

SECTION 603 – SANITARY SEWER FORCE MAINS

1. GENERAL

Pipelines for sanitary sewer force main 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 pipeline shall be four and one-half feet (4-1/2') below the finished grade.

3. PIPE MATERIAL

PVC Pipe:

Polyvinyl chloride pipe shall conform to AWWA Specification C900 "Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-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 73°F and shall be dimension requirements of **DR14**. Pipe shall be manufactured from clean, virgin, NSF approved Class 12454-A or 12454-B PVC conforming to requirements of ASTM D1784 (latest revision).

For pipeline larger than 12-inch, polyvinyl chloride pipe shall conform to AWWA Specification C905, "Polyvinyl Chloride (PVC) Pressure Pipe, 14-inch through 36-inch for water", unless otherwise designated on the plans or special provisions. The pipe shall be Class 235 (cast iron O.D.) suited for a working pressure of 235 p.s.i. at 73°F and shall be dimension requirements of **DR18**. Pipe shall be manufactured from clean, virgin, NSF approved Class 12454-A or 12454-B PVC conforming to requirements of ASTM D1784 (latest revision).

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.

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.

HDPE Pipe:

Pipe diameters from 4 to 63 inches shall be High Density Polyethylene (HDPE) as per AWWA C906. HDPE pipe shall be SDR 11DIPS.

Material for pipes to be used for potable water application shall be approved by the National Sanitation Foundation (NSF).

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 SRD 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 meet requirements of ANSI NSF Standard 61.

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.

<u>Service</u>	<u>Striped Pipe</u>	<u>Solid-Colored Pipe</u>
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

4. PIPE JOINTS

PVC Pipe:

Polyvinyl chloride pipe joints shall conform to requirements of AWWA C900, Class 200 or AWWA C905, Class 235, respective to the pipe specified, cast-iron (CI) pipe dimensions only, elastomeric-gasket joint only.

HDPE Pipe:

Fusion welds shall be used for all pipe joints.

5. PIPE FITTINGS

PVC Pipe:

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. All fittings shall have standard tar coating exterior and cement lined interior, AWWA Specification C-104. Pipe fittings for PVC pipe shall also conform to this specification.

HDPE Pipe:

HDPE Pipe fittings shall meet the same specifications as HDPE pipe, Section 3.

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.

6. INSTALLATION OF PIPE AND FITTINGS

PVC Pipe:

Polyvinyl chloride pipe and accessories shall be handled in such a manner as to insure 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 owner 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. Pipe lying shall proceed upgrade with spigots pointing in the direction of flow.

HDPE 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. Saddles may be installed using electro-fusion process in accordance with manufacturer's recommendations upon approval of Engineer.

7. FITTING BLOCKING

PVC Pipe:

All tees and plugs, and all bends deflecting the alignment of four (4) inch and larger pipe lines by 22-1/2 degrees or more, shall be provided with thrust blocks, tie rods or 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. or equal.

HDPE Pipe:

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.

8. PRESSURE AND LEAKAGE TESTING

All newly installed force mains 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 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 and valves shall be examined for leakage. Any damaged or defective pipe, fittings, valves, 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.

9. 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.

10. MARKING TAPE AND TRACER WIRE

Marking tape shall be provided whenever pipe is installed through open cut excavation. The tape shall be of 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 “SANITARY SEWER LINE BELOW.”

All force main piping shall be installed with a continuous, Direct Burial #12 AWG Solid (.0808" diameter) tracer wire, 45 mil high molecular weight-high density **green 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 wire shall be placed above the force main. 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 (green cover for waste water), H-20 roadway rating manufactured by Copperhead Industries LLC, or approved equal by the Engineer. 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 the force 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.