



- RCA - Reinforced Concrete Arch
- RCHE - Reinforced Concrete Horizontal Elliptical
- CS - Galvanized Round Corrugated Steel
- CSMA - Galvanized Corrugated Steel - Metal Arch
- ACS - Aluminized Corrugated Steel
- CA - Round Corrugated Aluminum
- AC SMA - Aluminized (Type 2) Corrugated Steel - Metal Arch
- CAMA - Corrugated Aluminum - Metal Arch

**SIZE DESIGNATIONS FOR ARCH CULVERTS AND HORIZONTAL ELLIPTICAL CULVERTS**

Bid item size designations for arch culverts and horizontal elliptical culverts are based on minimum waterway requirements, **TABLE 817-1**. Unless shown otherwise in the Contract Documents, provide CSMAC, ACSMAC, CAMAC, RCPA or RCPHE.

<b>TABLE 817-1: MINIMUM WATERWAY REQUIREMENTS FOR ARCH CULVERTS AND HORIZONTAL ELLIPTICAL CULVERTS</b>			
<b>Bid Item Size Designation (minimum Sq. Ft. area of waterway)</b>	<b>CSMAC/ACSMAC/CAMAC (Sq. Ft. area of waterway)</b>	<b>RCPHE (Sq. Ft. area of waterway)</b>	<b>RCPA (Sq. Ft. area of waterway)</b>
1.0	1.1	1.8	1.7
1.5	1.6	1.8	1.7
2.0	2.2	3.3	2.2
2.5	2.9	3.3	2.8
3.0	4.5	3.3	4.4
4.0	4.5	4.1	4.4
5.0	6.5	5.1	6.4
6.0	6.5	6.3	6.4
7.0	8.9	7.4	8.8
8.5	8.9	8.8	8.8
10.0	11.6/11.7	10.2	11.4
11.0	11.6/11.7	12.9	11.4
12.5	14.7/15.6	12.9	14.3
14.0	14.7/15.6	16.6	14.3
16.5	18.1/19.3	16.6	17.7

**a. Pipe Culverts, Erosion Pipe, Storm Sewer and End Sections.** Provide the type of pipe specified in the Contract Documents. If the type of pipe and end section is not specified in the proposal or the plans, provide any of the types permitted in **TABLE 1901-1: USES OF PIPES**. Use the same type of pipe base metal (steel) throughout any individual run, installation of pipe or for pipe extensions. Provide end sections of the same type as the pipe, except as follows:

Provide CS, ACS, CA or RC with PEP, PVCPC, PP or SRPE.

**b. Sanitary Sewer.** Use cast iron pipe of the bell and spigot type.

**c. Reinforced Concrete Box Storm Sewer.** Construct reinforced concrete box storm sewer in place as shown in the Contract Documents according to **DIVISION 700**.

**817.2 MATERIALS**

Provide materials that comply with the applicable requirements.

- Pipes, Fittings and End Sections ..... **DIVISION 1900**
- Steel Encasement Pipe ..... **DIVISION 1600**
- Concrete and Fly Ash Slurry Grout ..... **SECTIONS 401 & 402**

Aggregates for Concrete Not On Grade .....	<b>SECTION 1102</b>
Portland Cement .....	<b>DIVISION 2000</b>
Water .....	<b>DIVISION 2400</b>
Coarse, Fine and Mixed Aggregates .....	<b>DIVISION 1100</b>
Reinforcing Steel .....	<b>DIVISION 1600</b>
Plastic Joint Compound .....	<b>DIVISION 1500</b>
Material for Sealing Joints in Pipes .....	<b>DIVISION 1500</b>
Factory Molded Joints .....	<b>DIVISION 1500</b>
Flowable Fill .....	<b>SECTION 843</b>
Aggregates For Backfill .....	<b>SECTION 1107</b>

Provide materials for the sanitary sewer system as shown in the Contract Documents.

The Engineer will accept the materials for the sanitary sewer system based on catalog cuts, product data (including general bulletins), materials of construction, manufacturer's certifications or affidavits of compliance with specified standards, and visual inspection for compliance with dimensional and other requirements detailed in the Contract Documents.

### 817.3 CONSTRUCTION REQUIREMENTS

**a. General.** If PEP or PVC pipe is used, prior to the pre-construction conference, submit for evaluation by the Engineer, a résumé of experience installing thermoplastic pipe. A representative of the manufacturer of the thermoplastic pipe must attend the pre-construction conference for all projects where the Contractor has minimal or no experience with thermoplastic pipe, or if no résumé is submitted.

If "Provide Only" is specified, provide and deliver the pipe, coupling bands and end sections to the storage location shown in the Contract Documents.

If "Install Only" is specified, KDOT will provide the pipe, coupling bands and end sections. The location of the materials is shown in the Contract Documents.

If neither "Provide Only" or "Install Only" is designated, provide and install the pipe, coupling band and end sections as shown in the Contract Documents.

Use Grade 3.0 concrete to construct headwalls for erosion pipe. Perform formwork, placing, curing and protection of concrete according to **DIVISION 700**.

If aluminum pipe or aluminized corrugated steel pipe is to come in contact with fresh portland cement concrete or grout, completely cover the contact area of the pipe with an asphaltic paint (approved by the Field Engineer) to prevent corrosion.

When Contract Documents mix base metal and/or coating types, isolate the 2 materials according to the manufacturer's recommendations, to prevent galvanic reactions.

**b. Trench Excavation.** Follow OSHA safety regulations for sloping the sides of excavations. Use shoring and bracing as required.

Do not disturb any railroad, existing street or highway, when tunneling underneath is required (See **SECTION 819** for tunneling, jacking or boring requirements). Methods of tunneling are subject to Engineer approval.

When it is required to remove an existing street or highway surface in constructing the pipe or sewer, replace the surface with an equivalent material at Contractor's expense, unless otherwise shown in the Contract Documents.

Beginning at the outlet end and proceeding toward the upper end, excavate the bottom of the channel to the line, grade and elevation shown in the Contract Documents. Construct the width of the trench according to the Contract Documents.

Firm the foundation in the trench to prevent subsequent settlement. Remove soft, unstable materials and replace with suitable materials.

If blasting is used to remove rock, take the precautions to protect the previously placed portions of the structure.

### **c. Bedding.**

(1) General. Construct bedding according to the Contract Documents.

When shown in the Contract Documents, or ordered in writing by the Engineer, place a concrete cradle or encasement under or around the pipe to provide a suitable foundation for the pipe. Use the dimensions and grade of concrete as shown in the Contract Documents, or as directed by the Engineer.

(2) Pipes and Culverts 3 feet or less in diameter.

Alternate methods of bedding the pipe or culvert:

- Place a bed of granular material (4-inch minimum thickness) on the bottom of the channel, and then use a template to shape the granular material to accept the culvert.
- Place the pipe or culvert on the bottom of the channel, then place and tamp granular material (4-inch minimum thickness) under the haunch area of the pipe or culvert.

(3) Pipes and Culverts greater than 3 feet in diameter.

An alternate method of bedding the pipe or culvert is to place and compact a bed of granular material (approximately half the total quantity needed) on the bottom of the channel, then use a template to shape the granular material to accept the pipe or culvert. Place and tamp the remainder of the granular material after the pipe or culvert is placed so that 20% of the overall height of the pipe or culvert is bedded in the granular material.

**d. Installation.** Do not install pipe until the Engineer approves the foundation bed.

(1) General. When placing 2 or more pipe culverts adjacent to each other, separate the pipe culverts by a distance equal to a minimum of  $\frac{1}{2}$  the diameter of the pipe. The minimum distance for pipe culverts is 18 inches, and the minimum distance for metal arch culverts is 24 inches.

When bell and spigot pipe is used, install the pipe at the outlet end so the spigot ends point to the direction of flow. Install all pipes true to line and grade, with ends abutting. When using multiple sections of pipe in an individual run, place the longest section at the upstream end, the next longest section at the outlet end, and shorter sections in the middle of the run. When laid in the trench, fit and match pipes to form a smooth, uniform invert. Carefully clean bell ends before pipes are lowered into the trenches.

(2) Corrugated Steel/Aluminum Pipe. Before installing corrugated steel pipe, repair any damage to the metallic coating on the pipe. Clean the damaged area to bright metal by blast cleaning, power disk sanding or wire brushing. Apply zinc-rich paint over the cleaned area. Use zinc-rich paint to repair both aluminized and galvanized coatings.

Before installing asphalt coated pipe, repair any damage to the asphalt coating on the pipe. Use material that is compatible with the original asphalt coating. The repaired area shall have the same thickness as the original asphalt coating. For erosion pipe, weld any bends or angles prior to applying the asphalt coating.

When installing helical, corrugated pipe, rotate the sections during installation so that the corrugations on the end of one section match those on the end of the adjoining section.

Place sections of corrugated metal pipe with the ends abutting and join with the manufacturer's coupling bands. Install and tighten the coupling bands according to the manufacturer's recommendations.

(3) Reinforced Concrete Pipe. On 24-inch or smaller RCP's, use plastic joint compound to join the sections. Cement joints of pipe over 24 inches in diameter with a cement mortar or plastic joint compound. Use cement mortar composed of 1-part portland cement and 3 parts fine aggregate mixed with sufficient water to form a plastic mortar. As each section of pipe is laid, clean the bell or hub of the preceding pipe and fill the bottom portion with mortar. After the pipe is placed, fill the remaining portion of the joint. Smooth finish and wipe clean the inside of the joint. After the initial set, protect the mortar on the outside from the sun using soil or other approved covering. Prepare and apply plastic joint compound according to the manufacturer's recommendations.

(4) Thermoplastic Pipe. Install thermoplastic pipes according to **subsection 817.3d.** and the following additions and exceptions:

- Assemble thermoplastic pipe according to the manufacturer's instructions, starting at the downstream end.
- Properly assemble the gasketed bell and spigot joints to prevent the infiltration of soil fines.

**e. Concrete Headwalls.** Construct headwalls for erosion pipe with Grade 3.0 concrete. Formwork, placing, curing and protection of the concrete shall comply with **DIVISION 700.** Place reinforcing steel as shown in the Contract Documents.

**f. Backfilling.**

(1) General. Do not begin backfilling the pipe until the Engineer approves the pipe installation. Place backfill according to the Contract Documents.

If the top of a pipe or culvert extends above the original ground line, continue the compacted backfill to the top of the pipe culvert. Take the necessary precautions to prevent distortion of the pipe or culvert while backfilling.

Place granular material in uniform layers a maximum of 12 inches thick. When deemed necessary by the Engineer, terminate the granular backfill material a minimum of 8 inches below the subgrade or ground level, and use suitable soil to backfill the remaining portion.

(2) Erosion Pipe. Install cover over the erosion pipe according to the Contract Documents. Place the cover in lifts 18 inches (maximum, loose measurement), and compact each lift to Type A compaction, **SECTION 205**. On projects where Type B compaction is required on the adjacent roadway, compact the cover according to Type B compaction, **SECTION 205**. Use hand or mechanical tampers or rollers to achieve compaction.

(3) Structural Plate Structures and Metal Pipes Greater than 60 inches. Backfill structural plate structures and metal pipes greater than 60 inches in diameter with granular backfill. Use deflection control measures, including hand tamping, to maintain the original shape of the structure.

(4) Reinforced Concrete Pipe. If the height of fill over the top of a reinforced concrete pipe is greater than 27.5 feet, place the backfill using the imperfect trench method in this manner:

- Place the reinforced concrete pipe in the excavation, as specified.
- Place and compact the earthen backfill to a height above the top of the pipe equal to the external width of the pipe.
- After the backfill is placed and compacted as specified, excavate the compacted earth from the prism directly over the pipe.
- Backfill the resulting trench with earth placed in the loosest possible condition.
- After the trench is filled with loose earth, construct the remainder of the embankment as specified in the Contract Documents.

(5) Thermoplastic Pipe. Backfill according to the Contract Documents.

- Prevent damaging or floating the pipe during the backfilling operations. Do not deform or damage the pipe while compacting the granular backfill. Hand tamping may be necessary adjacent to the pipe to prevent distortion.
- The maximum barrel deflection of the pipe (reduction of the barrel nominal base inside diameter) shall not exceed 5%. Use a mandrel to measure the barrel deflection of the pipe. Take the measurement at least 30 days after the installation and backfilling. If oversized diameter pipes are installed, actual inside pipe diameters may need to be considered. Remove, reinstall, or replace any pipes deformed more than 5%.

**g. Cast Iron Pressure Pipes for Sanitary Sewers.** Construct according to this specification with the following additions and exceptions.

(1) Handling. Do not injure the pipe or pipe coating. Do not place any pipe or material inside of a pipe or fitting after the coating is applied.

(2) Cutting. Cut the pipe without damaging.

(3) Placing and Laying. While suspended in the sling and before lowering into the trench, the Engineer will inspect the pipe for defects by tapping lightly with a hammer. Damaged pipe will be rejected. Carefully embed the pipe with bell holes excavated so each pipe will rest firmly upon its bed for the full length. After placing a length of pipe in the trench, hold the packing material for the joint around the bottom of the spigot so the packing enters the bell as the pipe is pushed into position. Center the spigot in the bell and push the pipe into position in the required alignment. Lay pipe with the bells facing the direction of laying, except where necessary in making connections with other lines. Position a minimum of 2 lengths of pipe ahead of each joint, with packing installed and earth fill tamped alongside the pipe before the joint is poured, except at closures.

(4) Joints. Before jointing bell and spigot pipe, remove all lumps, blisters, excess coating materials, oil and grease from the bell and spigot ends of the pipe. Rub with a wire brush, wipe clean and dry the outside spigot and inside of the bell. Carefully place the packing, and tightly caulk to a uniform thickness. No loose or frayed ends of fiber may protrude into the space to be filled with joint filler. Carefully inspect each joint and check for proper depth before the joint runner is attached. The depth of lead in lead filled joints shall be a minimum of 2 ¼ inches back of the face of the bell. In a melting pot near the joint to be poured, heat lead to the proper temperature so that when stirred the surface will show a rapid change in color. Before pouring lead, remove all scum. On the outside of the pipe, dam the pouring gate with clay to fill the joint even with the top of the bell. Make each joint with 1 pour completely filling the joint space. Caulk toward the joint gate to secure tight joints without overstraining the bells. If

the packing has been insufficiently caulked, permitting the lead to be driven to a depth more than  $\frac{1}{4}$  inch from the face of the bell at any point during caulking, remove the lead and remake the joint.

**h. Sanitary Sewer System.** Install the sanitary sewer system as shown in the Contract Documents. Make all service connections unless specified otherwise in the Contract Documents.

Use Grade 3.5 concrete that complies with **SECTION 401** unless specified otherwise in the Contract Documents.

#### **817.4 INSPECTION**

**a. General.** A minimum of 30 days after installation of pipes and final fill, KDOT will conduct an internal inspection to evaluate issues that may affect long-term performance of pipes, such as cracks, joint quality, and alignment.

**b. Thermoplastic Pipe.** A minimum of 30 days following the installation and backfilling, measure the barrel deflection (reduction of the barrel based on the actual inside diameter) of each pipe run. If oversized diameter pipes are installed, actual inside pipe diameters may need to be considered.

Measure the deflection using a mandrel or other electronic device (approved by the Engineer) that can verify the dimensions of the pipe and is not limited by poor lighting, water-flow, pipe length or other limiting conditions of the installed environment. Measure the deflection in the presence of the Engineer.

Pipes larger than 24 inches may be entered and deflection levels measured directly. Take a measurement once every 10 feet for the length of the pipe.

If a mandrel is used for the deflection test, use a 9 (or greater odd number) arm mandrel, sized to the actual inside diameter of the pipe installed, and inspected by the Engineer prior to testing. Use a properly sized proving ring to check or test the mandrel for accuracy. Pull the mandrel through the pipe by hand with a rope or cable. When applicable, incorporate pulleys into the system to change the direction of pull so that inspection personnel need not physically enter the pipe or manhole.

If any pipes deform between 5% and 7.5%, conduct an evaluation (by a licensed Professional Engineer) and submit to the Engineer for review and approval. In the evaluation consider the severity of the deflection, structural integrity, environmental conditions and the design service life of the pipe. The Engineer may require removal, reinstallation or replacement of the pipe where the evaluation indicates that the deflection could be problematic.

The maximum barrel deflection of the pipe is 7.5%. Remove and reinstall or replace, as directed by the Engineer, any pipes deformed more than 7.5%.

#### **817.4 MEASUREMENT AND PAYMENT**

The Engineer will measure all types of pipe by the linear foot, along the centerline of the pipe. Gain in pipe length due to the fit of the pipe sections at the coupling bands or joints is not measured for payment.

The Engineer will measure each end section, concrete headwall and sanitary sewer system.

The Engineer will measure fly ash slurry grout by the cubic yard.

The Engineer will not measure excavation or backfill for separate payment.

Payment for "Entrance Pipe", "Cross Road Pipe", "Erosion Pipe", "Storm Sewer", "Sanitary Sewer", "End Section", "Concrete Headwall", "Fly Ash Slurry Grout" and "Sanitary Sewer System" at the contract unit prices is full compensation for the specified work.