

## SECTION 6

### STORM SEWERS AND CULVERTS

#### 6.01 GENERAL.

A. Scope. This section covers the construction of all storm sewers, drainage culverts, storm sewer manholes, inlets, reinforced concrete sewer structures, and other related appurtenances.

B. General Construction Requirements. Pipelines and culverts shall be constructed using the type of pipe material specified in the Project Documents and meeting the requirements of these Standard Specifications. Pipes may be designated by their use. Pipes used in an enclosed drainage system may be referred to as "Storm Sewer." Pipes used for conveying open channel and ditch drainage under roadways or entrances may be referred to as "Culverts."

Pipe shall be inspected before it is laid and any defective or damaged lengths shall not be accepted. If metallic pipes or End Sections have been damaged or scratched and the Engineer determines they are otherwise acceptable, the Contractor shall clean the damaged area by blast cleaning, disk sanding, or wire brushing, and paint the clean damaged area with a zinc rich paint.

Pipe shall be laid in the finished trench to a true and uniform grade as shown in the Project Documents. Bedding shall conform to the requirements of Subsection 2.08. Bedding of Polypropylene Pipe (PPP) and Polyethylene Pipe (PEP) shall meet the requirements specified by the pipe manufacturer. All pipes shall be laid with ends abutting and true to line and grade. Pipes shall be fitted and matched so that when laid together they will form a smooth and uniform invert.

When bell and spigot pipe is used, bell and spigot ends shall be carefully cleaned before pipes are lowered into the trenches. Construction of gravity sewers shall begin at the lower end with bell ends facing upstream, and with bell holes excavated as required.

The downstream end of new sewer extensions shall be plugged in a positive manner satisfactory to the Engineer until construction, cleaning, and testing are completed and the new construction is accepted by the Owner.

The Contractor shall take all precautions to ensure adequate trench ventilation and protection for workers installing the pipe.

C. Construction Loads. Construction loads on sewers and culverts may exceed the final design loads. The Contractor shall protect sewers and culverts from excessive loading due to the Contractor's construction activities and shall repair or replace any sewers or culverts so damaged.

#### 6.02 CRITICAL AREAS FOR WORK WITHIN THE CITY LIMITS.

A. "Critical Areas" are defined as the areas 500' landward and 300' water side of the Kansas River and Soldier Creek Levees within the City of Topeka and Shawnee County. Construction activities within these areas must adhere to all applicable Army Corps of Engineers requirements

for Federally protected levees and design and construction plans must be submitted to the Engineer for review by the Army Corps of Engineers. Army Corps of Engineers approval and permits are required for construction activities within this area.

B. All storm sewer and drainage culverts within “Critical Areas” shall be made with reinforced concrete or polypropylene pipe. “Critical Areas” are defined as the area upon which curb and gutter or pavement is to be placed. The critical area for streets shall extend one foot on each side beyond the back of curb, edge of pavement, or edge of shoulder, whichever is greater. This requirement does not apply to areas outside the corporate limits of the City of Topeka.

### 6.03 STORM SEWERS, DRAINAGE CULVERT PIPES, AND END SECTIONS

A. Materials. Pipes used as drainage culverts and storm sewers shall be limited to only those materials listed in paragraphs (1), (2), (3), (4) and (5) below unless otherwise specifically specified in the Project Documents or approved by the Engineer.

(1) Reinforced Concrete Pipe. Round reinforced concrete pipe (RCP) shall conform to the requirements of ASTM C76 wall "B" or "C". Pipe supplied shall conform to the requirements of the ASTM pipe classes specified in the Project Documents. Concrete pipe 15” through 30” shall be fabricated without lift holes. Concrete pipe larger than 30” may be fabricated with lift holes. Joints shall be a gasketed Bell and Spigot. Joint shall conform to the requirements of ASTM C 443 (AASHTO M315) for gasketed, watertight joints for circular concrete sewer and culvert pipe. Rubber gaskets shall conform to ASTM C 361 for Reinforced Concrete Low-Head Pressure pipe.

(2) Reinforced Concrete Pipe Horizontal Elliptical. Elliptical shaped reinforced concrete pipe designed for placement of the major axis in the horizontal direction referred to as “Reinforced Concrete Pipe Horizontal Elliptical” (RCPHE) supplied shall meet the requirements of ASTM C 507 for the ASTM pipe classes specified in the Project Documents. Joints shall be slip joints. All elliptical pipes may be fabricated with lift holes.

(3) Corrugated Steel Pipe and Corrugated Steel Pipe Arch. Corrugated Steel Pipe (CSP) and Corrugated Steel Pipe Arch (CSPA) shall be helically corrugated pipe meeting the requirements of AASHTO M36 and ASTM A760. The CSP material shall be Aluminized Steel Type 2 meeting the requirements of, AASHTO M274 and ASTM A929. All accessories shall be compatible with the pipe supplied and AASHTO M36. The pipe sizes, corrugations, and gauges shall be as specified in the Project Documents. Should the Project Documents make reference to “Corrugated Metal Pipe” or “CMP”, it shall mean Corrugated Steel Pipe as specified in this paragraph. Joints shall be either Hugger-type or Bell and Spigot.

i. Bell and Spigot Joints. Bell and spigot joints shall be “CONTECH Quick Stab Joint”, or an approved equal, for pipe sizes 15” through 48” diameter.

ii. Hugger-type joints. Hugger-type Joints shall conform to “CONTECH Hugger Band”, or an approved equal, for pipe sizes 15” and larger.

(4) Polypropylene Pipe. Polypropylene Pipe (PPP) for storm sewers shall meet the requirements of ASTM F2881 and AASHTO M330, Type S. The pipe sizes shall be as specified in the Project Documents. Pipe sizes larger than 36” in diameter shall not be used in this material type.

i. Joints. Joints shall be bell and spigot joints meeting ASTM F2881 and AASHTO M330. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477.

ii. Fittings. Fittings shall conform to ASTM F2882 or AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

(5) Polyethylene Pipe. Polyethylene Pipe (PEP) for storm sewers shall meet the requirements of AASHTO M294, Type S. The minimum pipe sizes shall be limited to 15” diameter and shall not be used for driveway culverts. Pipe larger than 36” in diameter shall not be used in this material type.

i. Joints. Joints shall be slit or snap couplings. The joint shall be soil tight according to the requirements of ASTM M252 or M294.

ii. Fittings. Fittings shall conform to ASTM M252 or M294. Gasketed connections shall utilize a closed cell synthetic rubber gasket meeting the requirements of ASTM D1056, Grade 2A2.

(6) End Sections. End Sections shall be the same material as the pipe to which it will be connected unless otherwise indicated in the Project Documents. If the Project Documents make reference to “Corrugated Metal Pipe” or “CMP” End Sections, it shall mean Corrugated Steel Pipe as specified in this paragraph.

i. End Section Designations.

(1) End Section (RC) - Round reinforced concrete End Section

(2) End Section (RCHE) - Elliptical (horizontal major axis) reinforced concrete End Section

(3) End Section (CS) - Round corrugated Aluminized Steel Type 2 End Section

(4) End Section (CSA) - Arched corrugated Aluminized Steel Type 2 End Section

(5) Joint Sealants for RCP and RCPHE. Joints in concrete pipes 24-inch diameter and smaller shall be sealed using a preformed mastic sealant conforming to the requirements of AASHTO M 198 and pre-approved by the Engineer. Mastic sealant must be designed to fit the type of pipe joint for which it is to be used. Joints in concrete pipes larger than 24 inches shall be sealed using approved preformed mastic sealant or cold troweled-on mastic sealant such as Philip Carey "Sewertite" or approved equal.

(6) Lift Hole Plugs. A preformed polyethylene plug shall be used to fill and cover lift holes. The plug shall be *POPIT* manufactured by POPIT Inc., Levittown, PA or an approved equal.

B. Construction Requirements. The full method of construction shall be observed and approved by the Engineer at the start of operations.

(1) Excavation. The Contractor shall excavate the bottom of the channel to the line, grade and elevation shown in the Project Documents beginning at the outlet end and proceeding toward the upper end. Excavation and the width of the trench shall be as specified in Subsection 2.02. If the culvert is being installed in a location where pavement is not otherwise planned for removal or replacement, pavement removal shall be as specified in Subsection 4.06.

The Contractor shall follow all OSHA safety regulations for all excavations and use shoring and bracing as required by Subsection 2.03. Shoring and bracing are subsidiary. Ground water shall be controlled as specified in Subsection 2.04. Trench stabilization shall be as specified in Subsection 2.05.

(2) Bedding. Bedding material shall be placed as specified in Subsection 2.08. Bedding material is subsidiary.

(3) Laying. The Contractor shall lay the pipe as specified in Subsection 6.01 and as per the manufacturer's recommendations. Lines shall be checked for alignment by visual inspection. The pipe between manholes shall not be more than  $\frac{1}{4}$  of the pipe diameter out of horizontal alignment. No tolerance is allowed for vertical mis-alignment. Pipe must be placed on the grade shown in the Contract Documents.

When placing two pipe culverts parallel to one another, the pipes shall be separated from each other a distance of  $\frac{1}{2}$  the diameter of the pipe with a minimum distance between round pipes of 18 inches and a minimum distance between elliptical or arch pipe of 24 inches.

i. RCP. All joints in circular concrete pipe shall be gasketed and watertight. The maximum allowable gap at any location on the joint shall be  $\frac{1}{4}$  inch. After the spigot is seated completely in the bell, the inside of the joint shall be checked for smoothness and any excess material removed from the inside of the pipe.

ii. RCPHE. The Contractor shall seal all joints. Prior to sealing, the joints of all pipes shall be visually inspected for the interior joint gap. The maximum allowable gap at any location on the joint shall be  $\frac{1}{2}$  inch. If troweled on mastic sealant is used for pipes larger than 24 inches in diameter, mastic shall be placed around the entire inside periphery of the bell and on the outside of the upper half of the spigot. After the spigot is seated completely in the bell, the inside of the joint shall be smoothed and any excess mastic material removed from the inside of the pipes.

iii. CSP and CSPA. When round CSP is installed, where possible the Contractor shall rotate the pipes so that the corrugations match from section to section. CSP and CSPA shall be tightly joined by the use of connecting bands unless bell and spigot pipe is used. Space between the connecting bands and pipe shall be kept free from

dirt and grit so that the corrugations fit snugly. Slack in the bands should be taken up by tightening of the bolts.

iv. PPP and PEP. PPP shall be tightly joined using gasketed bell and spigot joints. PEP shall be tightly joined using be slit or snap couplings. Space between the connecting pipe shall be kept free from dirt and grit so that the pipes fit snugly.

(4) Stubs and Plugs. Pipes designated in the Project Documents to be plugged for future connections shall be plugged to prevent infiltration, resist deterioration, and permit future reopening without substantial damage to the existing construction. All plugs shall be approved by the Engineer before backfilling. Special fittings, discs, and other devices may be installed with the approval of the Engineer. Such plugging devices shall be installed in accordance with the manufacturer's recommendations.

(5) Backfill and Compaction. Backfill and compaction shall be completed as specified in Subsections 2.09 and 2.10. Backfill and compaction are subsidiary.

(6) Pavement Replacement. Unless otherwise indicated in the Project Documents, the Contractor shall replace pavement as specified in Subsection 4.06.

C. Cleaning, Testing and Acceptance. After all installations are complete, including all backfill and compaction, the storm sewer or culvert shall be flushed clear of all foreign materials. Flushing shall be completed in manner complying with the SWPPP and shall not contribute to soil erosion or water pollution.

For PPP and PEP installations only, the pipe shall be tested for deflection. The Mandrel Deflection Test is conducted by pulling the test device through a completed sewer run, from manhole to manhole. If the Mandrel gets caught in the pipeline and cannot be pulled through the line (manhole to manhole) in one straight pass, the line fails. Pipe through which the mandrel does not pass will be considered unacceptable, and shall be re-laid, and also re-tested.

The allowable deflection shall not exceed 4% **of the nominal inside diameter.** The mandrel test shall not be performed within 30 days of pipe installation and backfill.

The mandrel shall be made of steel or other hard metallic, non-corrodible, nonpliable material and have non-adjustable legs. The mandrel shall: (1) be a rigid nonadjustable, odd number of legs (9 legs minimum), mandrel having an effective length not less than its **inside** diameter; and (2) be fabricated of steel or other hard metallic, non-corrodible, nonpliable material, fitted with pulling rings at each end, stamped or engraved on some segment other than a runner indicating the pipe material specification nominal size and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

The mandrel shall be pulled through the pipe by hand. The Engineer may require the mandrel to be certified by an independent testing laboratory to ensure that it meets dimensional requirements. The minimum diameter of the Mandrel shall be 96% x the nominal inside diameter of the pipe.

Prior to placement of any new surfacing material on City of Topeka projects, all new City of Topeka storm sewer installations shall receive a CCTV inspection. This inspection shall be reviewed and approved by the city storm water engineer prior to pavement placement. An additional Mandrel Deflection Test is to be performed at the end of the one-year warranty period.

The intent of the City Standard Specifications is that all storm sewer pipe be installed to the grade shown on the plan drawings. If ponding is identified, it is the contractor’s responsibility to prove that the ponding is within the tolerances outlined in the table below.

Pipe Size	Allowable Pooling Depth (in.)
15”-30”	½”
33”-78”	1”
≥84”	1½”

Bid Items, Measurement and Payment.

(1) Bid Items:

- (\*) STORM SEWER (##)** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) STORM SEWER (RCP), CLASS (\*\*)** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) STORM SEWER (RCPHE), CLASS (\*\*)** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) STORM SEWER (CSP), (#) Gauge** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) STORM SEWER (CSPA), (#) Gauge** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) STORM SEWER (PPP)** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) STORM SEWER (PEP)** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) X (\*) INCH CULVERT (RCPHE), Class (\*\*)** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) CULVERT (CSP), (#) Gauge** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) X (\*) INCH CULVERT (CSPA), (#) Gauge** Unit: Lineal Foot (nearest 1 L.F.)
- (\*) END SECTION (TYPE)** Unit: Each
- (\*) X (\*) INCH END SECTION (TYPE)** Unit: Each

(\*) - Inside diameter of pipe

(\*\*) – ASTM Class of pipe

(TYPE) – End section types as follows:

(CS) – corrugated steel pipe

(RC) – reinforced concrete

(RCHE) –reinforced concrete horizontal elliptical

(CSA) – corrugated steel arch

- (#) – Thickness of pipe wall
- (##) – Type as specified in the Project Documents

(2) Measurement. The various sizes and types of Storm Sewers and Culverts shall be measured to the nearest one foot along the flow-line of the pipe from end of pipe to end of pipe in inlets, manholes and other structures. Where an End Section is attached to a pipe, the fully enclosed portion of the End Section shall be included in the measured pipe length.

End Sections will be measured per each of the various sizes and types of End Sections.

(3) Payment. The completed and accepted lengths of Storm Sewers and Culverts, measured as specified above, shall be paid for at the Contract unit price per foot for each of the various sizes and types of Storm Sewers and Culverts.

Prior to final acceptance and payment, a CCTV inspection of all newly constructed pipes shall be made, and all pipes shall be accepted by the Owner's Engineer.

The number of completed and accepted End Sections shall be paid for at the Contract unit price per each of the various sizes and types of End Sections.

Payment, as provided for above, shall be full compensation for all trenching, shoring, backfilling, compaction, furnishing and laying, removal of excess material, dewatering of excavation, cleaning and testing as specified; and for all equipment, tools, labor, and incidentals necessary to complete the work.

## 6.04 PRECAST REINFORCED CONCRETE BOX STRUCTURES

### A. Materials

- (1) General. Reinforced Concrete Box (RCB) sections used for culverts or storm sewers shall conform to ASTM C1577 and the latest AASHTO LRFD Specifications.
- (2) Loading. RCB sections having less than 2 feet of cover and subjected to highway loading shall conform to ASTM C1577 and the latest AASHTO LRFD Specifications.
- (3) Reinforcement shall conform to ASTM A185 for steel welded wire reinforcement and ASTM A615 for Grade 60 reinforcing steel bars.
- (4) Strength. Minimum concrete strength shall be 5000 psi at 28 days.
- (5) Joints shall be sealed with joint cement or flexible gasket-type sealants.
- (6) Concrete shall conform to the requirements of Section 5.04.

(7) Mortar shall consist of one part Portland Cement and 1½ parts clean sharp sand with only enough water for workability.

(8) Geotextile. Geotextile fabric shall meet the requirements of Section 2210 of the KDOT Standard Specifications.

B. Construction Requirements

The Contractor shall provide excavation and subgrade for precast RCB structures as specified in Subsection 2.02.

Precast RCBs shall be laid with the groove end of each section faced up-grade. Sections shall be tightly joined and sealed according to the manufacturer's recommendations.

When geotextile is used to wrap joints, only geotextile that has been properly stored shall be used. The geotextile's exposure to the elements (between placement and covering) shall be a maximum of seven calendar days. Dropping any backfill larger than six inches in any dimension onto the geotextile from a height greater than one foot and dropping any backfill smaller than six inches in any dimension onto the geotextile from a height greater than three feet shall be avoided.

The geotextile shall not be contaminated with grease, mud, or other foreign substances. Replace contaminated or damaged geotextile.

Lifting holes shall be filled with precast plugs and sealed with mastic or mortar.

Precast RCB sections shall be checked for alignment with appropriate surveying equipment. The alignment shall meet the full intent of the Project Documents at all points of horizontal and vertical control. At locations between control points, a maximum horizontal variation in alignment of one foot may be allowed if, in the opinion of the Engineer, the misalignment causes no adverse effect.

Headwalls and/or wingwalls shall be either cast in place or pre-cast concrete meeting the requirements for concrete structures as specified in Subsection 5.04. Headwalls and wingwalls for pre-cast RCB's are subsidiary to the pre-cast RCB.

Backfill of the precast RCB structure shall be completed as specified in Subsection 2.10

C. Bid Item, Measurement and Payment

(1) Bid Item:

**(\*)FT. x (\*)FT. x (\*)FT. PRECAST REINFORCED CONCRETE BOX**

Unit: Lineal Foot (nearest 1 L.F.)

(\*) - Dimension of box



(2) Measurement. Precast RCBs shall be measured along centerline of the floor of the RCB to the nearest lineal foot from end to end of the structure.

(3) Payment will be made at the unit price bid per foot for each size box placed and accepted, which price shall include trenching, shoring, backfilling, compaction, furnishing and laying, joints, removal of excess material, dewatering of excavations as specified; and all materials, labor, equipment, tools, and incidentals necessary to complete the work.

## 6.05 MANHOLES AND INLETS

### A. Materials

(1) Precast Reinforced Concrete Manholes, Risers and Tops. Materials for circular vertical precast reinforced concrete manholes, risers and tops shall conform to the applicable requirements of ASTM C478. The minimum shell thickness shall be as follows.

<u>Depth</u>	<u>Minimum Shell Thickness</u>
0 to 16 feet	One twelfth internal shell diameter
16 feet or greater	One twelfth internal shell diameter plus one inch

(2) Precast Reinforced Concrete Structures, Risers and Tops. Materials for precast reinforced concrete structures, risers and tops excluding concrete pipe, box culverts and circular precast reinforced concrete manholes, shall conform to the requirements of ASTM C913. This shall include distribution boxes, catch basins, inlets (including Type I-P and II-P) and similar structures.

(3) Concrete. Cast-in-place manholes and inlets, and the cast-in-place or pre-cast concrete bases of pre-cast manholes and inlets, shall be constructed of Structure Class Concrete as specified in Subsections 5.01 and 5.04.

(4) Reinforcing Steel. Shall meet the requirements of the Project Documents and specified in Subsection 5.03.

(5) Structural Steel. Carbon structural steel shapes, plates, and bars used in manholes and inlets shall conform to the requirements of ASTM A36.

(6) Joint Sealants for Precast Manholes and Inlets. Preformed mastic used shall conform to the requirements of AASHTO M 198 and must be pre-approved by the Engineer.

(7) Non-shrink Grout. Grout shall be Five Star by U.S. Grout Corporation or an approved equal. Grout shall not be a gas liberating type but shall be non-metallic and non-corrosive.

(8) Iron Castings.

- i. Governing Standard. Except as modified or supplemented herein, all castings furnished shall conform to the requirements of ASTM A48, Class 35B or higher.
- ii. Acceptable Products. Castings shall be the product of Clay & Bailey, Deeter, Neenah, or an approved equal.
- iii. Submittals.
  - (1) Cast Test Bars. Cast test bars shall be delivered to the site with the castings. Laboratory verification of chemistry, Brinell Hardness, or tensile strength will be required at the Engineer's request and shall be delivered within two weeks of request at no additional cost.
  - (2) Certificate of Insurance. The casting manufacturer shall purchase and maintain product liability insurance in the amount of \$3,000,000.00. Prior to delivery of castings, the Contractor shall deliver to the Engineer the manufacturer's properly completed certificate of insurance.
- iv. Marking. All castings shall have the manufacturer's name and Julian heat date legibly cast thereon. Indistinct markings shall be grounds for rejection of individual castings. All castings of foreign origin must comply with current U.S. Customs marking regulations.
  - (1) Storm Sewers and Inlets. The designation "DRAINS TO RIVER DO NOT DUMP" shall be cast in 2-1/2 inch high block letters arranged around the circumference of all manhole and inlet covers intended for stormwater use. A likeness of a catfish shall be cast in the center of the lid. A standard open pick slot shall be manufactured into the lid.
- v. Dimensions and Weight. All castings shall conform to the dimensions and weights indicated in the Project Documents. Dimensions shall not deviate more than 1/16 inch per foot. Surfaces of lids or covers shall not vary more than 1/16 inch above or below surfaces of accompanying frames or rings when properly seated. The weight of individual castings shall not vary by more than 4 percent from that specified.
- vi. Minimum Tensile Strength. The tensile strength of each casting provided under this specification shall be at least 30,000 psi.
- vii. Workmanship. All castings shall be manufactured true to pattern. Compatibility and fit of component parts shall be subject to inspection and acceptance or rejection. Castings shall be free of defects, to include but not necessarily limited to, blow holes, sand inclusions, cracks, distortion, and/or deviations from specified or indicated dimensions. All castings shall be furnished in bare metal.

viii. Compliance with U.S. Customs Regulations. All castings imported into the United States shall conform to the applicable provisions of United States Customs regulations.

ix. Interchangeability. Manhole frames and covers shall be manufactured so as to be fully interchangeable. All of the covers provided shall be suitable for installation on any of the frames provided and shall not rock or tip under an applied load.

## B. Construction Requirements

(1) Excavation and Subgrade Preparation. The Contractor shall provide excavation and subgrade for manholes and inlets as specified for structures in Section 2. The Contractor shall obtain the Engineers approval of the excavation and subgrade prior to constructing manholes or inlets.

(2) Precast Reinforced Concrete Manholes and Inlets.

i. General. Pre-cast manholes and inlets shall be constructed in accordance with the Project Documents. The Contractor shall handle the pre-cast sections with care to avoid damage to joint ends of each section. Damaged sections may be subject to rejection at the discretion of the Engineer. All manhole and inlet construction shall be watertight. The invert and walls shall be cleaned of excess grout and laitance.

Inlets or storm drainage systems other than those conforming to the Standard Details may be used only with the approval of the Engineer and in conformance with complete details included in the Project Documents.

ii. Concentric and Eccentric Manholes. Precast Reinforced Concrete Manholes shall be constructed in sections. Precast reducer cone sections for 4'-0" diameter manholes shall be of the concentric type. Manholes of 5'-0" and larger diameter may have cones or concrete flattop lids of the eccentric type. Where eccentric types are used in pavements, the top section shall be rotated so that the lid is not in a wheel path or curb line.

iii. Joints. All joints shall be set and sealed with an approved preformed mastic sealant. Two rings of preformed mastic sealant must be used for joint between the manhole concrete and the cast iron ring.

iv. Base & Invert. Cast-in-place or pre-cast concrete bases for pre-cast inlets and shall be constructed as detailed in the Project Documents. Invert channels shall be smooth and shall conform to adjacent sewer sections as detailed in the Project documents.

v. Lifting Holes. Lifting holes shall be filled and sealed with non-shrink grout or concrete.

- (3) Cast-in-Place Concrete Manholes, Inlets, and Special Structures. Forms, mixing and placing of concrete, placing of reinforcing, finishing and curing shall conform to the requirements for Structure Class Concrete as specified in Section 5. Invert channels shall be smooth and shall conform to adjacent sewer sections as detailed in the Project documents.
- (4) Backfill and Compaction. The Contractor shall backfill and compact backfill for manholes and inlets as specified for structures in Section 2.09 and 2.10. The Contractor shall obtain the Engineers approval prior to backfilling around manholes or inlets.
- (5) Cast Iron. Castings shall be installed at the locations and to the requirements shown in the Project Documents. Castings shall be true to line and grade and match the structures to which they are attached. Castings shall be installed in the structures in accordance with the manufacturer's instructions and requirements.

Manhole Castings shall be sealed with two rings of preformed mastic sealant. In situations where the exterior walls of the manhole will be exposed to weather, the manhole casting shall be bolted to the precast cone section or flat slab top using 5/8 inch diameter galvanized bolts and threaded inserts in the concrete.

- (6) Leveling and Adjusting Manhole Rings, Frames and Covers. When either new manholes or existing manholes are in areas to be paved or re-graded, manhole frames shall be set such that it will be flush with, and at the same slope of as, the new pavement. For new manholes, all leveling or adjustment to pavement slopes shall be accomplished with a concrete leveling course at the top of the top slab on Type II manholes and at the top of the cone on Type I manholes. Where the ring of an existing manhole is being adjusted, the concrete leveling course may be constructed immediately below the frame. Bitumastic shall not be used for leveling or adjusting the slope of manhole rings.

Manholes and valve castings located in a traffic lane shall be adjusted to meet the grade and slope of the adjacent pavement within a tolerance limit of 1/8± inch. The tolerance shall be measured as the vertical distance between a 10-foot straight edge, centered over the manhole or valve casting in both the longitudinal and transverse directions, and the top of the manhole or valve casting.

- (7) Manhole Testing. Requirements for the testing of storm sewer manholes are specified in Subsection 6.03 C.

C. Bid Items, Measurement, and Payment.

- (1) Bid Items:

**(\*) FT. DIA. STANDARD MANHOLE, TYPE (\*\*)** (0'-6') Unit: Each

**(\*) FT. DIA. ADDITIONAL DEPTH FOR STD. MANHOLE, TYPE (\*\*)** Unit: Vertical Foot (nearest 0.1 V.F.)

<b>SPECIAL STRUCTURE</b>	Unit: Each
<b>ADJUST EXISTING (MANHOLE OR VALVE) COVER</b>	Unit: Each
<b>DITCH INLET, TYPE <u>(***)</u></b>	Unit: Each
<b>CURB INLET, TYPE <u>(#)</u>, L= <u>(##)</u> FT.</b>	Unit: Each
<b>ADDITIONAL DEPTH, CURB INLET TYPE <u>(#)</u>, L= <u>(##)</u> FT</b>	Unit: Vertical Foot (nearest 0.1 V. F.)
<b>CURB INLET, TYPE II-P</b>	Unit: Each
<b>ADDITIONAL DEPTH, CURB INLET TYPE II-P</b>	Unit: Vertical Foot (nearest 0.1 V.F.)
<b>CURB INLET- MANHOLE, TYPE II-P</b>	Unit: Each
<b>ADDITIONAL DEPTH, CURB INLET-MANHOLE, TYPE II-P</b>	Unit: Vertical Foot (nearest 0.1 V.F.)
<b>AREA INLET, TYPE II-P (<u>(###)</u> GRATE)</b>	Unit: Each
<b>ADDITIONAL DEPTH, AREA INLET TYPE II-P</b>	Unit: Vertical Foot (nearest 0.1 V.F.)
<b>AREA INLET- MANHOLE, TYPE II-P (<u>(###)</u> GRATE)</b>	Unit: Each
<b>ADDITIONAL DEPTH, AREA INLET-MANHOLE, TYPE II-P</b>	Unit: Vertical Foot (nearest 0.1 Ft.)

(\*) -- Diameter of the Manhole in feet

(\*\*) -- Type I, Type II, or other Type as designated in the Project Documents

(\*\*\*) – Type I, Type III, or other Type as designated in the Project Documents

(#) – Type I-P or other Type as designated in the Project Documents.

(##) – Outside length of inlet parallel to curb as designated in the Project Documents

(###) – Pedestrian, Traffic, Yard, or other type of grate as designated in the Project documents.

(2) Measurement.

i. Manholes and Inlets. Manholes and inlets shall be measured per Each of the various sizes and types of inlets and manholes installed.

ii. Additional Depth. If a manhole or inlet (not including ditch inlets) has a depth dimension greater than 6.0 feet, it shall be measured per Each as stated above and the portion of the structure’s “Additional Depth” or depth in excess of 6.0 feet measured to the nearest 0.1 Vertical Foot.

“Depth” for the various types of structures is defined as follows:

- Manholes – Top of cover frame to invert of lowest pipe
- Curb Inlets – Top of Curb to invert of lowest pipe
- Area inlets – Outside edge of the top of the grate to the invert of the lowest pipe.

Ditch Inlets shall be measured only per Each installed. “Additional Depth” is not measured for Ditch Inlets.

Special Structures for Manholes. “Special Structure” shall be measured per Each of the items installed.

iii. Adjust Existing (Manhole or Valve) Cover. Each existing manhole or valve frame and cover that is adjusted to grade and/or slope shall be measured per Each adjusted.

(3) Payment. Completed and accepted inlets and manholes, special structures, and the regrading of existing manhole covers, measured as provided for above, shall be paid for at the Contract unit per Each for the various sizes and types of items listed, which payment shall be full compensation for all excavation, backfill, shoring, sheeting, dewatering, concrete, masonry, castings, reinforcement, steps, mortar, grout, castings, connectors, and cleaning as specified; and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

The completed and accepted “Additional Depth” for inlets an manholes, measured as provided above, shall be paid for made at the Contract unit price per vertical foot of depth greater than 6.0 feet for each of the various sizes and types of inlets and manholes (except ditch inlets), which payment shall be full compensation for all excavation, shoring, installation, forming, reinforcing, castings, connectors, backfilling and cleaning as specified; and all materials equipment, tools, labor, and incidentals necessary to complete the work.

## 6.06 CONNECTION TO EXISTING STRUCTURES

A. Materials. Materials for the connection of pipes to existing structures shall meet the requirements specified in Subsection 6.05 B.

B. Construction Requirements. Connection to Existing Structures shall be done in such a manner as to prevent damage to existing structures. An opening for installation of pipe shall be cut to a diameter approximately 4 inches larger than the outside diameter of the pipe to be installed. New invert channels shall be constructed as needed to conform to the standard details.

C. Bid Item, Measurement and Payment.

(1) Bid Item:

**CONNECTION TO EXISTING STRUCTURE**

Unit: Each

(2) Measurement. Will be for each connection to an existing structure.

- (3) Payment. Completed and accepted "Connect to Existing Structure" shall be paid for at the Contract unit price per Each connection of a sewer pipe to an existing structure, which price shall include all excavation, cutting, connecting, rebuilding of invert, grouting, backfilling, and compacting as specified; and all materials equipment, tools, labor, and incidentals necessary to complete the work.

#### 6.07 IN-SITU LINING OF EXISTING STORM SEWER PIPE

- A. General. The following notes and specifications outline the minimum standards for materials and methods for waterproofing, sealing, structural reinforcement and corrosion protection of existing stormwater pipe.
- B. Materials. Provide materials for centrifugally cast concrete pipe (CCCP), as manufactured by Centripipe, Strong Seal, or approved equal, and shall extend over the specified length shown in the project plans in a continuous structural concrete pipe within a pipe.
- C. Construction Requirements. The repair means and methods shall be engineered for the depth, diameter, shape, traffic loading, groundwater pressures and condition of corrosion. Prior to construction, all design calculations shall be signed and sealed by a certified engineer licensed in the state of Kansas and submitted to the owner's project engineer for review and approval.
- a. The CCCP wall thickness shall be a minimum of 3 inches and the submitted engineering design shall be based upon the compressive and bending strength of the liner material. The design loading shall be the sum of any changes in the cover depth after the liner's installation and a minimum HS-20 highway truck loading for the culvert pipe taking into account the type of soil used for the road's fill and the type of pavement structure. The calculated minimum finished thickness of the liner shall be based on a maximum possible crack width of 0.0625-inches with a factor of safety of 2.0. Pipes up to larger than 72" will be required to have welded wire mesh reinforcement in the liner.
- b. Before CCCP installation, all laterals and drop inlets must be sealed with a temporary plug. The contractor shall provide for the flow of water around the section or sections of main pipe where the rehabilitation is located. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system or similarly suitable method. Pump and bypass lines shall be of adequate capacity to handle the flow. Once the desired liner thickness is met, CCCP material shall be allowed six hours curing time prior to all plugs being removed from the laterals and drop inlets and flows re-instated.
- c. Areas of water seepage shall be sealed off by an approved method. Pools of water shall be removed; however, a completely dry surface is not required. The contractor shall patch holes and fill voids in and around existing pipe as directed by the owner's project engineer.
- d. It shall be the responsibility of the contractor to remove all debris from the pipe. The interior surface shall be cleaned with a high-pressure water-blast sufficient to remove all laitance and loose material and flush debris from the pipe.
- e. Prior to applying the CCCP, the contractor shall repair the pipe invert with pl-12,000

invert repair mortar as manufactured by AP/M Permaform or approved equal. The invert repair mortar shall have a minimum compressive and flexural strength per ASTM C-109 and ASTM C-293 as follows:

Time	Compressive Strength	Flexural Strength
24-hour	5,000 psi	800 psi
28 day	11,500 psi	1,200 psi

f. The CCCP shall utilize pl-8,000 pipe lining mortar as manufactured by AP/M Permaform or approved equal. The mortar must be specifically designed for horizontal pipe centrifugally cast installation process. The CCCP shall be applied with a bi-directional rotating spincaster to ensure uniform liner thickness. Thickness tabs shall be placed at various intervals to assure the thickness of the lining material. The spincaster shall be positioned within the center of the pipe to apply the mixed mortar. As the mortar begins to be centrifugally cast evenly around the interior, retrieve the applicator head at the best speed for applying the thickness that has been selected. If mixed mortar flows are interrupted for any reason, simply arrest the retrieval of the applicator head until flows are restored. The CCCP mortar shall have a minimum compressive and flexural strength per ASTM C-109 and ASTM C-293 as follows:

Time	Compressive Strength	Flexural Strength
24-hour	4,000 psi	1,200 psi
28 day	10,000 psi	1,530 psi

g. Do not apply mixed mortar when ambient temperatures are expected to fall below 45°F or 7° C within 72 hours of placement. Both ambient and substrate temperatures must be at least 45°F or 7° C at the time of placement. Protect the installed CCCP from freezing for a minimum of 7 days.

h. The contractor shall submit certification from the manufacturer that they are certified and trained in CCCP installation. In addition, the contractor shall submit verifiable references showing a minimum of 5,000 lineal feet of CCCP completed within the past 5 years and have a competent technical services manager on site to oversee the given project.

j. The contractor shall collect and provide a minimum of 4 test samples of the invert material and 6 test samples of the CCCP material for independent third-party laboratory testing. Each test sample obtained by the contractor shall be representative of the in-situ material and application used. The third-party independent laboratory testing shall be approved by the City or County.

k. The contractor shall provide the City or County with a three-year warranty on the CCCP liner installed.

**D. Bid Item, Measurement and Payment.**

(1) Bid Item:

**IN-SITU CENTRIFUGALLY CAST CONCRETE PIPE LINER**

Unit: Lineal Foot



(2) Measurement. Will be from end to end of an existing sewer pipe.

(3) Payment. Completed and accepted "In-situ Centrifugally Cast Concrete Pipe Liner" shall be paid for at the Contract unit price per lineal foot of a storm sewer pipe which price shall include all materials, equipment, tools, labor, and incidentals necessary to complete the work.

## 6.08 IN-SITU REHABILITATION OF EXISTING STORM SEWER PIPE

### A. GENERAL

The Contractor shall furnish all material, tools, equipment and labor necessary to rehabilitate the existing pipeline at the locations shown in the Drawings, as detailed and in conformance with the Specifications.

- a) The Cured in Place Pipe (CIPP) shall be continuous and jointless from manhole to manhole or access point to access point and shall be free of all defects that will affect the long-term life and operation of the pipe.
- b) The CIPP shall fit sufficiently tight within the existing pipe so as to not leak at the manholes or through the wall of the installed pipe. If leakage occurs at the manholes the Contractor shall seal these areas to stop all leakage using a material compatible with the CIPP as directed by the Engineer at the price bid therefore in the Proposal. If leakage occurs through the wall of the pipe the liner shall be repaired or removed as recommended by the CIPP manufacturer. Final approval of the liner installation will be based on a leak tight pipe.
- c) The CIPP shall be designed for a life of 50 years or greater.
- d) The CIPP shall be designed as a fully structural stand-alone pipe-within-a-pipe. Where specified in the contract documents the installed CIPP shall be a structurally designed pipe within a pipe, meet or exceed all contract specified physical properties, fitting tightly within the existing pipe all within the tolerances specified. The installed CIPP shall withstand all applicable surcharge loads (soil overburden, live loads, etc.) and external hydrostatic (groundwater) pressure, if present, for each specific installation location.
- e) The installed CIPP shall have a long term (50 year) corrosion resistance to the typical chemicals found in domestic stormwater.
- f) All materials furnished shall be marked with detailed product information, stored in a manner specified by the manufacturer, and tested.

### B. APPLICABLE STANDARDS

- a) Specifications of the following listed standards will be referred to hereinafter by standards abbreviation and specification number which shall include the latest revision thereof.
  1. ASTM - American Society for Testing and Materials.
  2. ACI - American Concrete Institute
  3. NACE - National Association of Corrosion Engineers
  4. SSPC - Society of Protective Coatings

### C. SUBMITTALS

#### A. Pipeline Rehabilitation

1. Technical data sheet on each product used, including applicable ASTM test results

indicating the product conforms to and is suitable for its intended use per these specifications.

2. Manufacturer's product data, including physical properties, results of applicable ASTM tests for the material supplied, and requirements for installation, curing and field quality control.
3. Manufacturer Qualifications: Submit a list of a minimum of 10 successful similarly sized pipeline rehabilitation projects completed during the past 3 years.
4. Installation Contractor Qualifications:
  - a. Manufacturer certification that installer has been trained and approved by manufacturer in the preparation, handling and installation of specified products, if applicable.
  - b. List of recently completed successful similarly sized pipeline rehabilitation projects, including project name and location, names of owner and engineer, and description of products used, and installation procedures.
  - c. Proof of any necessary federal, state or local permits or licenses necessary for the project.
  - d. For a Product to be considered Commercially Proven, a minimum of 1,000,000 linear feet or 4,000 manhole-to-manhole line sections of successful storm water collection system installations in the U.S. must be documented to the satisfaction of the Owner to assure commercial viability.
  - e. For an Installer to be considered as Commercially Proven, the Installer must satisfy all insurance, financial, and bonding requirements of the Owner, and must have had at least 3 (three) years active experience in the commercial installation. In addition, the Installer must have successfully installed at least 1,000,000 feet of the same product bid in storm water collection systems and a minimum of 500,000 feet of the product bid in 8-inch or larger sizes in storm water collection systems. Acceptable documentation of these minimum installations must be submitted to the Owner.
  - f. Field Supervisor/Foreman: Minimum five (5) years as a foreman/superintendent for a cured-in-place lining crew (installing actual product included with this bid/project), and a minimum of 300,000 linear feet of cured-in-place lining, diameters up to, and including, thirty-six (36) inch diameter. A minimum of five (5) years as a foreman/superintendent for a cured-in-place lining crew, a minimum of 50,000 linear feet of cured-in-place lining of twenty-four (24) inch or greater diameter, installed under his/her supervision. Such experience shall include the actual product, by trade name, Installer proposes to install.
  - g. The rehabilitation manufacturing process shall operate under a quality management system which is third-party certified to ISO 9000 or other recognized organization standards. Proof of certification shall be required for approval.
  - h. The Contractor performing the rehabilitation work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a manner that fulfills all requirements of this Contract.
  - i. The Contractor shall have not less than five (5) years' experience in the last five years within the United States in complete CIPP rehabilitation of storm sewer systems using the methods indicated in these specifications.
  - j. For a product and installer to be Commercially Proven, the installer must own and operate a legally permitted permanent facility to impregnate the CIPP tubes. To ensure the Owner all installed products will meet the minimum product quality control standards set forth by the manufacturer, all CIPP liners shall be impregnated by the approved product's licensed installer that is performing the work. No pre-impregnated CIPP products will be accepted from a third-party vendor. Provide a copy of your permits for this facility with the bid.

- k. Within seven (7) days after the Bid Letting, the Contractor shall submit to the Owner, for review and approval prior to award of the Contract, resumes of the personnel to be performing the work, including those personnel to be performing the installation of the CIPP liner, to determine if the Contractor is responsible for meeting the requirements of the work. The Owner has the right to reject the use of personnel that, in the opinion of the Owner, do not have adequate or relevant experience installing CIPP Liner systems in sewer mains of similar diameters as those being rehabilitated as part of this project. Failure to provide the required experience may be grounds for rejection of the bid at the discretion of the Owner.
- 5. Manufacturer's design analysis.
- 6. Additional submittal requirements related to the grouting operation as specified herein.
- 7. Design details for any additional ancillary systems and equipment to be used in site and surface preparation and testing.

#### D. WARRANTY

- a) The materials used for the project shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant the liner to be free from defects in raw materials for three (3) years from the date of installation and acceptance by the Owner. The Contractor shall warrant the liner installation for a period of three (3) years. During the Contractor warranty period any defect, which may materially affect the integrity, strength, function and/or operation of the pipe, shall be repaired at the Contractor's expense in accordance with manufacturer's recommended procedures.
- b) After a pipe section has been lined and for a period of time up to three (3) years following completion of the project, the Owner may inspect all or portions of the lined system. The specific locations will be selected at random by the Owner and will include all sizes of CIPP from this project. If it is found that any of the CIPP has developed abnormalities since the time of "Post Construction Television Inspection," the abnormalities shall be repaired and/or replaced according to the manufacturer's recommended procedures. If, after inspection of a portion of the lined system under the contract, problems are found, the Owner may televise all the CIPP installed on the contract. All verified defects shall be repaired and/or replaced by the Contractor and shall be performed in accordance with the manufacturer's recommended procedures and per the original specifications, all at no additional cost to the Owner.

#### E. CONSTRUCTION REQUIREMENTS

##### I.) BYPASS PUMPING

- a) Where flow control is required to perform a specified repair or replacement operation, plugging or blocking shall be used wherever possible.
- b) If plugging or blocking is not feasible or at the Contractor's discretion, Contractor shall provide the necessary pumps and temporary piping and associated accessories as required for pumping of stormwater around areas of construction so as to not impede drainage of the stormwater. Backup pumping capability will be required.
- c) The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The temporary pumping system shall comply with the requirements of all codes and regulatory agencies having jurisdiction. Contractor shall be responsible for any spillage that results in civil or criminal charges from any local, state, or

- federal agency and will bear all costs for these charges and any restoration required.
- d) It is essential to the operation of the existing drainage system that there be no interruption in the flow of stormwater throughout the duration of the Project. Contractor shall provide, maintain, and operate all temporary facilities such as plugs, pumping equipment (both primary and backup units as required), conduits, all necessary power or fuel source, and all other labor and equipment necessary to handle the stormwater by-pass flow.
  - e) Contractor shall maintain flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers, and that will protect public and private property from damage and flooding.
  - f) Contractor shall protect water resources, wetlands, and other natural resources.
  - g) Contractor shall insure that the flow diversion pumping system is properly operated and maintained and shall provide responsible personnel to oversee the diversion pumping system at all times.
  - h) Work shall be so scheduled and timed as to cause the least possible interference with the operation of the existing stormwater collection system.
  - i) Sewage and water contaminated with sewage shall not be conveyed to storm sewers.

## II.) CURED IN-PLACE PIPE

- A. The cured-in-place liner system shall incorporate a resin-impregnated non-woven felt tube installed by inversion and expanded and cured by circulation of heated water or through the use of steam and air pressure (Insituform or SAK or pre-approved equal).
- B. Resin-impregnated tube
  - 1. Tube. The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F 1216 or ASTM F 1743, Section 5. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.
  - 2. The wet out tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the design thickness.
  - 3. The tube shall be sewn to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapping layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.
  - 4. The outside layer of the tube (before wet out) shall be coated with an impermeable flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet out) procedure.
  - 5. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.
  - 6. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television equipment may be made.
  - 7. Seams in the tube shall be stronger than the non-seamed felt.
  - 8. The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured within the tube composite meets the requirements of ASTM F 1216 and ASTM F 1743, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project.
  - 9. The resin shall be a different color from the tube to allow for visual identification of

areas of the tube that have or have not been wet out. The color of the resin shall be changed by the addition of dye or pigmentation.

10. The CIPP shall be designed as per ASTM F 1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall. The design safety factor shall be 2.0. The CIPP shall meet the chemical resistance requirements of ASTM F 1216, Appendix X2.
11. For the design of the CIPP system, the following assumptions shall be made. The host pipe should be considered fully deteriorated, and the CIPP liner shall be designed as a fully structural pipe-within-a-pipe. The live load on the pipe should include traffic loading. The ground water table shall be assumed to be at the ground surface.
12. If the bituminous coating on the inside of the existing pipe will inhibit the cure of the CIPP, a preliner shall be used. The preliner shall act as a barrier between the bituminous coating on the pipe wall and the new CIPP. The preliner shall cover the full circumference of the pipe and extend its full length. It shall remain in place during the installation of the CIPP without tearing and shall be able to withstand the curing temperature without melting. Information on the preliner shall be submitted to the Engineer prior to installing the lining.
13. Resin-impregnated tube system shall be as manufactured by Insituform Technologies, Memphis, TN; Inliner Technologies, Paoli, IN; National Liner, Houston, TX; Spiniello Companies, Morristown, NJ; Pipenology, LLC, O'Fallon, MO or pre-approved equal.
14. The cured pipe material shall conform to the structural properties, as listed below.

CIPP Minimum Physical Properties

Property	Test Method	Cured Composite	
		min. per ASTM F 1216	(400,000) psi Resin
Modulus of Elasticity	ASTM D 790 (Short Term)	250,000 psi	400,000 psi
Flexural Stress	ASTM D 790	4,500 psi	4,500 psi

a. The required structural CIPP wall thickness shall be based, as a minimum, on the above physical properties in accordance with the Design Equations in Appendix X.1 of ASTM F 1216 and the following minimum design parameters:

b.

Minimum Design Parameters

Design Safety Factor	2
Flexural Modulus to be Used in Design Ovality (to be verified by preinstallation video tapes)	50%
Groundwater Depth (above invert)	(varies, assume at ground surface elev.) ft.
Soil Depth (above crown, see plans for depth information)	(varies) ft.
Soil Modulus	700 psi
Soil Density	120 pcf
Live Load	H20 Highway
Design Condition	Fully Deteriorated

- c. The Contractor shall provide calculations for the thickness of the CIPP liner which show compliance with the minimum design parameters outlined above. The Engineer shall be the sole judge as to the percent ovality. Percent ovalities in excess of 10% will require a point repair prior to installing CIPP. Where it is determined that a thickened tube/bag is required, the Contractor shall provide a thicker tube at no additional cost to the Owner or Engineer.
- d. The soil depth varies for each section of pipe and can be estimated from the profile data provided in the plans. CIPP design shall be based on the actual soil depth.
- e. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

### III.) CURED IN-PLACE PIPE END SEALS

- A. The cured-in-place pipe end seals shall be a hydrophilic seal compatible with the installed cured-in-place liner system. End seal shall be a seamless sleeve type seal. End seal shall be held in place during lining by a mechanical fastener.
- B. Cured-in-place pipe end seals shall be Insignia™ End Seal Sleeve as manufactured by LMK Technologies, Ottawa, IL; Perma Main™ End Seals, as manufactured by Perma-Liner Industries LLC, Clearwater, FL, or approved equal.

### IV.) GENERAL PIPE INSTALLATION

- A. The repair installation shall be continuous and tight fitting.
- B. Prior to installation of any type of pipe, the existing pipe must be cleaned with high pressure water blasting to remove any obstructions that might prevent installation of the new pipe. Cleaning shall constitute removal of all debris, solids, roots, deposits, and other matter which would preclude the installation of the new pipe into the storm sewer line. It may be necessary to pull a mandrel or cleaning pig through the pipe to remove the corrosion growth and loose liner material.
- C. Prior to installation of the cured in place pipe, the Contractor shall inspect the sewer segments receiving the pipe using high-definition closed circuit television inspection (780p minimum). Any portion of the sewer determined to be unprepared to receive the cured in place pipe or the slipliner pipe shall be cleaned again to remove the obstruction. The sewer shall then be inspected again to verify the obstruction has been removed. Additional cleaning and inspection shall be at no additional expense to the Owner.
  - 1. Contractor shall submit high-definition closed circuit television inspection video (780p minimum) once installation of the CIPP liner is complete. All CCTV videos submitted should be coded using PACP Version 7.
- D. Contractor shall take all necessary measures to control the flow of stormwater during construction. Surcharging of the sewer facilities upstream of the sections of line being rehabilitated will not be allowed under any circumstances. Contractor shall provide temporary bypass pumping, if necessary.
- E. Pipe shall be protected during handling against impact shocks and free fall and the pipe interior shall be free of extraneous material.
- F. Pipe Handling: Pipe lining material shall be handled in a manner to ensure installation of the material in an undamaged and structurally sound condition. Handling equipment and

procedures shall be in accordance with the approved manufacturer's recommendation for proper handling of its products. Improper handling of pipe that results in damage to pipe will be grounds for rejection of the pipe for installation. The Engineer will be the final judge as to the acceptability of any material on the project. Cutting of pipe is discouraged. The Contractor is urged to plan his job to minimize the necessity for cutting. Prior to installation each pipe shall be inspected for defects and cracks. All defective, unsound or damaged pipe shall be rejected. The interior of all pipes shall be thoroughly cleaned and kept clean thereafter. All joint surfaces shall be kept absolutely clean during the jointing process.

G. Contractor shall take all necessary measures to control the flow of storm water during construction. Surcharging of the storm sewer facilities upstream of the sections of line being rehabilitated will not be allowed under any circumstances. Contractor shall provide temporary bypass pumping, if necessary.

## V.) PIPE INSTALLATION

### A. CURED-IN-PLACE PIPE INSTALLATION:

Installation shall be in accordance with ASTM F 1216, Section 7, or ASTM F 1743, Section 6 with the following modifications:

1. Resin Impregnation - The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used. To ensure thorough resin saturation throughout the length of the felt tube, the point of vacuum shall be no further than 25 feet from the point of initial resin introduction. After a vacuum in the tube is established, a vacuum point shall be no further than 75 feet from the leading edge of the resin. The leading edge of the resin slug shall be as near too perpendicular as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven and approved by the engineer.
2. The beginning and end of the CIPP shall be sealed to the existing host pipe. The end seal shall be a hydrophilic seamless seal compatible with the installed cured-in-place liner system and shall provide a watertight seal.
3. Tube Insertion -The wet-out tube shall be positioned in the pipeline using either inversion or a pull-in method. If pulled into place, a power winch should be utilized, and care must be exercised so as not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.
4. Temperature gauges shall be placed inside the tube at the invert level of each end to monitor the temperatures during the cure cycle.
5. Curing shall be accomplished by utilizing hot water under hydrostatic pressure or air and steam in accordance with the manufacturer's recommended cure schedule.
6. Inspection - CIPP samples shall be prepared, and physical properties tested in accordance with ASTM F 1216 or ASTM F 1743, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Table 1 of the applicable ASTM. Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F 1743. The minimum wall thickness at any point shall not be less than 87½% of the design thickness. Visual inspection of the CIPP shall be in accordance with ASTM F 1743, Section 8.6.

## B. FINISH

- a. The installed CIPP shall be continuous over the entire length of a storm sewer line section and be free from visual defects such as foreign inclusions, dry spots, pinholes, major wrinkles and de-lamination. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to inside the lined pipe.
- b. Any defect, which will or could affect the structural integrity or strength of the linings, shall be repaired at the Contractor's expense, in accordance with the procedures submitted.
- c. The beginning and end of the CIPP shall be sealed to the existing host pipe. The sealing material shall be compatible with the pipe end and shall provide a watertight seal.
- d. If the wall of the CIPP leaks, it shall be repaired or removed and replaced with a watertight pipe as recommended by the manufacture of the CIPP system.

## C. TESTING AND ACCEPTANCE

- A. The liner shall be evaluated by the Engineer based on a review of television recordings and certified test data for the installed pipe samples and shall be deemed acceptable if the following criteria are met:
  1. No observable groundwater infiltration.
  2. All service connections are open and clear. All service and manhole connections are made watertight using the approved system.
  3. No observable evidence of splits, cracks, breaks, kinks, wrinkles larger than 1 inch that are not caused by the existing condition of the sewer, delaminations, or crazing in the liner.
- B. If any defective liner is discovered after it has been installed it shall be repaired to achieve the specified acceptance criteria or, if that is not achievable, removed and replaced with either a sound liner or a new pipe at no additional cost to the Owner and without a time extension to the Contract.

## D. CERTIFICATION TESTING

- i. The Contractor shall provide specimens from one location per 1000 feet of CIPP lining installed to allow an independent laboratory to conduct the tests specified below. For each inversion, two CIPP samples shall be provided, using at least one of the following two methods. At least one of the samples shall be clamped mold sample as described in paragraph "2." below. The second sample may be taken per either paragraph "1." or paragraph "2." below.
  1. The sample shall be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.
  2. The sample shall be fabricated from material taken from the tube and the resin/catalyst system used and cured in a clamped mold placed in the downtube.
  3. The samples for each of these cases shall be large enough to provide a minimum of three specimens and a recommended five specimens. Each specimen shall be



clearly marked to indicate the installed location of the liner, the date of installation, the pipe diameter, and the resin used.

- ii. For each specimen, the thickness shall be determined, and the following test shall be performed.
  1. **Short-Term Flexural (Bending) Properties** - The initial tangent flexural modulus of elasticity and flexural yield strength in accordance with ASTM D790.
- iii. The test results shall be sent directly to the Engineer by the Contractor's laboratory. The results shall report the actual test results for each of the properties being tested. The laboratory shall certify the reports as to the results and test method utilized.
- iv. Each individual reported value shall meet or exceed the value of that property as specified herein or as used in the design calculations, whichever is higher. Should the test results not meet the minimum strength requirements; the Owner will have the option of rejecting the CIPP sections found to be defective. If rejected, the CIPP shall be repaired or, if that is not feasible, removed and replaced at no additional cost to the Owner.
- v. All the expenses for the certified testing of the CIPP lining furnished under this contract shall be paid for by the Contractor.

VI.) Bid Item, Measurement and Payment.

- (1) Bid Item:

**CURED-IN-PLACE PIPE (CIPP)**

Unit: Lin. Ft.

- (2) Measurement. Will be by the linear foot.

- (3) Payment. Compensation shall be at the actual length of cured-in-place pipe installed. The length shall be measured from center of manhole to center of manhole. The unit price per linear foot installed shall include all materials, labor, equipment and supplies necessary for the complete CIPP liner installation.

6.09 CCTV INSPECTION

A. General. The following notes and specifications outline the minimum standards for materials and methods for performing CCTV inspections of stormwater pipes when CCTV Inspection is a bid item.

B. Construction Requirements. Following backfill and compaction of a storm water pipe, each pipe will be inspected (structure to structure). The following is required.

- a. The contractor shall flush all pipes with clean water prior CCTV to inspection. The CCTV inspection shall be performed with either standing water in the pipe or under a steady flow of water.
- b. A CCTV inspection will be performed using a robotic camera with high-resolution video and pan/tilt capabilities to record observations of the pipe interior

(structure to structure). Inspection will include both upstream and downstream structures; pipes will be inspected for condition and workmanship. Observations of the pipe will include joints, wyes, sags, etc. Observations of the structures will include pipe connection(s), inverts, benches, and drops. Inspection data will be generated digitally with software that is NASSCO 7 certified. Inspection data will be exported in a standard PACP exchange file and include a **.mdb** file. Once the Contractor has submitted inspections for review, the Owner will have 5 business days to review and respond. The Contractor shall wait for a notice to proceed before constructing any improvements above new storm sewer pipes. Contractor to provide an electronic file of each inspection. Each file and inspection will be labeled accordingly, "Station to Station", e.g. Sta. 1+05 to Sta. 3+78. If existing Facility Ids are available, they may be referenced in lieu of stationing. Files will be delivered via UBS Flash Drive or a file share link.

C. Bid Item, Measurement and Payment.

a. Bid Item:

**CCTV INSPECTION OF STORM SEWER PIPE**                      Unit: Linear Foot

b. Measurement. Will be by the Linear Foot for all pipes specified in the Contract Documents.

c. Payment. Payment shall be for all inspection work completed and accepted for payment by the Owner. This price shall include all materials, equipment, tools, labor, and incidentals necessary to complete the work.

END OF SECTION