall be dimension requirements of **DR14**. Pipe shall be NSF 61 product certified and shall be Class 12454 PVC.

Provisions must be made for contraction and expansion at each joint with a rubber ring and integral thickened bell as part of each joint. Pipe shall be supplied in 20-foot lengths. A non- toxic lubricant shall be used to assemble all pipe and fittings. Gaskets and lubricants shall be NSF 61 product certified.

Each length of pipe shall have marked on the exterior the appropriate manufacturer and pipe specification information. Prior to installation of any pipe on the project, the Contractor shall be required to furnish in writing the proper certification from the manufacturer or a recognized testing agency that the pipe fulfills every requirement of the specifications set forth above.

5. HDPE Pipe

Pipe diameters from 4 to 65 inches shall be High Density Polyethylene (HDPE) as per AWWA C906. HDPE pipe shall be SDR 11 DIPS.

All material must be inspected two working days before the bore begins.

All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made.

All pipe and fittings shall be ductile iron pipe size. Iron pipe size may be used in certain applications if specified and/or approved by the Engineer.

All pipe and fittings shall be ANSI/NSF 61 product certified.

All pipe and fittings shall be made of materials conforming to polyethylene code designation PE 4710 meeting ASTM D 3350 cell classification 345464C.

Color Coding: The piping shall be permanently coded to provide service identification. Stripes along the entire outside length of the pipe, 120 degrees apart, shall be made by co-extrusion or impregnation in accordance with the following schedule. Fully colored pipe co-extruded from permanently pigmented HDPE is also acceptable.

Service	Striped Pipe	Solid-Colored Pipe
Potable Water	Blue stripes	Blue
Reclaimed Water	Purple stripes	Purple
Wastewater	Green stripes	Green

Markings on the pipe shall include the following:

Nominal size and OD base
Standard material code designation
Dimension
Pressure class
AWWA designation (AWWA C906)
Material test category of pipe

6. PIPE JOINTS

Ductile iron pipe joints may be flanged end, mechanical joint, or approved push-on type joint. Ductile iron pipe joints shall conform to AWWA Specifications C-111. Ductile iron pipe joints shall conform to NSF 372, Reduction of Lead in Drinking Water Act (2014), as applicable. Polyvinyl Chloride pipe joints shall conform to requirements of AWWA C900, Class 200, respective to the pipe specified, cast-iron (CI) pipe dimensions only, elastomeric-gasket joint only. Butt fusion welds shall be used for all HDPE pipe joints.

7. PIPE FITTINGS

All pipe fittings shall be NSF 61 product certified.

Ductile iron fittings shall conform to AWWA Specification C-110 or C-153 (compact fittings), and shall be of the class required by working pressures. Ductile iron fittings shall conform to NSF 372, Reduction of Lead in Drinking Water Act (2014), as applicable. All fittings shall have standard tar coating exterior and cement lined interior, AWWA Specification C-104.

Mechanical joint adaptors or flanges may be used to mechanically connect HDPE pipe to transition points with other pipe materials. This joining method shall be performed in strict accordance with the pipe manufacturer's recommendations.

8. INSTALLATION OF DUCTILE IRON PIPE AND FITTINGS

Ductile iron pipe, fittings, and accessories shall be handled in such a manner as to ensure delivery at the site of the work in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating. No other pipe or material of any kind shall be placed inside of any pipe or fitting. Cutting of pipe shall be done in a neat and workmanlike manner by a method which will not damage the pipe. Before installation, the pipe shall be inspected for defects. Any defective, damaged, or unsound pipe shall be rejected. All ductile iron pipe and fittings shall be installed in accordance with AWWA C600, Installation of Ductile Iron Water Main and their Appurtenances and/or the manufacturer's recommended procedures. Pipe shall be laid in a flat bottom trench with compacted backfill.

A polyethylene wrap shall be installed for all ductile iron fittings, valves, pipe, and appurtenances. Polyethylene wrap shall be clear for use with potable water, a minimum 0.008" or 8 mil thick low density film in accordance with AWWA C105. Polyethylene wrap shall be secured with vinyl adhesive tape or plastic tie straps.

9. INSTALLATION OF POLYVINYL CHLORIDE PIPE

Polyvinyl chloride pipe and accessories shall be handled in such a manner as to ensure delivery to the site of the work in sound, undamaged condition. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved methods.

Before installation, the pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place. The pipe shall be properly protected against the detrimental effects of heat, harmful chemicals and ultraviolet radiation. Special attention shall be given to the ends of each pipe section so that the outer roundness of the pipe remains virtually unchanged. Deformation of the pipe and fittings will make connections between sections of the pipe difficult or impossible and shall be reason for rejection. At the direction of the Engineer, the Contractor shall at no cost to the City conduct dimension tests of PVC pipe and fittings in accordance with ASTM D2122. Any pipe section or fitting not meeting the ASTM standards shall be rejected and replaced.

Cutting of pipe shall be done in a neat and workmanlike manner by a method that will not damage the pipe. All PVC pipe and accessories shall be installed in accordance with AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe Fitting for Water and/or the manufacturer's recommended procedures. Pipe shall be laid in a flat bottom trench with compacted backfill.

10. INSTALLATION OF HIGH DENSITY POLYETHYLENE PIPE

HDPE pipe and fittings shall be joined by butt fusion process into a continuous length of pipe at the job site. Fusion Welds shall be performed by an experienced technician that has been properly trained to meet the pipe manufacturer's procedures. The joining process shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations, including pipe temperature, alignment, and fusion pressure.

11. SANITARY PRECAUTIONS

Sanitary precautions shall be taken in laying new pipe, especially in preventing the introduction of foreign materials into the pipe. Water should be kept out of the trench where new pipe is laid and the open ends of the pipe shall be plugged or capped overnight to eliminate potential sources of contamination.

12. FITTING BLOCKING

All tees, crosses plugs, and all bends deflecting the alignment of six (6) inch and larger pipe lines by 22-1/2 degrees or more, shall be provided with thrust blocks, or restrained joints to prevent movement. Blocking shall be constructed of concrete poured against the undisturbed trench wall, forming a solid bearing area placed to the direction of the displacing pressure. Refer to Typical Blocking Details for minimum blocking dimensions. In lieu of concrete blocking, restraining glands may be utilized. The restraining glands shall be Megalug as manufactured by Ebba Iron Inc., GripRings as manufactured by Romac Industries, Inc., or equal.

To prevent pullout at material transitions, by movement of the HDPE pipe, the Contractor shall butt fuse Wall Anchors onto the HDPE pipe ends and pour concrete anchors around the Wall Anchor. The concrete shall be Class 1 as specified in Section 202 – Portland Cement Concrete.

13. WATER SERVICE LINES

Water service lines shall be Type K copper tubing and shall originate with appropriate tapping in the main and suitable adapter for compression type fitting connection terminating at curb cock. The Contractor shall place the curb box over the curb cock, within the prescribed limits and after the curb and gutter is in place. Water service lines shall be NSF 61 product certified and conform to NSF 372, Reduction of Lead in Drinking Water Act (2014), as applicable. All curb valves and valve boxes shall be manufactured by any of the firms provided on the City of Salina Approved Materials List.

At Contractor's option, water service lines 1-inch, 1-1/2-inch, and 2- inch may be blue High Density Polyethylene (HDPE) CTS with a material designation of PE 4710. Resin used in the extrusion of water polyethylene pipe shall conform to the latest addition of the ASTM D 2737 and 3350 Cell classification 445574E. Piping shall have a minimum of SDR-9, pressure class 200, and shall conform to all applicable requirements of AWWA C901 and be ANSI/NSF 61 product certified. Stainless steel inserts shall be used at all compression fitting connections. All HDPE service lines shall be installed with tracer wire in accordance with specifications.

14. CONNECTION TO EXISTING SYSTEM

At locations indicated on the drawing, the Contractor shall connect the new extensions into the existing system, using appropriate fittings as required. Each connection shall be made only after notification of water customers within the valved off portion, giving the time and approximate period of interrupted service. Contamination of the existing system shall be avoided by elimination of water from the muddy trench and the liberal use of approved disinfectant introduced into the opened pipe line and into new fittings or pipe. The exposed interiors of pipe, fittings and valves are to be wetted with a 1% (10,000 mg/L) or higher concentration of chlorine solution before closure. The completed connection shall be flushed clean with water from the existing system by manipulating valves in such a way that contaminated water does not backflow into the existing system; flushing to continue until all discolored water is eliminated. The valve shall be closed on the new extension and the existing system restored to service as soon as possible after flushing. In no case shall water from the new extension be allowed into the existing system prior to chlorinating and flushing of the extension as hereinafter specified. It shall be the Contractor's responsibility to determine, well in advance of the actual cutting in operations, the type and quantity of all fittings required to make each connection to the existing system.

Connections to existing system shall be considered subsidiary items and no separate payment shall be made.

15. PRESSURE AND LEAKAGE TESTING

All newly installed mains (PVC and DIP) shall be pressure and leakage tested prior to final acceptance. Pressure and leakage testing shall comply with Kansas Department of Health and Environment's Minimum Design Standards, entitled "Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas" (2008 Addition), Appendix C Procedures for Pressure and Leakage Testing of Water Mains. Pressure and leakage testing requirements for materials other than DIP or PVC will be determined on a case-by-case basis.

Simultaneous or separate pressure and leakage tests may be performed. The test durations and pressures for each option are specified below. If separate tests are made, the pressure test should be conducted prior to the leakage test.

Procedure	**Test Pressure**	**Duration of Test**
Simultaneous Pressure & Leakage Test	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation.	2 Hours
Separate Pressure Test	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation.	1 Hour
Separate Leakage Test	150% of working pressure* of segment tested.	2 Hours

*Working pressure is defined as the maximum anticipated sustained operating pressure. However, in no case shall the test pressure exceed the pressure rating for the pipe, valves, appurtenances, or thrust-restraints.

A. Pressure Test. Before testing, the pipeline shall be backfilled and braced sufficiently to prevent movement under pressure.

If concrete thrust blocks are used, sufficient time shall be allowed before testing to ensure that the concrete has cured sufficiently. The test ends shall be restrained to withstand thrusts potentially developed under the test pressures.

After filling the main with water and expelling air, a pump is utilized to increase the water pressure within the line up to the required test pressure and to maintain that pressure for the required duration. The measured water pressure within the main (after reaching the required test pressure) shall not vary by more than 5 psi during the duration of the test. While the line is under pressure, the system and all exposed pipe, fittings, valves, and hydrants shall be examined for leakage. Any damaged or defective pipe, fittings, valves, hydrants, or joints shall be repaired or replaced and the pressure test repeated until satisfactory results are obtained.

B. Leakage Test. If the leakage test is to be performed simultaneously with the pressure test, the system shall be allowed to stabilize at the test pressure before conducting the leakage test.

Equipment necessary for conducting the leakage test includes a pump equipped with a make-up reservoir and a pressure gauge for measuring water pressure in the main. In addition, there must be an accurate method for measuring the quantity of water pumped into the main being tested. Methods used to measure water volume include a calibrated make-up reservoir, a calibrated positive-displacement pump, or a water meter.

The specified test pressure for the leakage test is the same for the pressure test and the test shall be conducted for at least 2 hours in duration. Leakage is defined as the quantity of water that must be supplied into the main in order to maintain the water pressure within 5 psi of the specified test pressure after the pipe has been filled with water and air expelled. No pipe installation shall be acceptable if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

where,

L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, 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.

When testing against closed metal seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size is allowed.

Leakage less than the quantity specified by the above equation shall be considered "allowable leakage" resulting from such factors as trapped air, take-up of restraints, and temperature variations during testing. However, observed leaks shall be repaired regardless of leakage measurements through metered equipment.

Should any length of pipe tested have leakage greater than that specified above, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

16. DISINFECTION OF WATER MAINS

All new or repaired potable water lines shall be disinfected before put in to service. Disinfection shall comply with Kansas Department of Health and Environment's Minimum Design Standards, entitled "Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas" (Latest Edition), Appendix D - Procedures for the Disinfection of Water Mains.

A. Preliminary Flushing of Mains. Before being chlorinated, the main shall be completely filled with water to eliminate air pockets and then flushed to purge the line of dirt and debris. This is typically done after the completion of the leakage and pressure tests. Preliminary flushing shall be accomplished at a rate of at least 2.5 ft/sec. The introduction of water into the new main extension shall be planned carefully to prevent backflow into any portion of the existing system.

Preliminary flushing shall not be conducted if tablets or granules of calcium hypochlorite have been placed in the pipe during installation. In this case, special care must be exercised in ensuring that the main does not become contaminated with dirt or other materials during construction.

B. Chlorination of Mains.

All chlorine products shall be NSF 60 product certified.

There are three methods of chlorination of water mains: tablet, continuous, and slug. Before any disinfection method is utilized, valves must be positioned so that the highly chlorinated water in the main being treated does not flow into water mains that are in active service.

The continuous and slug methods require the use of appropriate chlorine feed equipment and the determination of the necessary chlorine feed rate for the chlorine solution.

1. Tablet Method: The tablet method consists of pre-placing calcium hypochlorite granules or tablets in the main during pipe installation in sufficient amounts so as to obtain a 25 mg/L available chlorine dose. For calcium hypochlorite granules, they

should be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 ft. intervals. Additionally, one tablet should be placed in each hydrant, hydrant branch, and other appurtenances.

Calcium hypochlorite granules should not be placed in the pipe so as to come in contact with exposed joint compounds, such as those used on solvent-welded plastic pipe, because of the danger of fire or explosion from the reaction of the joint compound with the calcium hypochlorite.

Instead of granules, calcium hypochlorite 5-g tablets can be attached with a food-grade adhesive to the top inside surface of each section of the main's pipe.

After installation is complete, the main shall be filled with potable water at a velocity no greater than 1 ft/sec. The chlorinated water must be maintained in the main for at least 24 hours. At the end of the minimum contact period, the treated water in all portions of the main must have a residual of not less than 10 mg/L free chlorine as confirmed by measurement of the chlorine residual.

2. Continuous Method: Though this method is referred to as "continuous," it does not require continuous feeding of chlorine into the main over a 24 hour period. The key feature is that the main is "continuously" in contact with at least 10 mg/L free chlorine concentration over 24 hours with an initial dose of 25 mg/L.

3. Slug Method: The slug method consists of the formation of a slug of chlorinated water in the main with a free chlorine concentration of at least 100 mg/L. The slug of highly chlorinated water must flow through the main at a slow enough rate so that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of at least 3 hours.

The free chlorine residual must be regularly measured in the slug during the required minimum 3 hours of contact time. If at any time, the free chlorine residual in the slug drops below 50 mg/L, additional chlorine must be applied to the head of the slug in order to reestablish the level of free chlorine in the slug to be at least 100 mg/L.

Following disinfection, bacteriological samples consisting of at least 2 samples taken at least 16 hours apart must be taken in accordance with KDHE's "Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas".

C. Final Flushing of Mains. After the appropriate minimum retention period, highly chlorinated water shall be flushed from the main until chlorine residual measurements show that the chlorine concentration of the water leaving the section of main is no higher than that generally prevailing in the distribution system. Care must be exercised when disposing of water with excessive chlorine residuals, per AWWA C655, Field Dechlorination. Chlorine is toxic to fish and other aquatic life. Disposal of chlorinated water into storm sewers without prior neutralization of the chlorine residual shall be avoided if residual chlorine will still be present when the water directly or indirectly reaches a stream, river, or lake.

17. SEPARATION OF WATER MAINS AND SEWERS

A. Gravity Sanitary Sewers.

1. Parallel Placements: When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall not be less than 10 ft. The distance of separation shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. Where it is not practical to maintain a 10 ft. separation, KDHE will consider proposals providing equivalent protection by other methods on a case-by- case basis, if supported by data from the design engineer. Equivalent protection may require sanitary sewer construction with one of the following additional protective features: concrete encasement, vacuum sewers, or jointless pipe such as fused HDPE or cured-in-place pipe liner.

2. Crossing Placement: When a water pipe and a sanitary sewer cross and the sewer is 2 ft. or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of the following material (or approved equal) and pressure tested to assure water tightness pursuant to the most recent revision of KDHE's "Minimum Standards of Design of Water Pollution Control Facilities":

a. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR 26 with flexible gasketed compression type joints conforming to ASTM D3212. The gasket material shall comply with ASTM F-477.

Joints in the sewer pipe shall be located as far as practical from the intersected water main.

Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of the above specified materials and is 2 ft. or less below the water pipe, the existing sewer shall be encased in concrete with a minimum thickness of 6 inches for a 10 ft. distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. The above requirements shall also apply where a water main shall cross under an existing sanitary sewer. KDHE will consider proposals providing equivalent protection by other means on a case- by-case basis, if supported by data from the design engineer.

When a water main and a sanitary sewer shall cross, it is preferred that the water main cross over the sanitary sewer, regardless of whether the sanitary sewer is new or existing.

Special provisions shall be required to ensure adequate structural support for, and to maintain minimum pipe-to-pipe clearances between, a water main and a sanitary sewer at a water main and sanitary sewer crossing.

B. Sewer Connections – There are to be no physical connections between any parts of a potable water system and building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach a well, storage reservoir, or distribution system.

C. Pressure Sewer Lines – When pressure sewer lines (force mains) run parallel to water lines, the separation distance shall be as far as practical, maintaining a minimum horizontal separation distance of at least 10 ft. There shall be at least a 2 ft. vertical separation at crossings with the water main always crossing above the sewer force main. Where it is not practical to maintain the required horizontal or vertical separation distance between a water line and a sanitary sewer force main, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer.

D. Sewer Manholes – No water pipe shall pass through or come in contact with any part of a sewer manhole. Required horizontal separation distances between water mains and manholes are equivalent to those for water mains and gravity sanitary sewers.

E. Storm Sewers – The separation distance between a storm sewer (which is not a combined storm/sanitary sewer) and a water main should be based on geotechnical considerations. Required separation distances between water mains and combined storm/sanitary sewers are equivalent to those for water mains and gravity sanitary sewers.

F. Drains – Underground drains from fire hydrants, pits, or underground structures in general (valve pits, meter pits, underground pump stations, etc.) shall not be directly connected to sanitary or storm drains.

18. STREAM CROSSINGS

A. Where a waterline crosses beneath a navigable stream, at least 7 feet of cover between the bottom of the streambed and the top of the waterline must be provided.

B. Where a waterline crosses beneath a non-navigable stream, at least 5 feet of cover between the bottom of the streambed and the top of the waterline must be provided

19. SEPARATION OF WATER MAINS AND OTHER POLLUTION SOURCES – It is of the utmost importance that potable water lines be protected from any source of pollution. The following shall pertain to instances where septic tanks, absorption fields, waste stabilizations ponds, feedlots or other sources of pollution are encountered.

A. A minimum distance of 25 ft. shall be maintained between all potable water lines and all pollution sources, e.g., septic tanks, septic tank absorption fields, waste stabilization ponds, sewage contamination, wastewater, landfill leachate, and all Concentrated Animal Feeding Operation facilities.

B. Under no circumstances shall a water line be extended through an area that is a real or potential source of contamination to the water line or water supply.

C. Under no conditions shall the encasement of a water line be considered as adequate protection of a water line or a water supply for the purpose of extending the water line through a real or potential source of contamination.

20. MARKING TAPE AND TRACER WIRE

Marking tape shall be provided whenever water pipeline is installed through open cut excavation. The tape shall be of blue plastic material without integral wires or foil backing. The tape shall be not less than 2 inches wide, and shall have an identifying phrase in black letters repeated at maximum intervals of 3 feet. The tape shall be of a type specifically manufactured for

marking underground utilities. The tape shall be installed during backfilling operations. The tape shall be located 2 feet below finished grade. The tape shall be centered on the utility line with the identifying phrase on the top. The identifying phrase shall be "WATER LINE BELOW."

All piping shall be installed with a continuous, Direct Burial #12 AWG Solid (.0808" diameter) tracer wire, 45 mil high molecular weight-high density **blue polyethylene jacket** complying with ASTM-D-1248, 30 volt rating for location purposes by means of an electronic line tracer. Tracer wire installed in directional drill installations shall be steel core hard drawn 1,150 pounds average tensile break load. Tracer wire shall be Copperhead Industries, LLC, or approved equal by Engineer.

The tracer wire shall be placed above the water pipeline and HDPE service lines. For open cut installation the wire shall be taped to the pipeline at 25-foot intervals. The wire shall be terminated at the tracer wire box. Tracer wire box shall be located within one foot of valve box and set to same grade as valve box, or as requested in the field by Engineer. All splices in tracer wire shall be made with waterproof split bolt connectors.

All tracer wire terminals at valve locations shall be Copperhead Snakepit Magnetized Tracer Box Roadway Box RB14 2T (blue cover for potable water), H-20 roadway rating manufactured by Copperhead Industries LLC, or approved equal by the Engineer. All tracer wire terminals at hydrant locations shall be Copperhead Snakepit Magnetized Tracer Connection Cobra T3 (blue for potable water) manufactured by Copperhead Industries LLC, or approved equal by the Engineer; HDPE or SS bracket to mount to hydrant flange and 2 feet of ¾-inch stainless steel conduit. Boxes shall have dual terminals on lid and grounded using a 1 lb Magnesium grounding anode per manufacturer's installation requirements. Anode shall be placed at approximately same elevation as water main.

Upon completion of the tracer wire installation, the Contractor shall demonstrate to the CITY that the wire is continuous and unbroken through the entire run of the pipe by providing full signal conductivity when energizing for the entire run. If the wire is broken, the Contractor shall repair or replace it.

21. TAPPING SLEEVES

All tapping sleeves shall be constructed of 18-8 stainless steel, including the body, flange, nuts and bolts and manufactured by any of the firms provided on the City of Salina Approved Materials List.

22. INSTALLATION OF AIR RELIEF AND COMBINED AIR/VACUUM RELIEF VALVES

At high points in water mains where air can accumulate, provision shall be made to remove air by means of hydrants or air relief valves. Automatic air relief or combined air/vacuum relief valve shall not be used where flooding of the manhole or chamber may occur.

The open end of the air relief pipe from an automatically operated air relief valve shall be extended to at least 1 ft. above grade and provided with a screened, downward-facing elbow. The open end of the air relief pipe from a manually operated air relief valve should be extended to the top of the pit.

The open end of the relief pipe from a manual or automatic combined air/vacuum relief valve shall always be extended to a least 1 ft. above grade and provided with a screened, downward-facing elbow.

Air relief and combined air/vacuum relief valves shall be located as close to the pipe as possible with all interconnecting (riser) pipe to be oriented upward to the valve from the water line. The isolation valve shall be the same size as the interconnecting piping and shall be located between the water line and the air relief or combined air/vacuum relief valve.

23. STEEL SLEEVE ENCASEMENT

A. Casing Spacers. Casing spacers shall be used to install carrier pipe inside the encasement pipe. To provide support around the periphery of the carrier pipe as it is pushed through the casing, the spacers shall be of a projection type that has a minimum number of projections around the circumference totaling the number of diameter inches. For example, 8" pipe shall have a minimum of 8 projections and 12" pipe shall have a minimum of 12 projections. Casing spacers shall fasten tightly onto the carrier pipe so that the spacers do not move during installation. Casing spacers shall be equally spaced at intervals along the length of the pipe. Spacers must provide sufficient height to permit clearance between bell joint and casing wall. In order to avoid the transfer of earth and live loads to the carrier pipe, the space between the carrier and casing pipes should not be filled completely. Casing spacers shall be projection type totally non-metallic spacers constructed of preformed sections of high-density polyethylene.

Projection type spacers shall be Ranger II Non-Metallic Casing Spacer as marketed by GPT Industries, or approved equal. Wooden skids are not acceptable. All carrier pipe installed in casing pipe shall be assembled using restrained joint gaskets.

B. Encasement Pipe End Seals. The ends of the encasement pipe shall be sealed using a GPT Model C Custom Pull-on End Seal as marketed by GPT Industries, or approved equal. This seal is composed of a 1/8" thick neoprene wrap secured with two (2) stainless steel worm gear bands.

C. Steel Sleeve Encasement Pipe. Encasement pipe shall be A-53 Steel Pipe of size designated on the Drawings for the location. Encasement pipe of the respective minimal diameter shall have the minimum wall thickness shown in the drawings.

D. Installation of encasement pipe shall be performed under the direct supervision of a competent foreman experienced in such work. Encasement pipe shall be installed by combination of trenching, augering, and jacking. Size of auger used shall be only sufficient to permit encasement pipe to be jacked or pushed into place leaving a minimum of annular space surrounding the pipe. After completion of the installation of the encasement pipe, the pipe shall be carefully pushed through the opening to prevent loosening of joints.