SECTION 6

SEWERS AND CULVERTS

6.01 GENERAL.

A. Scope. This section covers the construction of all storm sewers, drainage culverts, sanitary sewers, 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. 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 Contractors construction activities and shall repair or replace any sewers or culverts so damaged.

6.02 CRITICAL AREAS FOR WORK WITHIN THE CITY LIMITS.

All storm sewer and drainage culverts within "Critical Areas" shall be made with reinforced concrete. "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), and (3) 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". Joints shall be slip joints. 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.

(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 AASTO 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) 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 is subsidiary. Ground water shall be controlled as specified in Subsection 2.04. Trench stabilization shall be a 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 ¼ of the pipe diameter out of alignment.

When placing two pipe culverts parallel to one another, the pipes shall be separated from each other a distance of ½ 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 and 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 ¾ 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.

ii. 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.

(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 the Project Documents, the Contractor shall replace pavement as specified in Subsection 4.06.

C. Cleaning and Testing. 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.

D. 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.)
(*)″ CULVERT (RCP), CLASS (**)	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.

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 C789 and AASHTO M259.

(2) Loading. RCB sections having less than 2 feet of cover and subjected to highway loading shall conform to ASTM C850 and AASHTO M273.

(3) Reinforcement shall conform to ASTM A185.

(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 SANITARY SEWERS

A. Materials. Sanitary sewer pipelines shall be one of the following types as indicated in the Project Documents:

- Ductile Iron Pipe (DIP),
- Polyvinyl Chloride Pipe (PVCP), or
- Vitrified Clay Pipe (VCP)

(1) Ductile Iron Pipe Materials. DIP may be "Push-on" or "Mechanical Joint" and shall conform to ANSI/AWWA C151/A21.51.

i. General. Unless otherwise indicated in the Project Documents, required by trench load, or required by internal working pressure, all 4 inch DIP shall be Class 51 and all 6 inch and larger DIP shall be Class 50. Thickness design of DIP shall be in accordance with ANSI/AWWA C150/A21.50.

ii. Mechanical Joint and Flanged Fittings. The requirements of ANSI/AWWA C110/A21.10 shall apply to all mechanical joint and flanges fittings.

iii. Lining. Unless otherwise specified or indicated in the Project Documents, all DIP and fittings, except pipe and fittings for sanitary sewer service, shall be coated and lined with the manufacturer's standard asphaltic material. Coating and lining shall conform to the requirements of ANSI/AWWA C151/A21.51.

Pipe and fittings for sanitary sewer service shall be lined with either Protecto 401 ceramic epoxy or polyethylene. The Protecto 401 or polyethylene lining on all pipe barrels and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defects found shall be repaired prior to shipment. The lining thickness shall be checked using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating. The Contractor shall submit to the Engineer a manufacturer's certificate or catalog cut showing that the pipe supplied complies with the specifications.

(1) Protecto 401 Ceramic Epoxy. The lining material shall be amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Lining shall have a nominal dry film thickness of 40 mils. In no case shall the lining thickness be less than 30 mils.

(2) Polyethylene. The lining material shall be virgin polyethylene complying with ANSI/ASTM D 1248, shall be heat-bonded to the interior of the pipe or fitting, and shall have a nominal thickness of 40 mils. In no case shall the lining thickness be less than 30 mils.

iv. Mechanical Joint Pipe. All bolts, glands, and gaskets for mechanical joint pipe and fittings shall conform to ANSI/AWWA C111/A21.11.

v. Flanged Joints. Flanged joints shall conform to ANSI/AWWA C115/A21.15. Flanges shall be ductile iron, flat faced, and of solid construction. The use of hollow-back flanges will not be permitted. Flanged gaskets shall be neoprene, 1/8 inch thick, full-face type. Flange bolts shall conform to ASTM A307 with chamfered or rounded ends and shall project 1/4 to 1/2 inch beyond the outer face of the nut. Nuts shall be hexagonal ANSI/ASME B18.2.2 heavy semi-finished pattern, conforming to ASTM A307.

vi. Encasing. Unless otherwise specified or indicated in the Project Documents, all buried ductile iron pipe and fittings shall be encased in seamless, 8 mil polyethylene tubes conforming to ANSI/AWWA C105/A21.5.

(2) Vitrified Clay Pipe Materials.

i. Pipe. All vitrified clay pipe (VCP) shall meet the requirements of ASTM C700.

ii. Joints. VCP compression joints shall conform to the requirements of ASTM C425.

iii. Couplings. VCP compression couplings shall conform to the requirements of ASTM C425.

(3) Polyvinyl Chloride (PVC) Pipe Materials.

i. Pipes and Fittings. PVCP shall be made of PVC plastic having a cell classification of 12454-B or 12454-C as defined in ASTM D1784. PVCP and fittings shall meet the requirements tabulated in Table 6.04 A (3) i.

Table 6.04 A (3) i. – PVC Pipe and Fitting Material Requirements

Nominal Pipe Size	Specified Requirements of Pipes and Fittings
4” through 6”	ASTM D2665 (schedule 40 wall thickness)
8” through 15”	ASTM D3034 SDR 26
18” through 36”	ASTM F679 - PS 46

ii. Joints, Gaskets and Solvent Cement. PVCP push-on joints shall conform to ASTM D3212. PVCP gaskets shall conform to ASTM F477. Solvent cements for joining PVC pipe and socket-type fittings shall conform to ASTM D2564.

(4) Riser Pipes. Riser pipes shall be constructed of approved sewer pipe and fittings as shown in the Project Documents or as approved by the Engineer.

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

(1) Protection of Water Supplies. Sewer lines constructed of DIP with polyethylene or Protecto 401 lining or, PVCP may be constructed within 10 feet of a private water supply well provided a length of pipe is centered on the well. All other sewer lines must be at least 50 feet from a private water supply well.

Where a gravity sanitary sewer line is laid parallel with a water line, the horizontal distance between them shall be 10 feet, measured from edge of pipe to edge of pipe. The sewer and the water line shall be laid in separate trenches with undisturbed earth between them.

Where sanitary sewer lines cross water lines, the sewer line shall be either DIP with a polyethylene or Protecto 401 lining or, PVCP. One 20 foot length of pipe shall be centered on the crossing, or, if a 20 foot length of pipe is not available, the sewer may be encased in concrete for 10 feet either side of the water line. Encasement shall be as shown on the Sanitary Sewer Standard Detail Sheet. Where the water line is at least 2 feet above the sewer, the requirements of this paragraph shall not apply.

(2) Trench Excavation. The Contractor shall excavate the bottom of the trench to the line, grade and elevation shown in the Project Documents beginning at the outlet end and proceeding toward the upper end. The excavation and the width of the trench shall be as specified in Subsection 2.02. If the sanitary sewer 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 Section 2.03. Shoring and bracing is subsidiary. Ground water shall be controlled as specified in Subsection 2.04. Trench stabilization shall be a specified in Subsection 2.05.

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

(4) Laying. The Contractor shall lay the pipe as specified in Subsection 6.01 and as per the manufacturer's recommendations.

i. Laying Ductile Iron Pipe. DIP shall be installed in accordance with the Project Documents. The Contractor has the option to use mechanical, push-on, or flanged joints, except that flanged joints are not be permitted in any underground location.

(1) Mechanical Joints. The Contractor shall clean the inside of the bell and 8 inches of the spigot end of pipe and coat the ends with a soap solution (½ cup granulated soap per gallon of water) or other approved lubricant. The Contractor shall place the gland and rubber gasket on the spigot and seat the spigot in the bell. The Contractor shall press the gasket and gland into place, set bolts and initially tighten nuts by hand until further tightening by hand cannot be accomplished. Nuts shall be tightened on opposite sides of joint alternately. Final tightening of nuts shall be completed with torque limiting wrench set in accordance with the following table:

Bolt Size (Inches)	Range of Torque (ft./lb.)
5/8	40 - 60
¾	60 - 90
1	70 - 90

1¼		90 -120

(2) Push-on Joints. Construction of push on joints shall be in accordance with the recommendations of the manufacturer. Gaskets shall be placed on the pipe before the pipe is lowered into the trench.

(3) Flanged Joints. Flanged gaskets shall be placed and flanged pipes shall be joined in such a manner as to not damage either the flange facing or the gasket. Flanged pipe joints shall be cleaned, assembled and tightened with a torque wrench to the ranges specified for mechanical joints in Subsection 6.05 B (4).

(4) Encasement. Unless otherwise specified or indicated in the Project Documents, all buried DIP and fittings shall be encased in seamless, 8 mil polyethylene tubes. Ends of polyethylene tubing shall be overlapped at least 12 inches and shall be thoroughly sealed with polyethylene adhesive tape. All cuts, tears, punctures, or other damage to the polyethylene shall be repaired by the Contractor using approved polyethylene adhesive tape or with a short length of polyethylene sheet or tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.

ii. Laying Vitrified Clay Pipe. VCP with resilient material joints shall be installed in accordance with the manufacturer's recommendations and in accordance with the Project Documents. All joints shall be wiped clean as the work progresses. Exposed ends of VCP shall be protected from damage and shall be plugged or covered to prevent entry of obstructing matter. Joints in VCP shall not be covered until inspected and approved by the Engineer.

iii. Laying PVC (Polyvinyl Chloride) Pipe. PVCP shall be installed in accordance with ASTM D2321 and in accordance with the Project Documents. Installations of solvent weld joint pipe and fittings shall be made in accordance with ASTM F402.

iv. Service (Wye) Connections. The Contractor shall install wye fittings for service connections at the locations shown in the Project Documents and approved by the Engineer. Wyes shall be located a minimum distance of 5’ from manholes. Wyes for all types of pipe shall be installed as recommended by the manufacturer and approved by the Engineer. Concrete cradles will not be required under wyes when PVCP is used.

v. Riser Pipes. The Contractor shall install riser pipes at the locations shown in the Project Documents and as identified by the Engineer. Each riser pipe shall be plugged with an approved plugging device.

vi. House Service Lines. The Contractor shall construct house services lines as detailed in the Project Documents. Connections between new and old work shall be made by means of suitable adapters and/or in a manner satisfactory to the Engineer. Service line connections directly into manholes shall be prohibited, unless approved in advance by the Engineer.

vii. Abandonment of House Service Lines or Wye Connections. House service lines or wye connections to be abandoned shall be plugged at the property line with an approved plugging device. Following installation of the plugging device, the plugged end of the service line shall be encased in concrete. The concrete encasement shall extend outward from the plugging device 4 to 6 inches in all directions. Abandoning house service lines or wye connections as specified above is subsidiary to other items of the Contract.

viii. 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 in accordance with the manufacturer's recommendations. Plugging of stubs and other pipes as specified above is subsidiary to other items of the Contract.

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

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

C. Cleaning and Testing of Sanitary Sewers.

(1) Cleaning. The Contractor is responsible for the cleaning of sanitary sewers and manholes. After installation of sewers is complete, including all backfill and compaction, the sewer shall be flushed clear of all foreign material. Flushing shall be completed in manner complying with the SWPPP and shall not contribute to soil erosion or water pollution.

All debris shall be removed from manholes immediately following the structure's construction. All lift holes shall be plugged with non-shrink grout prior to testing. Vacuum or hydrostatic testing of manholes is recommended prior to backfilling to assist in locating leaks. However, the final test and acceptance of manholes shall be based only on tests completed after the manholes are backfilled.

(2) Testing. Testing of manholes shall be subsidiary to the manhole and testing of gravity sewers shall be subsidiary to the sewer. Manhole and sanitary sewer testing shall be witnessed by the Engineer. The Contractor shall provide all labor, materials, tools, equipment, and incidentals required to complete testing of sanitary sewers and sanitary sewer manholes. After cleaning, the Contractor shall test sanitary sewers and manholes as follows:

i. Manhole Testing. All manholes shall be either vacuum or hydrostatically tested in the presence of the Engineer and in accordance with these procedures. Existing manholes or new manholes constructed over existing lines do not require testing. **If the seal on a new manhole is broken by an adjustment or**

other procedure, than a new vacuum test is required. Manholes greater than 72" diameter may be tested hydrostatically at the request or approval of the Engineer.

(1) Vacuum Test. Plug all manhole entrances and exits, other than the manhole top access, by using suitably sized and rated pneumatic or mechanical pipeline plugs. Follow the manufacturer's recommendations and warnings for proper and safe installation of such plugs, taking care to securely brace the plugs and the pipe. Attach the vacuum test device to the manhole top and draw a vacuum to 10 inches of Mercury. With the valve at the vacuum line connection closed and the vacuum pump off, measure the time required for the vacuum to drop to 9 inches of Mercury. The manhole passes the test if the time is greater than 60 seconds for a 48 inch diameter manhole, 75 seconds for a 60 inch diameter manhole, and 90 seconds for a 72 inch diameter manhole. If the manhole fails the test, the Contractor shall locate the leak and make proper repairs to the interior of the manhole with non-shrink grout. The manhole shall be retested and repaired or replaced until acceptable test results are obtained.

(2) Hydrostatic Test. Manholes may be tested using internal or external hydrostatic pressure. External hydrostatic testing shall only be used where the groundwater level is at least 4 feet above the invert of the manhole. In all other cases, the internal hydrostatic test procedures must be followed. Sewers connected to the manhole shall be adequately plugged.

For the internal hydrostatic test, the manhole shall be filled with water to the top of the ring or to a maximum depth of 25 feet above the invert. Water gain or loss shall not exceed 1.14 gallons per day per vertical foot of manhole for either external or internal hydrostatic testing. Infiltration and exfiltration shall be determined after 24 hours of hydrostatic testing by determining the gain or loss of water in the manhole. Contractor shall be responsible for retrieving any plugs or material accidentally washed down a sewer.

ii. Deflection Testing. All flexible and semi-rigid pipes used for sanitary sewer lines 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.

Deflection shall not exceed 5% of the **average inside** diameter of the pipe for pipes up to and including 12 inch. For pipes over 12 inches in diameter, 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.

The mandrel shall be made of steel or other hard metallic, non-corrodible, non-pliable 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, 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 insure that it meets dimensional requirements.

Nominal Pipe Size (inches)	Minimum Mandrel Diameter (inches)
6”	5.7”
8”	**7.3”**
10”	**9.2”**
12”	**10.9”**
12” +	**Nominal Inside Diameter x 96%**

iii. Gravity Sewer Line Testing. In addition to the visual inspection, the Contractor shall furnish all labor, tools and equipment necessary to perform low pressure air tests on all pipe installed under the contract, including laterals and service stubs. The methods and equipment used to make the test shall be approved by the Engineer before any testing is started. The Contractor shall, at their own expense, correct any excess leakage and repair any damage to the pipe or its appurtenances indicated by, or resulting from, the test. For the purpose of testing, a section of the sewer shall be considered as the length of sewer between successive manholes. Any section that fails the test shall be repaired and retested by the Contractor until the leakage is within the allowable limit.

(1) Low Pressure Air Test. This test method provides procedures for testing sewer lines using low-pressure air to prove the integrity of the installed material and the construction procedures. Tests shall conform to the requirements of this section, ASTM F 1417 and C 828. The section of pipe between successive manholes shall be sealed with suitable plugs.

This low-pressure air test may be dangerous to personnel if, through lack of understanding or carelessness, a line is over-pressurized or plugs are installed or restrained improperly. No one shall be allowed in the manholes during the actual testing. All plugs shall be braced during the testing. Do not over-pressurize the line. Do not exceed 9.0 psig.

One of the plugs shall have an orifice through which to pass air into the section of pipe being tested. The air supply source (air compressor) shall have a 9 psig pressure relief valve. The air supply line shall have a positive on-off valve and suitable means for readily disconnecting it at the control panel. A second orifice in the plug shall be used for constantly reading the internal pressure of the pipe. This orifice shall be continuously connected to a pressure gauge having a range of from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of ± 0.04 psi.

The line under test shall be slowly pressurized to approximately 4 psi. Regulate the air supply so that the pressure is maintained between 3.5 and 4.0 psig for at least 2 minutes. The air temperature should stabilize in equilibrium with the temperature of the pipe walls. Disconnect the air supply and decrease the pressure to exactly 3.5 psi before starting the test. Determine the time required for the pressure to drop from 3.5 psi to 2.5 psi, and compare this interval to the required minimum holding time provided by the City of Topeka to determine if the rate of air loss is within the allowable.

If the pressure drops 1.0 psig before the appropriate time has elapsed, the air loss rate shall be considered excessive and the pipe section has failed the test. For testing of long sections or sections of larger diameter pipes, or both, a timed-pressure drop of 0.5 psig shall be used in lieu of a 1.0 psig drop. It is not necessary to hold the test for the entire period of time when it is evident that the rate of air loss is zero or less than the allowable if authorized by the Engineer. Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs should not be removed until air pressure in the test section has been reduced to atmospheric pressure.

iv. Television Inspection. After the sewer line has passed the air test, the City shall inspect the line with television equipment. The Contractor at no additional cost to the City/County shall repair all defects found by this inspection.

v. Force Main Testing. After the force main has been installed, anchored or blocked as specified, the pipe shall be filled with water and subjected to pressure and leakage tests.

All piping shall be tested by water pressure at not less than twice the maximum operating pressure or at 100 psig, whichever is greater, for a sufficient period to examine the pipeline for leakage, cracks, defects or other faults. Any leaks shall be repaired and tests repeated until all defects have been repaired.

After approval of repairs, the pressure shall be set at twice the maximum operating pressure or at 100 psig, whichever is greater, and maintained for a period of 3 hours with the total loss of water being measured. The amount of water allowed to be lost during this time shall comply with AWWA C600 for DIP and AWWA Manual M23 for PVCP.

The test pressure shall be applied by a hand operated force pump, or other suitable device, with the pump taking suction from a reservoir of small enough volume so that the amount of water loss can be measured volumetrically.

The Contractor shall furnish all water necessary for filling the lines and for making the tests.

Any leaks which appear during the one-year warranty period shall be repaired at the expense of the Contractor.

D. Bid Items, Measurement and Payment.

(1) Bid Items:

(*)″ SANITARY SEWER	Unit: Lineal Foot (nearest 1 L.F.)
(*)″ SANITARY SEWER (DIP)	Unit: Lineal Foot (nearest 1 L.F.)
(*)″ SANITARY SEWER (VCP)	Unit: Lineal Foot (nearest 1 L.F.)
(*)″ SANITARY SEWER (PVCP)	Unit: Lineal Foot (nearest 1 L.F.)
SERVICE (WYE) CONNECTION, (*)″	Unit: Each
(*)″ RISER PIPE (TYPE)	Unit: Lineal Foot (nearest 1 L.F.)
(*)″ HOUSE SERVICE LINE (TYPE)	Unit: Lineal Foot (nearest 1 L.F.)

(*) - Diameter of pipe
(TYPE) – DIP, VCP, or PVCP

(2) Measurement. "(*)″ Sanitary Sewer", "(*)″ Sanitary Sewer (DIP)", "(*)″ Sanitary Sewer (VCP)", and "(*)″ Sanitary Sewer (PVCP)" for the various sizes of sanitary sewer pipes shall be measured as the horizontal distance from centerline of manhole to centerline of manhole measured to the nearest foot.

"Service (Wye) Connection, (*)″" shall be measured per Each service (wye) of the various sizes installed.

"(*)″ Riser Pipe (Type)" shall be measured as the length along the centerline of the riser, measured to the nearest foot for the various sizes and types of riser pipe installed.

"(*)″ House Service Line" shall be measured as the horizontal distance, to the nearest foot, from the centerline of the main sewer to the end of the house service line for the various sizes and types of service line pipe installed.

(3) Payment. The completed and accepted lengths of Sanitary Sewers, measured as specified above, shall be paid for at the Contract unit price per foot for each of the various sizes and types of Sanitary Sewers, which payment shall be full compensation for all excavation, shoring, bedding, pipe, joints, fittings, laying, materials, backfilling,

cleaning and testing as specified; and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

The completed and accepted "Service (Wye) Connection, (*) inch", measured as provided above, shall be paid for made at the Contract unit price per Each for each of the various sizes of Service Wyes, which payment shall be full compensation for all equipment, tools, labor, and incidentals necessary to complete the work as specified.

The completed and accepted "(*) inch Riser Pipe (Type)", measured as provided above, shall be paid for made at the Contract unit price per foot for each of the various sizes and types of Riser Pipes, which payment shall be full compensation for all equipment, tools, labor, and incidentals necessary to complete the work as specified.

The completed and accepted "(*) inch House Service Line (Type)", measured as provided above, shall be paid for made at the Contract unit price per foot for each of the various sizes and types of House Service Lines, which payment shall be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the work as specified. If Rock Excavation as defined in Subsection 3.06 is required to install "House Service Line", that rock excavation shall be measured and paid for as defined in Subsection 3.06.

6.06 Encasements, Cradles, and Arches. The Contractor shall construct concrete encasements, cradles and arches at the locations, to the dimensions, and to the requirements shown in the Project Documents or as determined by the Engineer. Concrete shall be Commercial Grade meeting the requirements set forth in Subsection 5.01.

A. Bid Items, Measurement and Payment.

(1) Bid Items.

CONCRETE ENCASEMENT FOR (*)″ PIPE	Unit: Lineal Foot (nearest 1 L.F.)
CONCRETE CRADLE FOR (*)″ PIPE	Unit: Lineal Foot (nearest 1 L.F.)
CONCRETE ARCH FOR (*)″ PIPE	Unit: Lineal Foot (nearest 1 L.F.)

(2) Measurement. Concrete Encasements, Cradles, and Arches for the various sizes of storm or sanitary sewer pipes shall be measured as the length, to the nearest foot, of the cradle, arch or encasement along the centerline of the pipe.

(3) Payment. Completed and accepted Concrete Encasements, Cradles, and Arches for the various sizes of storm or sanitary sewer pipes shall be paid for at their respective Contract unit prices, which payment shall be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the work as specified.

6.07 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.

Depth	Minimum Shell Thickness
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) Resilient Connectors. A flexible pipe to manhole connector shall be used whenever a sanitary sewer pipe penetrates into a concrete manhole or structure and shall be of the two types specified in Paragraphs a and b below:

i. Type Cast Into Manhole Wall At The Manufacturing Facility. The connector shall be the A•LOK X-CEL as manufactured by A•LOK PRODUCTS, INC., Tullytown, PA or approved equal. The connector shall be molded from materials with physical/chemical properties that meet or exceed the physical/chemical resistant properties and performance requirements outlined in ASTM C923.

The Z•LOK pipe to manhole connector as manufactured by A•LOK PRODUCTS, INC., Tullytown, PA or an equal product may be used with approval of the Engineer.

ii. Pipe To Manhole Connector For Penetrations Into Existing Concrete Manholes And Structures. The connector shall be the G3 Boot System featuring component packaging as manufactured by A•LOK PRODUCTS, INC., Tullytown, PA or approved equal.

The connector shall be made from materials that conforms to the physical and chemical requirements outlined in Section 4, "Materials and Manufacture" of ASTM C923 "Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals", and the overall design will meet or exceed Section 7, "Test Methods and Requirements" of ASTM C923.

(9) 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) Sanitary Sewers. The designation "CITY OF TOPEKA SANITARY SEWER" shall be cast in 2-1/2 inch high block letters flush with the traffic surface on all manhole covers intended for wastewater use. Letters shall be arranged around the circumference of the cover. A surface pick slot and concealed pick slots shall be manufactured into the lid.

(2) 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.

x. Inside Drops for Manholes. Fasteners for inside drops shall be 3/8" stainless steel fasteners. Straps shall be 1-1/2" wide, 11gauge (.1196") stainless steel. Pinch bolt and nuts shall be 3/8" diameter, Type 18-8 stainless steel. The inside drop system by Reliner/Duran Inc. has been approved for use in drop manholes. Other systems may be used as approved by the Engineer. The Contractor shall submit catalog cuts to the Engineer to obtain approval of systems used as inside drops in manholes or inlets.

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) Sewer Pipe Connections. All sanitary sewer pipe connections to manholes shall be flexible, unless approved by the Engineer. Storm sewer pipe connections to inlets or manholes may be either rigid or flexible. All connections shall be made carefully to prevent leakage and breakage of the pipe.

i) Rigid connections shall be made using concrete or grout to fill the annular space around the pipe in manhole walls. A clamp-on resilient connector shall be installed on the pipe prior to being grouted into wall. Pipes shall be encased with concrete as shown on the Standard Detail Drawing. Concrete used in concrete collars shall cure for a minimum of 48 hours unless otherwise directed by the Engineer.

ii) Flexible connections shall allow for limited differential settlement to occur between the pipe and manhole. The uniform compaction of the bedding material under the pipe and up to the springline of the pipe is essential to the control of this differential settlement. Cast-in-place resilient connectors shall be used with all flexible connections. To ensure a flexible watertight connection, no mortar

shall be placed around the connector on the outside of the structure or around the top half of the connector on the inside when completing the invert work.

(5) Inside Drops for manholes shall be constructed as detailed on the Standard Manhole Details Drawing. Stainless steel straps shall be secured to the structure wall with 3/8" stainless steel fasteners at 4 ft. intervals (minimum of 2).

(6) 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.

(7) 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.

(8) 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.

(9) Manhole Testing. Requirements for the testing of sanitary sewer manholes are specified in Subsection 6.04 C. 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.)
INSIDE DROP FOR MANHOLE	Unit: Each

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

iii. Special Structures and Inside Drops for Manholes. "Special Structure" and "Inside Drop for Manhole" shall be measured per Each of the items installed.

iv. 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, inside drops, 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.

6.08 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.

(1) Rigid Connections. A clamp-on resilient connector shall be installed on pipe prior to being grouted into wall. Annular space around the pipe shall be filled solid with grout.

(2) Flexible Connections. A flexible pipe to manhole connector shall be used for sanitary pipe penetrations into existing concrete manholes and structures. The seal between the connector and the manhole wall shall be made by placing the connector and expansion ring into the center third of the concrete opening. The band is then expanded and locked by utilization of torque wrench or porta-power unit to transmit the force required to seal the rubber connector against the concrete.

The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with recommendations of the manufacturer.

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.

END OF SECTION