

**817 - PIPE CULVERTS, EROSION PIPE, STORM SEWERS,
SANITARY SEWERS & END SECTIONS**

SECTION 817

PIPE CULVERTS, EROSION PIPE, STORM SEWERS, SANITARY SEWERS AND END SECTIONS

817.1 DESCRIPTION

Install the size and type of pipe culvert, erosion pipe, storm sewer, sanitary sewer, end section and concrete headwall specified in the Contract Documents.

BID ITEMS

Entrance Pipe (*) (**) (+) (++)
 Cross Road Pipe (*) (**) (+) (++)
 Erosion Pipe (*) (**) (+) (++)
 Liner Pipe (*) (**)
 Storm Sewer (*) (**)
 Sanitary Sewer (*) (**)
 End Section (*) (**) (+) (++)
 Concrete Headwall
 Fly Ash Slurry Grout (xx)
 *Size
 **Type
 +Provide Only
 ++Install Only
 xx High Strength or Low Strength

UNITS

Linear Foot
 Linear Foot
 Linear Foot
 Linear Foot
 Linear Foot
 Linear Foot
 Each
 Each
 Cubic Yard

TYPES OF PIPES

RCP - Round Reinforced Concrete Pipe
 RCPA - Reinforced Concrete Pipe-Arch
 RCPHE - Reinforced Concrete Pipe Horizontal Elliptical
 CMP - Round Corrugated Metal Pipe
 CMMAC - Corrugated Metal - Metal Arch Culvert
 CSP - Galvanized Round Corrugated Steel Pipe
 CSMAC - Galvanized Corrugated Steel - Metal Arch Culvert
 ACSP - Aluminized (Type 2) Round Corrugated Steel Pipe
 ACSMAC - Aluminized (Type 2) Corrugated Steel - Metal Arch Culvert
 PEP - Polyethylene Pipe
 CP-ES - Clay Pipe - Extra Strength
 CP - Clay Pipe - Standard Strength
 CIP - Cast Iron Pipe
 CIPP - Cast Iron Pressure Pipe
 CISP - Cast Iron Soil Pipe
 PVCP - Polyvinyl Chloride Pipe
 SP - Steel Pipe
 BCCMP-FP - Corrugated Metal Pipe - Fully Paved
 BCCSP-FP - Corrugated Steel Pipe - Fully Paved
 HDPE - High Density Polyethylene - Liner Pipe

TYPES OF END SECTIONS

RC - Round Reinforced Concrete
 RCA - Reinforced Concrete Arch
 RCHE - Reinforced Concrete Horizontal Elliptical
 CM - Round Corrugated Metal
 CMMA - Corrugated Metal - Metal Arch
 CS - Galvanized Round Corrugated Steel
 CSMA - Galvanized Corrugated Steel - Metal Arch

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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 CMMAC, RCPA or RCPHE.

TABLE 817-1: MINIMUM WATERWAY REQUIREMENTS FOR ARCH CULVERTS AND HORIZONTAL ELLIPTICAL CULVERTS			
Bid Item Size Designation (minimum Sq. Ft. area of waterway)	CMMAC (Sq. Ft. area of waterway)	RCPHE (Sq. Ft. area of waterway)	RCPA (Sq. Ft. area of waterway)
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	2.8	3.3	2.8
3.0	4.4	3.3	4.4
4.0	4.4	4.1	4.4
5.0	6.4	5.1	6.4
6.0	6.4	6.3	6.4
7.0	8.7	7.4	8.8
8.5	8.7	8.8	8.8
10.0	11.4	10.2	11.4
11.0	11.4	12.9	11.4
12.5	14.3	12.9	14.3
14.0	14.3	16.6	14.3
16.5	17.6	16.6	17.7

a. Pipe Culverts, Erosion Pipe, Storm Sewer & End Sections. Provide the type of pipe specified in the Contract Documents. If the type of pipe and end section is not specified, 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 with ACSP,
- Provide CSMA with ACSPMAC,
- Provide CM or RC with PEP.

b. Sanitary Sewer. If there is no entry for type, use vitrified clay. Use cast iron pipe of the bell and spigot type. Clay pipe may be the bell and spigot type or plain-end 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 & Fly Ash Slurry Grout	DIVISION 400
Portland Cement	DIVISION 2000
Water	DIVISION 2400
Coarse, Fine and Mixed Aggregates	DIVISION 1100
Reinforcing Steel	DIVISION 1600
Plastic Joint Compound	DIVISION 1500
Material for Sealing Joints in Pipes	DIVISION 1500
Factory Molded Joints	DIVISION 1500

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Flowable Fill **SECTION 843**

TABLE 817-2: GRADATION OF GRANULAR BACKFILL FOR PEP AND PVC									
Usage	Composition	Percent Retained - Square Mesh Sieves							
		1"	¾"	½"	⅜"	No. 4	No. 8	No. 40	No. 200
Flexible Pipe Backfill	Sand Gravel, Chat or Crushed Stone. Singly or In Combination	0	0-30	-	-	35-60	50-75	70-90	90-100

- Soundness, minimum 0.85.
- Wear, maximum 45%.
The soundness and wear requirements do not apply to sand-gravel aggregates having less than 10% retained on the No. 8 sieve.
- Plasticity Index, maximum 8.
- The material shall be free of weeds, sticks, grass roots and other foreign material.
- Test the aggregates according to the applicable requirements of **SECTION 1115**.

817.3 CONSTRUCTION REQUIREMENTS

a. General. 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.

Excavate for, and form the foundation bed for the pipe culvert according to **SECTION 204**.

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

(1) Excavation. 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 sufficient to lay and backfill the pipe with a minimum width equal to the diameter of the pipe plus 6 inches on each side. Follow OSHA safety regulations for sloping the sides of excavations. Use shoring and bracing as required. Do not disturb railroad or 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. Firm the foundation in the trench to prevent subsequent settlement removing soft unstable materials and replace with suitable materials. If the foundation is in rock, place an equalizing bed a minimum of 6 inches thick of well-compacted sand or similar material upon the rock. If the foundation is on firm earth, pare or mold the earth to give full support to each pipe for a depth a minimum of ¼ the external diameter of the pipe. When bell and spigot pipe is used, cut notches to receive the bell. The Contractor may undercut the trench and backfill with well compacted sand or other suitable material to obtain proper, uniform bearing of the storm sewer pipe at no additional cost to KDOT. 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.

Excavate pipe according to **subsection 204.3b.(5)**.

(2) Laying. Do not lay pipe until the Engineer approves the foundation bed.

When placing 2 or more pipe culverts adjacent to each other, separate the pipe culverts by a distance equal to a minimum of ½ 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.

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.

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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.

In finished trenches, start laying pipe at the outlet end so the spigot ends (when bell and spigot pipe is used) 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 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. Lay pipe in the bed so the lower portion of each pipe is supported for its entire length to a depth a minimum of $\frac{1}{4}$ the external diameter of the pipe. 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. Avoid unnecessary handling in the trench when lowering.

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.

Sections of clay pipe may be joined using factory molded joints with plain end compression coupling (slip type collar) or bell and spigot type. Cement joints of all other types 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.

On 24 inch or smaller RCP's, use plastic joint compound to join the sections.

(3) 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.

(4) Backfilling. Do not begin backfilling the pipe until the Engineer approves the pipe installation. Backfill all trenches and excavated areas with suitable material without disturbing or damaging the pipe.

Backfill trenches within the embankment or beneath entrances, side roads, sidewalks, other intersecting traveled ways, or those designated in the Contract Documents to the required grade in layers 6 inches (maximum, compacted thickness). Compact to Type A compaction according to **SECTION 205**.

On all sewers which do not meet the requirements of the preceding paragraph, carefully deposit and satisfactorily tamp the material in uniform layers a maximum of 6 inches thick until the backfill reaches the top of pipe. Backfill and tamp the remainder of the trench either in uniform layers a maximum of 12 inches thick, or completely fill the trench and settle by satisfactory methods of jetting or flushing. Continue operations until the backfill is slightly above ground level.

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.

Backfill pipe culverts according to **SECTION 204**.

When approved by the Engineer, granular material (of sufficient moisture content and that may be adequately rolled or tamped in place) may be used for backfill material. 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.

Dispose of excess material and leave the area in a neat presentable condition.

b. Polyethylene (PE) and Polyvinyl Chloride (PVC), Pipe Storm Sewer. Excavate and form a bed for PE and PVC pipes according to AASHTO LRFD Bridge Design Specifications, Section 12 and the following:

- The minimum trench width is $1\frac{1}{2}$ times the pipe diameter plus 12 inches.
- The space between the pipe and the trench wall shall be wider than the compaction equipment used in the pipe zone.
- The trench width in unsupported, unstable soils will depend on the size of the pipe, the stiffness of the backfill and insitu soil, and the depth of cover.

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Backfill PE and PVC pipe with either granular backfill or flowable fill, according to **SECTION 204**, with these additions and exceptions:

- If the fill to the top of the subgrade is 3 feet or less, backfill with granular material to the top of the subgrade.
- If the fill to the top of the subgrade is greater than 3 feet, backfill with granular material to a point 1 foot above the top of the pipe.
- Prevent damaging or floating the pipe during the backfilling operations.

The maximum barrel deflection of the pipe (reduction of the barrel base inside diameter) is 5%. Measure the barrel deflection of the pipe using a mandrel. Wait a minimum of 30 days (following the installation and backfilling) before taking the measurement. Remove, reinstall or replace as necessary, any pipes deformed more than 5%.

c. Vitrified Clay Pipe Joints in Sanitary Sewers.

(1) Cement Mortar Joints. Clean the ends of the pipe with a wet brush. Form the joint by tamping a gasket of hemp or oakum saturated in cement mortar into the bell or hub. Completely fill the remaining annular opening with cement mortar composed of 1 part portland cement and 2 parts fine aggregate, mixed with sufficient water to form a plastic mortar. Level off the mortar to an angle of 45° with the outside of the pipe. Fill the inside of the joint with mortar, finish smooth and wipe clean.

(2) Hot Poured Joints. Make the joints after the pipe is clean and dry. Form the joint by tamping a gasket of hemp or oakum into the bell or hub in sufficient quantity to seal the joint without unnecessarily filling the annular space. Fill the remaining annular opening with hot poured asphalt joint material.

(3) Plastic Compound Joints. Prepare and apply the plastic compound used for filling joints according to the manufacturer's recommendations.

(4) Compression Coupling Joint. Install the compression coupling as used with plain-end pipe having factory molded joints according to the manufacturer's recommendations.

d. Cast Iron Pressure Pipes for Sanitary Sewers.

(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 ¼ inch from the face of the bell at any point during caulking, remove the lead and remake the joint.

e. High Density Polyethylene Liner Pipe. Before installing the liner pipe, push or pull a standard test section of liner pipe, or an approved mandrel of the same length and outside diameter, through the section of pipe being rehabilitated to ensure adequate clearances. Repair or remove any obstructions, protrusions, joint offsets, debris or out-of-roundness that could damage the liner pipe or prohibit passage of the liner pipe during the installation operations.

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Provide the Project Engineer with a printed copy of the manufacturer's recommendations for installing the liner pipe. Install the liner pipe according to the manufacturer's recommendations. Install the liner pipe with the assistance of a technical representative of the liner pipe manufacturer. The manufacturer's representative will provide technical expertise pertaining to the installation of the liner pipe and filling the annular space between the existing pipe and liner pipe with fly ash slurry grout.

Fill the space between the liner pipe and the existing structure with fly ash slurry grout, according to the pipe manufacturer's recommendations.

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 and concrete headwall.

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

The Engineer will not measure excavation for separate payment.

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