

SECTION 02606

SANITARY & STORM STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Design Drawings, specified herein and required to furnish and install all sanitary and storm structures including but not limited to precast and cast-in-place manholes, air release manholes, bypass pumping vaults, drainage structures, headwalls, outfalls, etc.

1.2 RELATED WORK

- A. Division 2, Sections on Earthwork
- B. Section 03300, Cast-In-Place Concrete
- D. Section 05501, Miscellaneous Metal Fabrications
- E. Section 05536, Floor Access Hatch Covers
- F. Section 05540, Castings
- G. Division 15, Sections on Piping
- H. Section 02607, Sanitary Structure Lining System

1.3 REFERENCES

- A. KY Standard Specifications and Drawings: In this section, reference is made to the current Kentucky Transportation Cabinet (KYTC) Standard Specifications for Road and Bridge Construction and the KYTC Standard Drawings. In addition, construction requirements and material specifications not specifically covered in this section or in the referenced SD1 Technical Specifications shall conform to KYTC Standards. The ENGINEER or CONTRACTOR of a storm sewer project is responsible for obtaining a current edition of the KYTC Standard Specifications and the latest edition of the KYTC Standard Drawings when designing or performing work that either involves SD1 funding or is to be accepted by SD1.

B. Reference Standards:

1. ASTM C 33, Standard Specification for Concrete Aggregate.
2. ASTM C 76, Class III Reinforced Concrete Pipes.
3. ASTM C 443, Specifications for Joints for Circular Concrete Sewer and Culvert Pipe, using Rubber Gaskets.
4. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.
5. ASTM C 579, Standard test method for compressive strength of chemical resistant mortars, grouts, monolithic surfacing and polymer concretes.
6. ASTM C 857, Standard Practice for Minimum Structural Design Loading for underground Precast Concrete Utility Structures.
7. ASTM C 891, Standard Practice for Installation of Underground Precast Concrete Utility Structures
8. ASTM C 913, Standard Specification for Precast Concrete Water and Wastewater Structures
9. ASTM C 923, Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
10. ASTM D 695, Standard Test Method for Compressive Properties of Rigid Plastics.
11. ASTM D 790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
12. ASTM C 990, Standard Specification for Joints for Concrete Pipe, Manholes, Precast Box Sections Using Preformed Flexible Joint Sealants.
13. ASTM C 1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
14. ASTM C 1478, Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
15. ASTM D 1737, Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
16. ASTM D 2240, Standard Test Method for Rubber Property
17. ASTM D 412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension
18. ASTM D 4161, Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
19. ASTM D 6783, Standard Specification for Polymer Concrete Pipe.
20. ASTM F 477, Specification for Elastomeric Seals (gaskets) for Joining Plastic Pipe.
21. ASTM 4060, Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
22. ASTM 4541, Standard Test Method for Pull Off Strength of Coatings using Portable Adhesion Testers
23. AWWA C 110, Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.

24. AWWA C 111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. AWWA C 115, Flanged Ductile-Iron Pipe with Threaded Flanges.
25. AWWA C 151, Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
26. AWWA C 302, Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 1. Design Drawings showing design and construction details of all precast concrete and cast-in-place manholes including details of joints between the manhole bases and riser sections and stubs or openings for the connection of sewers. Design Drawings shall show invert elevations of all pipe connections entering and leaving the manhole along with flowline slope across the base. Shop Drawings shall show the delta angles for all points of intersection, except where more than one line intersects at the same manhole. Where more than one line intersects, the angles relating all lines shall be shown. All angles shall be shown to the nearest second.
 2. Manufacturer's name for all precast structures.
- B. For the following submit:
 1. Manholes: Include plans, elevations, sections, details, and frames and covers.
 2. Drainage Structures: Include plans, elevations, sections, details, and frames, covers, and grates.
 3. Cast-in-place and Precast Structures: Include plans, elevations, reinforcing, concrete mix design, and structural calculations stamped by a Professional Engineer, registered in the State of Kentucky, competent in structural design.
 4. Pipe material and layout for prefabricated sections
 5. Any other items as requested by the ENGINEER or SD1.
- C. Comply with all the requirements of Section 01340.

PART 2

STRUCTURES

2.1 GENERAL

- A. Concrete for all cast-in-place storm drainage structures (including channels and benches) shall conform to Section 03300 of the SD1 Technical Specifications including a minimum 28-day compressive strength of 4,000 psi.
- B. Grout shall consist of a mixture of water and cement or cement with fly ash, one part cement or cement with fly ash to two parts mortar sand as defined in Section 601.03.03B of the KYTC Standard Specifications, by volume.
- C. Non-shrink grout shall be an approved non-shrink, non-staining grout consisting of either a mixture of hydraulic cement, water, fine aggregate, and an approved nonferrous expansive admixture, or a packaged commercial product and shall meet the requirements of Section 601.03.03B of the KYTC Standard Specifications.
- D. Round precast structures shall conform to ASTM C 478. Square and rectangular precast structures shall meet the requirements of ASTM C 913. Structural calculations shall be provided for all precast structures as requested by SD1.
- E. Benching is required in the bottom of all structures (curb inlets, yard drains, standard inlets, manholes) per SD1 standard details. Cast-in-place benches shall be of 4,000 psi concrete. The invert channels shall be constructed as to cause the least possible resistance to flow. The shapes of invert channels shall conform uniformly to inlet and outlet pipes. Smooth and uniform finishes will be required. Inverts may also be precast into the structure.

2.2 PRECAST CONCRETE MANHOLES, AIR RELEASE MANHOLES, AND BYPASS PUMPING VAULTS

- A. General:
 - 1. Precast manholes shall conform to the details shown on the Standard Details.
 - 2. Concrete shall be minimum 4000 psi compressive strength.
 - 3. Except where otherwise specified precast manhole components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C 478 except as modified herein.
 - a. Standard Manholes shall be six (6) feet or more in depth, measured from the base of the cover frame to the invert of the outlet and

shall be concentric cone-type, top construction as shown on the Design Drawings.

b. Shallow Manholes shall be less than six (6) feet in depth, measured from the base of the cover frame to the invert of the outlet and shall be of flat-top construction as shown on the Design Drawings.

4. Precast, reinforced concrete manhole bases, riser sections, flat slabs and other components shall be manufactured by wet cast methods only, using forms which will provide smooth surfaces free from irregularities, honeycombing or other imperfections.
5. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact.
6. Precast concrete manhole sections (including eccentric and concentric cones, risers and rings) shall conform to ASTM C 478 except sections deeper than 12 feet shall have reinforcing equal to that of ASTM C76 Class III reinforced concrete pipes, unless otherwise noted on the Design Drawings.
7. Lifting holes, if used in manhole components, shall be tapered, and no more than two shall be cast in each section. Tapered, solid rubber plugs shall be furnished to seal the lifting holes. The lifting holes shall be made to be sealed by plugs driven from the outside face of the section only. If lifting holes do not protrude completely through the wall, no sealing is required.
8. Mark date of manufacture, manhole number as shown on the Design Drawings, and name or trademark of manufacturer on outside of barrel.

B. Manholes downstream of force mains

1. Where a force main connects to a new or existing manhole, that manhole shall be lined with a corrosion resistant monolithic lining conforming to SD1's Technical Specifications. SD1 may also require existing manholes up to 4 manholes downstream of the new force main discharge be similarly lined on a case-by-case basis. The cover on the force main discharge manhole shall be a solid lid (not vented). SD1 may require that additional downstream vented manhole lids be replaced on a case-by-case basis.
2. Any existing manholes to be lined shall be inspected by the DESIGN ENGINEER and SD1 to determine the conditions of the manholes and confirm if the manholes are suitable for lining. If in the opinion of SD1, the existing manholes cannot be lined, then the manholes shall be replaced.

C. Manhole Bases Sections:

1. Precast concrete manhole base sections shall be "monolithic", consisting of base slab and base riser (barrel) section.
 - a. If floatation is found to occur based on the Design Engineer's review, the engineer shall specify thickness of precast base. Precast base sections shall be furnished with an integral anti-flotation footing, thickness as specified hereinafter, extending trench bank-to-bank as shown in the Standard Details (minimum 8" projection).
 - b. Precast concrete manhole base slab thickness shall comply with the following schedule:

0.0' – 15.0'	Vertical Height	- 8" Slab
15.1' – 20.0'	Vertical Height	- 10" Slab
20.1' – 25.0'	Vertical Height	- 12" Slab
25.1' – 30.0'	Vertical Height	- 14" Slab
 - c. Manholes over 30 feet shall be designed by a Professional Engineer registered in the State of Kentucky. Submittals shall be provided to SD1 for review & approval.
 - d. Manhole bases shall have two cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall not be less than 5 inches.
 - e. There should be a minimum of twelve (12") inches between the outside diameters of all pipe penetrations in the base section. The maximum inside diameter (or horizontal dimension) of pipe to be used with a given size manhole shall be as specified on SD1 standard detail.
 - f. Base riser shall extend a minimum twelve (12) inches above the top of the highest pipe in the base.
2. Flow channel (invert) and apron (bench) shall be poured separately at the point of manufacture to the dimensions shown on the Design Drawings.
 - a. The flow channel through manholes should be made to conform in shape and slope to that of the sewers.
 - b. Invert shall be smooth and semi-circular in cross-section of the same diameter of the pipe leaving the manhole.
 - c. Changes of direction of flow or sewer centerline within the manhole shall be made by forming the flow channel along a smooth curve with as long radius as the inside of the manhole will allow.
 - d. Bench shall slope toward invert at not less than one (1) inch per foot.
3. All precast base sections with pipe openings shall fulfill the connection requirements identified hereinafter in Paragraph 2.6 herein.

C. Manhole Barrel Sections:

1. Manhole barrel sections shall have reinforcing steel in their walls, Wall

thickness shall not be less than 5 inches.

2. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide the correct height with the fewest joints. Openings in the barrel of the manholes for sewers or drop connections will not be permitted closer than one foot from the nearest joint. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.
3. The barrel sections shall be of the height required, but not less than one (1) foot in height. No opening shall be cut into a barrel section, the maximum dimension of which exceeds one-half (1/2) the section height.
4. Joints between manhole components shall be the tongue and groove. The circumferential and longitudinal steel reinforcement shall extend into the tongue and groove ends of the joint without breaking the continuity of the steel.
5. Precast manhole section joints shall be joined with one of the following products:
 - a. ASTM C 443, a single, continuous rubber O-ring gasket and shall conform to AWWA C302.
 - b. ASTM C-990, flexible butyl resin sealant such as Conseal CS-102, CS-202 as manufactured by Concrete Sealants, Inc.
 - c. Hamilton-Kent "Kent-Seal No. 2"
 - d. Press Seal Gasket "E-Z Stik"
 - e. Or Equal

D. Cone Sections and Top Slab:

1. A precast concentric cone or precast top slab shall be provided at the top of the manhole barrel to receive the cast iron frame and cover or floor access hatch cover as shown on the Design Drawings. Eccentric cones will be evaluated on a case by case basis or where directed by SD1
2. Cone sections and top slabs shall be designed for an H-20 wheel loading.
3. Cone sections for standard manholes shall have a minimum 8" thick upper walls and shall not exceed 3'-0" in height.
4. Concrete top slabs shall not be less than 8 inches thick.

E. Drop Manhole:

1. Drop Manholes shall conform to all provisions specified herein, with the additional requirements for the drop pipe as shown on the Design Drawings.

2. The drop pipe shall be of the same material and diameter as the inlet sewer pipe used.
 3. Drop pipe shall be totally enclosed in concrete, formed, with a minimum covering dimension of six (6) inches.
 4. No drop pipes shall be allowed inside of the manholes, unless otherwise approved by SD1.
 5. Base shall be cast to support drop connection.
- F. Acceptable Manufacturers
1. KOI
 2. Hanson
 3. or equal

2.3 MANHOLE RISERS

- A. Manhole risers (adjusting rings) 6" to 10" height shall be concrete.
- B. Manhole risers 2" to 5" height shall be high density polyethylene as manufactured by Ladtech, Inc or equal. Manholes that will be raised more than 10 inches will use 1-foot barrel section on inside of manhole.
- C. Or other method approved by SD1 on a case by case basis

2.4 PRECAST STORM CURB INLETS, STANDARD INLETS, CATCH BASINS & YARD DRAINS

- A. Precast storm drainage structures with knockout panels shall only be used for curb inlets (catch basins) and yard drains no greater than 6-ft in depth, unless load calculations are supplied. For pre-cast rectangular structures (other than those with knockout panels), at least 6 inches of wall (measured from the interior corner) is required on each side of the pipe beyond the precast opening for the pipe. This rule is not applicable for structures which have pipe installed in opposite walls or where one outlet reinforced concrete pipe is utilized. Less than 6 inches of wall may be approved by SD1 with the submittal of design calculations.
- B. Base and riser sections shall be custom-made with openings to meet indicated pipe alignment conditions. The minimum distance allowed between precast holes, measured from edge to edge in a standard inlet section shall be 6 inches.
- C. Joints between yard drains and standard inlet sections in the roadway or yard areas shall be sealed with one of the following:

1. ASTM C 443, a single, continuous rubber O-ring gasket and shall conform to AWWA C302.
 2. ASTM C-990, flexible butyl resin sealant such as Conseal CS-102, CS-202 as manufactured by Concrete Sealants, Inc.
 3. Hamilton-Kent "Kent-Seal No. 2"
 4. Press Seal Gasket "E-Z Stik".
 5. Or equal
- D. Joints between riser sections for curb inlets (catch basins) are not required to have gaskets or butyl sealant between sections. These joints can be stacked dry as long as there are no holes or gaps in the joints. All holes or gaps shall be filled with non-shrink grout.
- E. For precast structures with openings cast into the unit, the minimum vertical distance from the pipe openings to the top of the structure or segment wall shall be 12 inches. If this distance is less than 12 inches, then additional reinforcing steel shall be furnished for this section. All pipe openings shall not be in joints between two precast sections unless specifically approved by SD1. The top slab must be designed for HS-20 loading in paved areas only.
- F. All standard inlets shall conform to the appropriate Standard Drawings No. STM-08 through STM-11. All storm drains outside of the right-of-way shall be Standard Drawing No. STM-07, unless specifically approved otherwise by SD1. All curb inlets and catch basins shall conform to the appropriate Standard Drawings No. STM-01.1, STM-01.2, STM-04 and STM-12.

2.5 HEADWALLS AND OUTFALLS

- A. Headwalls and outfalls shall be constructed of either cast-in-place or precast reinforced concrete that conforms to KTC Standard Specifications for Road and Bridge Construction.
- B. Safety guards and railings: Safety guards and railings shall be provided along the top and sloped/winged sidewalls on all headwall inlet and outlet structures having a vertical drop of 4'-0" or greater. Such guards or railings shall be at least 42-inches in height measured vertically above the wall. Guards or railings shall not have an ornamental pattern that would provide a ladder effect. Vinyl coated chain link fencing and galvanized materials are an acceptable guard type.
- C. Grates: Grates shall be provided on inlet headwalls for all pipes 24" and less.
- D. All headwalls and outfalls shall conform to the appropriate Standard Drawings, including but not limited to, No. STM-15, STM-16, STM-17.1, STM-18.1 and STM-19.

2.6 FLEXIBLE PIPE JOINT SEAL & CONNECTIONS

A. For sanitary structures and manholes:

1. A flexible pipe joint seal shall be provided in the connection of pipe to manholes and other miscellaneous structures. The rubber seal shall meet the requirements given in ASTM C 923. The seal shall be of a size specifically designed for the pipe size and material.
2. All connecting elements of the seal shall be Type 304 stainless steel.
3. Flexible pipe joint seal shall allow for pipe alignment of up to fifteen (15) degrees deflection.
4. Pipes entering manholes that do not have existing flows and have slopes greater than ten (10) percent may have fittings (22.5 or 11.25 degree bends) installed immediately outside the manhole. This is to be evaluated on a case by case basis by SD1 or ENGINEER.
5. Acceptable Products:
 - a. Kor-N-Seal by NPC, Inc.
 - b. A-Lok by A-LOK Products, Inc.
 - c. Dura-Seal III by Dura-Tech
 - d. Or equal.

B. For storm structures and manholes with flexible pipe joint seals:

1. CONTRACTOR may use flexible connections at storm manholes which shall be elastomeric gaskets or couplings, manufactured in accordance with ASTM C 1478, Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Structures, Pipes, and Laterals.
2. CONTRACTOR may use a concrete collar for opening around the pipe. The pipe shall be encased with minimum 6 inch collar of concrete from the inside face of the wall to 1'-0" outside the outer face of the wall. The pipe shall be adequately supported to prevent settling while the concrete encasement is curing. The inside faces of the structure walls shall be finished with a trowel. If a concrete collar is used, the collar shall be allowed to cure to 75% of its design strength before backfilling. The diameter of the opening shall be no more than 8 inches greater than the outside diameter of the pipe.
3. For precast structures with knockout panels, all holes for pipes shall be via a controlled cut and shall not be cut into the structural members (i.e., top beams and corner columns) and non-shrink grout shall not be allowed to be placed around the pipes without prior approval from SD1 or its Engineer. The pipes shall be encased with a minimum 6 inch concrete collar all around the outside of pipe or a minimum of 3 inches beyond the

hole knocked in the wall, whichever is greater. Also, the concrete encasement shall extend from the inside face of the wall to 1'- 0" outside the outer face of the wall. The collar shall be allowed to cure to 75% of its design strength before backfilling.

2.7 STORM LATERAL CONNECTIONS

- A. Roof downspouts, footing or foundation drains, and sump pumps shall discharge in accordance with the local governing subdivision regulations. All storm lateral connections (downspouts, footing or foundation drains, sump pumps, etc) to the storm sewer shall be prohibited unless explicitly reviewed and approved by SD1 due to uncommon circumstances (i.e. inadequate discharge distances from foundations, narrow side yards, etc.).

2.8 MANHOLE, CATCH BASIN & STRUCTURE STEPS

- A. Reinforced Polypropylene Manhole Steps: ½ inch Grade 60 steel reinforcing rod, ASTM A-615, encapsulated in copolymer polypropylene, ASTM D 2146-68 under Type II, Grade 16906. Steps shall be PS1-PF (Press Fit polypropylene plastic) as manufactured by MA Industries, or equal. Steps shall be epoxy grouted into specially sized holes cast into the manhole section. Holes shall be formed in the manhole section using an insert plug that is removed upon curing.
- B.
- C. No steps shall be aligned over the flow channel. Step spacing shall be 16" as shown the Standard Detail Drawing.
- D. Omit steps for structures that are less than 4-ft deep unless otherwise shown on the plans.

2.9 EXTERNAL SLEEVE FOR STRUCTURE (Sanitary Only)

- A. Provide external sleeve around all manhole joints as designated on the plans. Any manholes located within fifty (50) feet or less of a creek/ stream or within a floodplain shall have an external sleeve. External sleeve shall be a wraparound heat shrinkable sleeve that creates a barrier to water infiltration and protects support of the structure and frame from ground moisture prevents corrosion and freeze-thaw damage. The system shall be compatible with and bond to concrete, metal, and fiberglass using an adhesive type primer. The sleeve shall have the following physical properties:

Softening Point	212 degrees Fahrenheit	ASTM E-28
Lap Shear Strength	12 PSI	DIN 30 672
Tensile Strength	2900 PSI	ASTM D-638

Elongation	600%	ASTM D-638
Hardness	46 Shore D	ASTM D-2240
Abrasion Resistance	45 mg	ASTM D-1044
Peel Strength	9PLI	ASTM D-1000
Water Absorption	0.05%	ASTM D-570
Low Temperature	-40 degrees Fahrenheit	ASTM D-2671D
Minimum Width	12 inches	

B. System shall accommodate ground movement and resists soil stress.

C. Acceptable Products:

1. WrapidSeal – Manhole Encapsulation System by Canusa –CPS.
2. Link- Seal Riser- Wrap Heat Shrink System.
3. Or Equal.

2.10 PVC STORM DRAINAGE STRUCTURES AND CATCH BASINS

A. PVC storm drainage structures and catch basins shall be approved on a case-by-case basis by SD1.

PART 3 EXECUTION

3.1 MANHOLE BASES

A. General

1. Manholes shall be installed at the locations shown on the Design Drawings.
2. The dimensions shall be as shown on the detail sheets and the depths shall be as indicated by either finished top elevation given or depth dimension given on the plans.
3. Perform Site work as per the requirements of Specifications Sections 02050, 02110, 02220, and 02222.
4. Excavation for manholes and other underground structures shall be of sufficient size to adequately accommodate installation and proper centering.
5. The bases shall be placed directly on an 8-inch to 12-inch deep pad (compacted thickness) of pipe bedding material as specified in section 02220, placed to proper elevation and leveled, unless a deeper excavation is required to remove any loose sandy soils or soft to medium stiff, clayey soils down to a soil stratum suitable for support of the manhole and base.

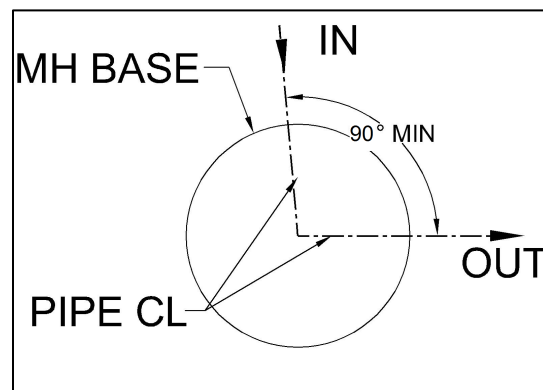
- a. The excavated soils shall be replaced with an appropriate Structural Backfill material or with controlled, low-strength material (CLSM), lean concrete, or an extra thickness of manhole base concrete.
 6. The excavation shall be kept free of water while the manhole is being constructed and manhole shall not be backfilled until inspected by the SD1.
 7. CONTRACTOR will be required to compact bedding material around the entire circumference of the manhole and manhole excavation area to at least 12-inches above the highest incoming or outgoing pipe.
 8. Compacted backfill as specified on the Design Drawings or section 02220 shall then be placed above the compacted bedding material up to finished grade.
- B. Pre-Cast Bases
1. The SD1 reserves the right to inspect precast manhole base sections at the construction site and to reject the use of such sections if the SD1 determines the products unsuitable for the SD1'S installation.
 2. Doghouse manholes shall not be permitted unless written approval by SD1 or SD1 representative.
- A. Cast-in-Place Bases
1. Cast-in-Place Bases shall be used when installing a doghouse manhole over an existing sewer or as approved by the ENGINEER.
 - a. Cast-in-place bases shall be placed on suitable foundations after the pipes are laid as specified in 3.1.A.5.
 2. The base shall be cast monolithically to an elevation at least 12 inches above the top of the highest pipe entering the manhole, except where a drop connection is to be installed.
 - a. Base thickness shall be as per 2.1.B.1.
 - b. Base, walls and bottom shall be at least of the thickness shown and reinforced to withstand the loads to be expected.
 - c. Connections for sewer pipes shall conform to SD1's standard detail.
 - d. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components.
 - e. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface.
 - f. Raised or rough joint finishes will not be accepted.

3.2 PRECAST MANHOLE SECTIONS

- A. Set sections vertical with steps and sections in true alignment.
- B. Install sections, joints and gaskets in accordance with manufacturer's recommendations.

3.3 STRUCTURE CHANNELS

- A. All invert channels through structures shall be constructed of 4000 psi concrete.
- B. For precast bases, the flow line (channel) and benches shall be cast separately from the floor and side wall at the place of manufacture, unless otherwise approved by SD1.
- C. Channels shall be properly formed to the sizes, cross sections, grades and shapes shown or as ordered.
- D. Benches shall be built up to the heights shown or as ordered and given a uniform wood float finish.
- E. Care shall be taken to slope all benches for proper drainage to the invert channel.
- F. All flow channel angles between any new incoming pipe and new outgoing pipe shall be at least 90 degrees in the direction of flow as seen in the figure below. For any pipe with velocities exceeding 5 ft/s consult SD1 engineer for the required angle or for the need of an oversized manhole.



3.4 STORM CURB INLETS, STANDARD INLETS, CATCH BASINS, YARD DRAINS, HEADWALLS & OUTFALLS

- A. Inlets, catch basins, drains, junction structures, and other drainage structures shall be neatly and accurately built in accordance with the plans or SD1 Standard Drawings. The structure shall be either of cast-in-place concrete or precast

concrete. Precast structure sections shall be installed in accordance with ASTM C 891.

- B. All cast-in-place structures shall be built using 4,000 psi concrete as described in Paragraph 2.1. The structures shall be built on prepared foundations and conform to the dimensions and shapes shown on the Plans and SD1 Standard Drawings. The construction shall conform to the methods, forms, placement, protection, and curing for concrete as specified in accordance with KTC and SD1 Standards. Any required reinforcement shall conform to the Plans and SD1's Standard Drawings. Installed concrete reinforcing shall be inspected and approved by SD1 before any concrete is placed.
- C. Headwalls and outfalls shall be constructed of either cast-in-place or precast reinforced concrete in conformance with SD1's Standard Drawings and KTC Standard Specifications for Road and Bridge Construction. All headwalls and outfalls built into slopes shall be properly seated as to avoid disconnection from the adjoined pipe.

3.5 DOGHOUSE MANHOLES

- A. For joining new pipe to existing pipe, refer to Paragraph 3.1.B.2 of this section for requirements. Doghouse manholes shall only be used for connections to sewer mains with high flows, as determined by the ENGINEER. Doghouse manholes must be approved by SD1. For applications using doghouse manholes, refer to Paragraph 3.1.C of this section and SD1 Standard Detail No. SD-106 for requirements.

3.6 PIPE CONNECTIONS TO NEW STRUCTURES

- A. For connections to new structures:
 - 1. A flexible pipe-to-manhole joint connector shall be used for joining piping to manholes and other miscellaneous structures. The rubber seal shall meet the requirements given in ASTM C 923. The seal shall be of a size specifically designed for the pipe size and material and be as specified herein.
 - a. If a Kor-N-Seal joint seal or equal with a stainless steel tightening band is used, CONTRACTOR shall tighten the band to the proper torque as specified by the manufacturer.
 - b. If the slope of the incoming sewer exceeds 10% from the horizontal, a fitting may be used outside the manhole wall to facilitate a more perpendicular connection to the manhole wall. The use of this fitting is to be evaluated on a case by case basis by SD1.

2. All pipe connections to manholes shall match crowns. If matching crowns is not possible, a drop manhole may be approved by SD1.
3. All drop manholes shall be approved by SD1. Drop manholes may be acceptable under the following conditions:
 - a. If the slope of the influent sewer is greater than or equal to five (5) percent, SD1's drop connection detail 114 shall be followed. All other influent sewer slopes and drop connections will be evaluated on a case by case basis.
 - b. All other drop manhole requests shall be approved on a case by case basis including but not limited to pipe realignments, connections to existing manholes, etc.
 - c. If the total height of the drop is greater than sixteen (16) feet, a drop shaft assembly shall be specifically designed for the hydraulic conditions present by a licensed professional engineer in the Commonwealth of Kentucky for the hydraulic and shall be approved by SD1.
4. Slide manholes shall not be used, unless otherwise approved by SD1.

3.7 PIPE CONNECTIONS TO EXISTING STRUCTURES

- A. Perform by core drilling in accordance with Section 01045.
- B. The connection to the structure shall be in accordance with the materials specified herein.
- C. The flow channel and bench for the new connection shall be constructed onsite or the existing flow channel and bench modified to accept the new piping.
- D. New connections to existing structures need to be greater than ninety (90) degrees to the existing flow channel in the direction of the flow.
- E. Where new flows joining an existing eight (8) inch sewer that is flowing half pipe or greater, or the existing pipe is twelve (12) inches or greater, an oversized manhole shall be installed to allow a smooth, sweeping flow transition. Consult SD1 for required manhole diameter.
- F. For sanitary applications, perform all connections in accordance with Paragraphs 3.9 and 3.11 herein.

3.8 SANITARY SEWER STUBS FOR FUTURE CONNECTIONS

- A. Installation of stubs for future connections shall be evaluated on a case by case basis and approved by SD1. If stubs are approved, PVC, ductile iron, or fiberglass pipe stubs with approved watertight plugs shall be installed in manholes. SD1 requires that future connections to existing manholes be cored and the benching modified to accept the new connection. Where pipe stubs, sleeves or couplings for future connections are shown or ordered, CONTRACTOR shall provide all materials and work for their construction.
- B. If stubs are approved by SD1, stubs out of manholes shall be a two (2) to five (5) foot stick of pipe with sealed caps. When future connections are made to these manholes, the stubs shall be removed and a full stick of pipe shall be installed at the proper slope.
- C. Where connections are made to existing manholes installed after May 15, 2000, the existing manhole shall be vacuum tested prior to the connection being made. If the manhole is vacuum tested prior to alterations and fails, it is the responsibility of SD1 to repair or replace the manhole. If the manhole passes the vacuum test prior to connection, but fails the vacuum test after the connection is made, then the CONTRACTOR shall repair or replace the manhole per SD1's direction and approval.

If the CONTRACTOR fails to vacuum test the manhole prior to any connections being made, and the manhole fails the vacuum test after the connection, the CONTRACTOR shall repair or replace the manhole per SD1's direction and approval.
- D. If the connection to an existing manhole is cored, the connection shall be booted and the existing manhole shall pass a vacuum test after all work is complete, if the existing manhole was installed after May 15, 2000.
- E. If the elevation or grade of an existing manhole is altered, the existing manhole shall pass a vacuum test after all work is complete, if the existing manhole was installed after May 15, 2000.

3.9 GRADING AT MANHOLES & STRUCTURES

- A. Manholes shall be installed to conform to the following convention unless otherwise called for on the plans. The ground surface shall be graded to drain away from the manhole. Final dimensions shall be determined after grading has taken place.
 - 1. Manholes in roads, parking lots, paved areas and lawns shall be installed flush with the surrounding area.
 - 2. Manholes in wooded or other inaccessible areas shall be installed twelve (12) inches above the final grade.

3. Confirm with land owner prior to installation of manholes in cultivated fields, hay fields and pastures. If land owner agrees manhole shall be installed with the cone section flush with the final grade. After installation of the casting, a slope fill 1:5 (1 vertical to 5 horizontal) shall be installed to provide surface drainage away from the manhole.
- B. Manholes in paved areas shall be constructed to meet the final surface grade. In paved areas on State Highways, all manholes shall be 1/2 inch below final wearing surfaces. Manholes shall not project above finished roadway pavements to prevent damage from snowplows.
 - C. CONTRACTOR shall be solely responsible for the proper height of all manholes necessary to reach the final grade at all locations. CONTRACTOR is cautioned that ENGINEER'S review of Shop drawings for manhole components will be general in nature and CONTRACTOR shall provide an adequate supply of random length precast manhole riser sections to adjust any manhole to meet field conditions for final grading.

3.10 MANHOLE WATERTIGHTNESS (Sanitary Only)

- A. All manholes shall be free of visible leakage. Each manhole shall be tested for leaks and inspected. If the manhole fails a visual leakage inspection and/or vacuum testing, SD1 will consider the manhole defective and the Contractor shall provide the Engineer a plan for leak repairs for approval or replace the manhole and make any necessary reconnections to the new or existing pipelines at no additional cost to the SD1. No leak repairs shall be performed without the ENGINEER'S approval.
- B. Vacuum test manholes to ASTM C 1244. Testing to be witnessed by SD1. Manholes not subject to vacuum testing must be in writing from SD1. This specification shall govern the negative air pressure (vacuum) testing of sanitary sewer manholes and structures and shall be used as a method of determining acceptability by the SD1, in accepting maintenance of a sanitary sewer manhole or structure on behalf of the public. Other forms of testing of some manholes may be required, as deemed necessary by the SD1.
- C. Manholes shall be tested after installation with all connections in place along with the following completed prior to testing:

1. Lift holes, if any, shall be plugged with an approved, non-shrinkable grout prior to testing.
2. Drop connections shall be installed prior to testing.
3. The vacuum test shall include testing of the seal between the cast iron frame and the concrete cone, slab or grade rings.
4. The manholes shall be backfilled and finished to design grade prior to test.
5. Test pressure requirements of ASTM C-923 shall be met.

D. Test Procedure:

1. Temporarily plug, with the plugs being braced to prevent the plugs or pipes from being drawn into the manhole, all pipes entering the manhole at least eight inches into the sewer pipe(s). The plug must be inflated at a location past the manhole/pipe gasket.
2. The test head shall be placed inside the frame at the top of the manhole and inflated, in accordance with the manufacturer's recommendations.
3. A vacuum of 10" of mercury shall be drawn on the manhole. Shut the valve on the vacuum line to the manhole and disconnect the vacuum line.
4. The pressure gauge shall be liquid filled, having a 3.5 inch diameter face with a reading from zero to thirty inches of mercury.
5. The manhole shall be considered to pass the vacuum test if it holds at least 9 inches of mercury for the following time durations:

Time (Minutes)	4' Diameter	5' Diameter	6' Diameter
Manhole Depth			
20 Feet or Less	1	2	3
20.1 to 30 Feet	2	3	4

Note: Consult SD1 on manhole diameters larger than six (6) feet.- These test pressures exceed what is in ASTM C-1244

6. If a manhole fails the vacuum test, SD1 will consider the manhole defective and the CONTRACTOR shall provide the Engineer a plan for leak repairs for approval or shall replace the manhole and/ or defective components and make any necessary reconnections to the new or existing pipelines at no additional cost to the SD1. No repairs shall be made to the manhole unless approved by the ENGINEER.
7. All temporary plugs and braces shall be removed after each test.

8. Manholes will be accepted as having passed the vacuum test requirements if they meet the criteria stated above.

3.11 STRUCTURE ABANDONMENT

- A. Structure abandonment shall be per SD1 standard drawings and consist of removing structure frames, covers, grates, cone section of manholes, and similar items. All connecting pipes shall be bulk headed. The walls shall be lowered to 2 feet below final grade if in earth or to 12 inches below subgrade if in pavement. The remaining structure shall be filled with crushed stone or sand compacted to match all backfill requirements here-in or shall be filled with controlled density fill.

++ END OF SECTION ++