

## SECTION 5100 - SANITARY SEWER MAIN

### PART 1 - GENERAL

**1.01 SCOPE:** This Section covers installation of sanitary sewer mains and services. Topics include permits and fees, record drawings, pipe materials, trench widths, pipe laying, service taps, bedding, initial backfill, encasement, and water and drainage course crossings.

**1.02 RELATED WORK:** Refer to the following sections for related work:

Site Restoration	Section 1000-General Requirements
Trenching	Section 2100-Trenching and Tunneling
Concrete Cradle Material	Section 4000-Concrete Materials and Methods
Manholes	Section 5000-Manhole Construction

**1.03 FEES AND PERMITS:** The following permits and fees are required for sewer connection. Amounts of the various fees are set by code and may be obtained from the Public Works Department.

- A. Sewer work permit will be required for connection to or repair of an existing sanitary or storm sewer.
- B. Initial tap fee will be assessed to offset the cost of installing the tap.
- C. Connection fee will be assessed to recover the prorated cost of construction of sewer mains and laterals. Separate fees for laterals and mains will be collected. Connection fees do not apply to properties previously assessed for lateral and main districts.
- D. Right of way permit is required if work occurs in right of way.

**1.04 UNIFIED GOVERNMENT CODE REQUIREMENTS FOR SERVICE LINES ON PRIVATE PROPERTY:** Chapter 30, Code of Unified Government Ordinances contains detailed provisions on fees, permits, service lines, and taps. Copies of this Chapter are available at the Public Works Department office.

**1.05 KDHE REQUIREMENTS:** Contractor is notified that the Kansas Department of Health and Environment (KDHE) has requirements for the protection of potable water systems that may affect the work covered by this Section. These requirements are reproduced as *Attachment 5100-A* at the end of this Section. This reproduction was downloaded from the KDHE website in January 2008.

**1.06 SUBMITTALS:** Contractor shall submit the following for review:

- A. Sieve analysis of bedding material.
- B. Pipe and joint details.
- C. Special, fitting, and coupling details.

- D. Affidavit of compliance with applicable standard.
  - E. Test certificates.
- 1.07 CROSS CONNECTIONS PROHIBITED:** Do not make cross connections between storm sewers and sanitary sewers unless the system is a combined sewer system and the cross connection is authorized.
- 1.08 NOTIFICATION OF DISRUPTION:** Contractor shall make the following contacts with occupants of properties that will experience service disruption:
- A. Written notice, between 3 and 7 days in advance of the disruption, describing the work to be done, the approximate schedule, restrictions on water use, and a local telephone number for Contractor if problems arise.
  - B. Attempted personal contact and a written notice, one day before the disruption, giving the time limit of the disruption and repeating Contractor's telephone number.
  - C. In the event service cannot be restored within the scheduled time, attempted personal contact and written notice informing the occupants of the delay and offering compensation as outlined elsewhere in this Section.
- 1.09 SERVICE DISRUPTION LIMIT:** The maximum disruption of service to any property shall be 12 hours. In the event a residence cannot be reconnected within the disruption limit, Contractor shall pay for lodging and meals for the affected residents. In the event a business cannot be reconnected within the disruption limit, Contractor shall compensate businesses for the loss of water usage.
- 1.10 TIMING OF CONNECTION TO EXISTING SEWER SYSTEM:** To prevent storm water or trench water from entering the existing sewer system, the new main shall remain isolated from the existing system until backfill and acceptance tests are complete.

## PART 2 - PRODUCTS

### 2.01 SANITARY SEWER PIPE FOR GRAVITY MAINS:

- A. Vitrified Clay Pipe (VCP): VCP pipe and fittings shall conform to ASTM C700, Extra Strength Pipe. Joints shall conform to ASTM C425 bell and spigot, or plain-end pipe, factory applied with synthetic rubber seals. All clay pipe furnished shall be extra strength. Permit for spot repair only and only with Engineer's authority.
- B. Polyvinyl Chloride Pipe (PVC): PVC pipe and fittings for gravity systems shall conform to ASTM D3034. Wall thickness for pipes 8-inch to 10-inch diameter shall conform to SDR 26 wall thickness and for 4-inch and 6-inch service lines shall conform to ASTM D2665, Schedule 40. Wall thickness for pipes 12-inch to 15-inch diameter shall conform to SDR 35 wall thickness. Pipes with diameter of 18 inches and greater shall be either solid wall conforming to ASTM D3034, or ASTM F679, SDR 35, or profile wall pipe conforming to ASTM F794, PS=46 psi (when measured at 5 percent deflection). Joint shall conform to

ASTM D3212, and bell end shall be grooved to receive gasket. Synthetic rubber gasket shall conform to ASTM F477. Furnish permanent plugs for future service line connections and testing.

- C. Ductile-Iron Pipe (DIP): DIP pipe and fittings for gravity systems shall conform to ASTM A746. The minimum thickness for all sizes of DIP gravity sewer pipe shall be pressure class 350. Push-on joints shall be provided, conforming to AWWA C111 for all buried pipe unless otherwise specified or indicated. Fittings shall conform to AWWA C110 and be ductile iron. Pipe shall be furnished with factory applied 40-mil thickness polyethylene lining. Lining material shall be virgin polyethylene complying with ASTM D1248, compounded with sufficient carbon black to resist ultraviolet rays during above ground storage of the pipe. Where indicated on the drawings or Special Conditions, DIP pipe shall be encased in 8-mil polyethylene tube or sheet.
- D. Lined Reinforced Concrete Pipe (RCP): Round RCP pipe shall conform to ASTM C76 and ASTM C361. Portland cement shall be ASTM C150, Type II, and shall not contain tricalcium aluminate in excess of 5 percent. Rubber gaskets for joints in circular pipe shall be O-ring type, circular cross section conforming to ASTM C361, for fittings, closures, and specials. Wall thickness shall be Wall B or greater. Concrete shall have a minimum compressive strength of 6000 psi at 28 days. Use rubber to concrete compression type joints conforming to ASTM C361 for bell and spigot with gasket wholly confined in spigot groove or steel end ring joints with rubber O-ring gaskets. Pipe shall have factory applied 60-mil interior polyvinyl chloride lining over the upper 300 degrees segment of the pipe, fitting, or special. Lining shall have projecting ribs to provide mechanical bond to pipe. Lining shall extend across joints for field sealing.
- E. Composite Pipe (Hobas Pipe): Round composite pipe shall conform to ASTM D3262. Pipe shall be furnished in nominal lengths of 10 or 20 feet. Joints shall be fiberglass sleeve couplings with EPDM rubber compound sealing gaskets as the sole means to maintain joint watertightness and shall conform to ASTM D4161.

**2.02 SANITARY SEWER SERVICE LINES:** Service connections shall be made with manufactured tees or wyes for new installations and with saddle taps for existing mains.

- A. Wye/Saddle: Tee or wye fitting connections suitable for assembly to 4-inch or 6-inch house or building sewers shall be one of the following types:
  1. Reducing branch tee or wye fittings with elastomeric-gasket joints same as pipe. Service line connection shall be bell end with an elastomeric ring gasket and a minimum wall thickness of SDR 26.
  2. Saddle-type fittings with an elastomeric ring-gasketed, bell-end service connection and minimum wall thickness of SDR 26. Saddle-type fitting shall be supplied with a rubber sealing gasket and stainless steel straps for connection to pipe.
- B. Service Line: Service line shall be PVC schedule 40.

- C. Adaptor: Manufactured couplings are required to mate the main fittings with the schedule 40 service line.

**2.03 SANITARY SEWER PIPE FOR FORCE MAINS:**

- A. Polyvinyl Chloride Pressure Pipe (PVC): PVC pipe and fittings for force mains shall conform to AWWA C900 or AWWA C905 and shall be designed to have internal pressure plus allowance for surge pressure equal to 250 percent of the operating pressure listed in the Special Conditions, but not less than 200 psi. Gaskets shall conform to ASTM F477 and be synthetic rubber. PVC pressure pipe shall have cast-iron pipe equivalent outside diameters. Pipe joints shall be integral bell type pipe ends designed for joint assembly using elastomeric gaskets. Fittings shall be ductile iron and conform to AWWA C110 or AWWA C153 and be either mechanical joint or push-on type joint.
- B. Ductile-Iron Pressure Pipe (DIP): DIP pipe and fittings for force main shall conform to ANSI A21.50 and ANSI A21.10. Joints may be mechanical or push-on type. Pipe shall have cement lining conforming to ANSI A21.4 or polyethylene lining as specified in 2.01C. Where indicated on the drawings or Special Conditions, DIP pipe shall be encased in 8-mil polyethylene tube or sheet. DIP pipe and fittings within one (1) laying length of force main air release or air and vacuum relief valves shall be polyethylene lined.

**2.04 CARRIER PIPE FOR TUNNEL INSTALLATIONS:** Carrier pipe shall be ductile iron to allow for both pressure and gravity as specified above. Minimum pressure rating shall be 125 psi, or the rating of the line to which it is connected, whichever is greater.

**2.05 BEDDING:** KDOT Standard Specifications Section 1100, CA-5 coarse aggregate for concrete, washed stone or gravel, meeting the following gradation:

<u>Sieve Size</u>	<u>Percent Retained</u>
1-inch	0
3/4-inch	0 - 5
3/8-inch	40 - 60
No. 8	95 - 100

Alternate gradations of washed stone or gravel may be substituted with Engineer's approval.

**2.06 ENCASUREMENT MATERIAL:** As referenced in Section 4000 - Concrete Materials and Methods.

**2.07 MISCELLANEOUS MATERIALS:**

- A. Locator stakes for service and mainline stubs shall be nominal 2" x 4" wooden stakes of sufficient length to extend from the pipe to the surface of the ground.
- B. Temporary plugs shall be model recommended by pipe manufacturer, and watertight to a static head of 25 feet.

- C. Sleeve connectors for pipes of differing materials shall be commercially manufactured connections providing permanent, watertight, semi-flexible connection capable of withstanding the hydrostatic testing pressures.

**2.08 PIPE MATERIAL FOR SPOT REPAIR:** Sewer pipe that is deteriorated or damaged shall be replaced with the same material as existing unless otherwise approved by the Engineer. Clay pipe shall be replaced with PVC using an approved flexible connector with steel band manufactured specifically for connecting these materials. Unless approved by the Engineer, connection shall be made at existing joints.

### PART 3 - EXECUTION

**3.01 BYPASS PUMPING:** Except for reaches specifically listed in the Special Conditions as not requiring bypass pumping, Contractor shall provide bypass pumping for sewage flows as follows:

- A. The line segments scheduled for cured-in-place sectional or spot repairs, replacement by pipe bursting or pipe reaming, or containing manholes to be lined shall have all flows bypassed around them. The pumping system shall be sized for normal to peak flow conditions. Contractor shall maintain an operational backup pump on site where required in the Special Conditions. Direct discharge of flow to surrounding area drainage or separate storm sewer system is unacceptable. Do not attempt flow diversion on combined sewers or storm sewers if rainfall is anticipated before completion of the installation can be completed.
- B. The upstream manhole shall be monitored at all times, and an emergency deflate system shall be incorporated so that plugs may be removed at any time without requiring confined space entry. A plug shall be used to stop the sewage from reaching the line segment or manhole being lined or replaced. Remove plug at end of each working day and place relined, replaced, and existing sections and temporary or permanent service tie-ins back in service.
- C. When preparing to make connections to the existing system or other work which will interrupt service to the utility users, Contractor shall follow the Notification of Disruption procedures listed in Article 1.08 of this Section.

**3.02 TRENCHING:** See Section 2100-Trenching and Tunneling for trench excavation, protection, dewatering, and general backfill. Trench width, measured at 1 foot above the exterior top of pipe, shall be at least 15 inches greater but not more than 24 inches greater than the exterior width of the pipe. Excessive width trenches shall be corrected by use of bedding material throughout the initial backfill zone.

**3.03 PIPE LAYING (GRAVITY MAINS):** Installation of pipe shall proceed from the downstream end of the project with bell ends facing upstream. Alignment and grade shall be uniform between manholes, and a positive system of grade control shall be used for maintaining alignment. In the case of spot repairs, maintain constant grade and alignment between limits of repair. Rigid blocks shall not be used to hold pipe in place prior to depositing the bedding, unless pipe is to receive total concrete encasement. The ends of the installed pipe shall be plugged whenever the work is not in progress. Joint installation shall follow the manufacturer's recommendation.

Rigid pipe, RCP, or VCP shall be encased in concrete from the manhole wall to the first joint beyond the manhole, unless a flexible, watertight gasket, approved by Engineer, is used to connect the sewer to the manhole.

**3.04 PIPE LAYING (FORCE MAINS):** Pressure sewers (force mains) shall be installed to the slopes and depths shown on the drawings. If a detailed profile is not shown, main shall be installed to a continuous slope to prevent possible air entrapment at high spots of the line. Minimum depth of cover shall be 42 inches. Approved air relief valves shall be installed at all locations shown on the drawings. For materials other than ductile-iron pipe, the main shall be "snaked" in the trench to accommodate minor expansion and contraction, but in no case shall the minimum side clearance be less than specified. Thrust blocks shall be installed at pipe deflections, bends, tees, and plugs and shall be adequate to resist both operating and testing forces or as shown on the drawings. Thrust blocks shall be complete and cured before pressure testing. Damage caused by failure to provide adequate thrust supports shall be corrected at no additional cost to Unified Government. Force mains shall be marked with warning tape placed from one to two feet above pipeline.

**3.05 SERVICE LINES:** Taps not larger than 6 inches on existing mains shall be made by Unified Government Water Pollution Control Department, except where the existing main is ductile-iron pipe.

Taps shall rise from the main at a 45° angle. The requirements for service lines included here are for the portions of service lines within the street right-of-way or sewer easement; see the reference in Part 1 concerning code requirements for construction of service lines on private property. Service lines shall slope at a minimum of 1/4:12, except when approved by Engineer, a minimum of 1/8:12 may be used. Where not immediately connected to a building drain, service lines shall be marked with a locator stake. Minimum cover for service lines is 4 feet unless the line is encased in concrete.

**3.06 BEDDING:** Unless otherwise specified, granular bedding material shall be placed uniformly on both sides of the pipe to the limits given below and compacted to 95 percent standard density, as determined by ATSM D698. Depth of granular bedding material below the exterior bottom of pipe shall meet the following minimums:

<u>Pipe Diameter</u>	<u>In soil</u>	<u>In rock</u>
24 inches and less	4 inches	6 inches
27 inches to 60 inches	4 inches	9 inches
66 inches and greater	6 inches	12 inches

The top limit of granular bedding material shall be 12 inches above top of the pipe.

**3.07 WATER MAIN AND DRAINAGE COURSE CROSSINGS:** See paragraph 1.07C for requirements for sewers crossing a potable water main.

Sewers crossing a drainage course and having less than 4 feet of cover shall be encased in concrete and shall have a down stream impervious trench check. Applicable drainage courses are identified on the drawings.

- 3.08 CUT-OFF WALLS AND SLOPE ANCHORS:** Slope anchors shall be minimum of twelve inches thick and shall extend a minimum of 2 feet from the exterior of the pipe on all sides. They shall be cast against undisturbed earth in the trench walls and bottom. In rock, anchors shall be keyed a minimum of 6 inches into undisturbed rock.

Anchors shall be cast against pipe bells or a capped cross on bell-less pipe. Whenever there is more than 8 feet of vertical fall between manholes, and the pipe slope is greater than 10%, anchors shall be placed at intervals not to exceed 8 feet of vertical fall.

- 3.09 CONCRETE ENCASEMENT:** For concrete encasement, refer to Detail Drawings.

- 3.10 ALIGNMENT TESTING:** To verify alignment, deflection, and workmanship, installed pipe will be televised by the Unified Government Water Pollution Control Division. Televised pipe will be inspected for a smooth, structurally sound, straight, round main. Pipe may also be televised before the end of the warranty period. Unacceptable defects include infiltration, displacement at joints, intrusion of foreign material, service taps entering at the wrong angle, or cracked, distressed, or out of round pipe. Possible out of round PVC pipe and other flexible pipe may be further checked by mandrel testing at Contractor's expense. Pipe shall pass a mandrel with an outside diameter of 95 percent of the undeflected interior diameter and a length of not less than twice the inside diameter of the pipe.

Pipe not passing alignment tests shall be repaired or replaced and retested.

- 3.11 TIGHTNESS TESTS:** To verify watertightness, pipe shall be subjected to hydrostatic testing or low pressure air testing and observation of infiltration. Contractor option of A or B as follows for gravity mains.

- A. Hydrostatic testing of gravity mains shall be conducted one reach at a time. System shall be prefilled 12 hours in advance of testing. Test shall consist of filling upstream manhole to 4 feet above the invert or 2 feet above the top of pipe, whichever is greater, and measuring replacement water at the end of one hour. For lines 24 inches or less in diameter, exfiltration rate shall be less than 0.20 gallon per hour per inch of pipe diameter per 100 feet of pipeline. For larger pipes, the exfiltration rate shall be less than 4.80 gallons per hour per 100 feet of pipeline. Pipe shall be dewatered after testing.
- B. Low pressure air testing shall be conducted and evaluated in accordance with ASTM F1417 - Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air. Following is a condensed description of Time-Pressure Drop Method; by giving this condensed version, the Unified Government does not waive any requirements of the full test method. Air testing shall be conducted one reach at a time. Reach shall be sealed and pressurized to 4.0 psig. Pressure shall be maintained between 3.5 and 4.0 psig for minimum 2 minutes to permit temperature equalization. Once temperature is equalized, decrease pressure to 3.5 psi for start of test. Disconnect air supply and measure the time required for the pressure to drop to 2.5 psig. Reaches will pass the air test if the time for the pressure drop is greater than shown in the following table:

Note: Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 36 in. in diameter.

Pipe Diameter, in.	Minimum Time, min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

- C. Hydrostatic testing of force mains shall conform to AWWA C600 procedures as modified herein. Test shall be performed after backfill is complete. Contractor shall provide and install test plugs. Pressure test shall be conducted at 2.0 times the maximum operating pressure. Leakage test shall be conducted at the maximum operating pressure.
- D. Pipe not passing tightness tests shall be repaired or replaced and retested.
- E. Tightness tests are not required for spot repairs.

#### ATTACHMENTS:

Attachment 5100-A KDHE POLICIES FOR SEPARATION OF WATER MAINS & SEWERS

END OF SECTION 5100



## **KDHE POLICIES FOR SEPARATION OF WATER MAINS & SEWERS**

### **1. SEPARATION OF WATER MAINS AND SEWERS**

- a. **GRAVITY SANITARY SEWERS** – When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 ft (3.0 m). The distance 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. In cases where it is not practical to maintain a 10 ft (3.0 m) 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 polyethylene or cured-in-place.

When a water pipe and a sanitary sewer cross and the sewer is 2 ft (0.6 m) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossing, the sanitary sewer is to be constructed of one of the following materials (or approved equal) and pressure tested to assure water tightness pursuant to Chapter VI of the KDHE Minimum Standards of Design of Water Pollution Control Facilities:

Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.

PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, ASTM F789, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3212.

Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

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 one of the above specified materials and is 2 ft (0.6 m) or less below the water pipe, the existing sewer shall be encased in concrete with a maximum of 6 in (15 cm) thickness for a 10 ft (3.0 m) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. KDHE will consider proposals providing equivalent protection by other means on a case-by-case basis, if supported by data from the design engineer.

- b. **SEWER CONNECTIONS** – There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs, or distribution systems.

- c. **PRESSURE SEWER LINES** – When force mains run parallel to water lines, the separation distance shall be as far as practical, but at least a 10 ft (3.0 m) horizontal separation shall be maintained. There shall be at least a 2 ft (0.6 m) vertical separation at crossings with the water main crossing above the sewer force main. In cases where it is not practical to maintain the required vertical or horizontal 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.
- 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 or valve pits should not be directly connected to sanitary or storm drains.

**Source:**

KDHE POLICIES, GENERAL CONSIDERATIONS AND DESIGN REQUIREMENTS FOR PUBLIC WATER SUPPLY SYSTEMS IN KANSAS, 1995 Edition

Chapter VIII Distribution Systems

B. Protection Considerations

1. Separation of Water Mains and Sewers

Pages VIII-2 – VIII-4