

SECTION 03370 – SANITARY SEWER MANHOLE CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

- A. This section covers the construction of standard sanitary sewer manholes. Standard manholes shall be constructed complete with frame and cover, anchors, waterproofing, seals, barriers, joint sealant, fittings and all other specified requirements in accordance with the Contract Documents.

1.02 SPECIFICATION MODIFICATIONS

- A. It is understood that throughout this section, these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements or as otherwise indicated on the Contract Drawings.

1.03 RELATED SECTIONS

- A. Section 01015 – Specific Project Requirements.
- B. Section 01300 – Submittals.
- C. Section 02200 – Earthwork.
- D. Section 02250 – Trenching, Pipe Embedment and Backfill.
- E. Section 02702 – Sewer Pipe and Manhole Testing.
- F. Section 03000 – Miscellaneous Concrete.
- G. Section 05010 – Sanitary Sewer Manhole Castings.

1.04 CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - ASTM A536 Standard Specification for Ductile Iron Castings.
 - ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - ASTM C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 - ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
 - ASTM C191 Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
 - ASTM C443 Standard Specification for Joints for Circular Pipe and Manholes, Using Rubber Gaskets.
 - ASTM C478 Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
 - ASTM C827 Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
 - ASTM C923 Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 - ASTM C990 Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.

ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
ASTM D4976	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

1.05 DEFINITIONS

- A. Paved Areas – Areas for which the final surfacing will be street pavement, shoulders, driveways, parking lots, sidewalks, gravel roads or other surface features.
- B. Unpaved Areas – Areas for which the final surfacing is a green space.

1.06 INFORMATION PROVIDED BY THE CITY

- A. As provided in the Contract Documents.

1.07 SUBMITTALS

- A. Submit as specified in Section 01300 – Submittals.
- B. Shop Drawings:
 - 1. Submit for approval general arrangement drawings showing manhole size, height and location of access cover, steps and all pipe penetrations.
 - 2. Submit for approval joint construction details.
 - 3. Submit for approval details on reinforcement if requested.
- C. Product Data:
 - 1. Submit for review and approval manufacturer's catalogue/product data and installation instructions for the following:
 - (a) Manhole adjustment rings.
 - (b) Resilient connectors.
 - (c) Joint sealant.
 - (d) External joint seal.
 - (e) Internal joint seal.
 - (f) External frame chimney seal.
 - (g) Grade ring liner.
 - (h) Non-shrink grout.
 - (i) Antimicrobial additive.
 - (j) Waterproofing additive.
 - (k) Color tinting additive.
- D. Certificates:
 - 1. Certification from precast manufacturer that the precast structures were fabricated to include the specified antimicrobial additive, admixture identifier and waterproofing additives.
- E. Other:
 - 1. Precast concrete mix design.
 - 2. Compressive strength testing of cylinders.
 - 3. Compressive strength testing of cores.

1.08 QUALITY ASSURANCE

- A. The Contractor is responsible for the quality assurance and quality control of the Work.
- B. The installation contractor shall be a licensed underground utility contractor licensed for such work in the state of Missouri. The installing contractor's license shall be current and be state certified/state registered.

- C. Manufacturers of all precast concrete structures must be a KCMO “Approved Precast Concrete Product Supplier” as approved as part of the Public Works Quality Management Plan.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Cement, Aggregate and Reinforcement shall be in accordance with Section 03000 – Miscellaneous Concrete and as specified herein.
- B. Handle materials and other accessories in such manner as to ensure delivery to the trench in a sound undamaged condition. Take special care not to damage linings. If the lining is damaged, the Contractor shall make satisfactory repairs.
- C. Non-shrink grout – Deliver materials to project in Manufacturer's original, unopened packaging, with labels clearly identifying product name, manufacturer and expiration date. Store grout in a cool, dry place, out of the sun.
- D. Precast concrete sections shall not be delivered to the job until the concrete control cylinders have attained a strength of at least 80 percent of the specified minimum.
- E. Precast concrete sections shall be handled carefully and shall not be bumped or dropped. Hooks shall not be permitted to come in contact with joint sections.
- F. Precast concrete sections shall be inspected when delivered. All cracked and visibly defective units shall be rejected. City/Design Professional reserves the right to inspect the production of the units at the manufacturing plant.

1.10 MANHOLE TYPES

- A. Unless otherwise noted on the Drawings or in Section 01015 – Specific Project Requirements, all manhole types shall conform to the following:
 - 1. Standard Precast Manhole – Eccentric Cone: Use for all newly constructed manholes having a depth (measured from top of casting to top of base) of more than 6 feet. See Standard Drawing 03370-1.
 - 2. Standard Precast Manhole – Shallow Type: Use for all newly constructed manholes having a depth (measured from top of casting to top of base) of less than or equal to than 6 feet. See Standard Drawing 03370-2.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE

- A. Materials and Fabrication:
 - 1. Precast concrete shall conform to ASTM C478.
 - 2. Air entraining agents shall be added to the concrete to provide 4 to 6 percent entrained air.
 - 3. Submit for review and approval the precast concrete manufacture’s mix design(s) for precast structures.
- B. Quality Control:
 - 1. Compressive Testing of Cylinders – Conduct in accordance with ASTM C478. Provide compressive testing results as requested by the City/Design Professional or as required by Section 01015 – Specific Project Requirements.
 - 2. Compression Testing of Cores – Conduct in accordance with ASTM C478 and submit results as requested by the City/Design Professional and as required by Section 01015 – Specific Project Requirements.

2.02 MANHOLES

A. The minimum inside diameter of the manhole shall be as follows:

Table 1. Minimum Manhole Diameter

Sewer Pipe Size (inches)	Manhole Inside Diameter (inches)	Min. Manhole Frame Clear Opening (inches)
Up to 36" (inch)	60"	30"
42"(inch) through 48"(inch)	72" See Standard Drawing 03370-3	30"

- B. Reducing sections may be used at six (6) feet or more above the invert.
- C. Cone Sections shall be eccentric, unless otherwise specified by City/Design Professional.
- D. All required pipe openings shall be plant cast, unless otherwise noted.
- E. Pre-cast sections may be provided with lifting notches on the inside faces of the walls to facilitate handling. Lifting notches shall be not more than 3 inches deep. Holes extending through the wall will not be acceptable.
- F. If precast base sections are provided with integral concrete invert fill, a roughened surface shall be provided to improve the bond with the final invert fill. A minimum of 2 inches of the concrete invert fill shall be installed in the field.

2.03 MANHOLE ADJUSTMENT RINGS

- A. Adjusting rings shall be designed to withstand the wheel loading requirements of AASHTO HS25.
- B. Adjusting rings shall be designed and fabricated to withstand deterioration and degradation when exposed to hydrogen sulfide.
- C. Acceptable Manufacturers include:
 - 1. Cretex Pro Ring.
 - 2. East Jordan (EJ) Infrariser.
 - 3. LadTech.

2.04 RESILIENT CONNECTORS

- A. Manholes shall be provided with circular openings, with continuous, circular, resilient connectors cast into the wall.
- B. Resilient connectors shall be installed in accordance with the manufacturer's recommendations, except that connectors shall be positioned so that sealing or resealing operations may be accomplished from inside the manhole.
- C. Resilient connectors shall conform to ASTM C923.
- D. Mortar connections will be allowed only if prior approval has been given by the City/Design Professional.
- E. Acceptable Products/Manufacturer's include the following:
 - 1. The PSX: Direct Drive as manufactured by Press-Seal Corporation:
 - (a) When the PSX: Direct Drive connector is used, it shall be double banded and the take-up screws for the gasket clamps shall be positioned 180 degrees apart.

2. The Quik-LOK Connector as manufactured by A-LOK Products Inc.:
 - (a) When the Quik-LOK connector is used, it shall be double banded and the take-up screws for the gasket clamps shall be positioned 180 degrees apart.

2.05 JOINT SEALANT

- A. Joints shall be sealed using preformed flexible joint sealants conforming to ASTM C990. The minimum bead dimension shall be one inch.
- B. Install in accordance with manufacturer's recommendations.

2.06 EXTERNAL JOINT SEAL

- A. External manhole seals shall be installed on new manhole installations, replacements or when project conditions allow for excavation of the manhole sections.
- B. External joint seals shall be a minimum of 9 inches wide.
- C. Heat Shrinkable Wrap-around Sleeves: Acceptable products include the following:
 1. CCI Pipeline Systems: WrapidSeal™.
- D. External Joint Banding Systems:
 1. Infi-Shield®: External Gator Wrap.
 2. Mar Mac Construction Products, Inc.: MacWrap External Sealing Band.
 3. Cretex Specialty Products: Cretex Wrap.
- E. Standard Precast Manhole – Shallow Type:
 1. Install an internal Cretex Seal or Infi-Shield Uni-Band External Seal where the chimney meets the flat top of manholes.
- F. Materials for manhole seals shall be able to withstand hydrogen sulfide and other corrosive gases found in sewers.
- G. Install in accordance with manufacturer's recommendations.

2.07 INTERNAL JOINT SEAL

- A. Internal manhole seals shall be used when project conditions prevent the use of external manhole seals or at the direction of the City/Design Professional.
- B. Acceptable products for internal manhole seal shall include the following:
 1. Cretex – Internal Joint Seal.
- C. Materials for manhole seals shall be able to withstand hydrogen sulfide and other corrosive gases found in sewers.
- D. Install in accordance with manufacturer's recommendations.

2.08 EXTERNAL FRAME CHIMNEY SEAL

- A. Acceptable manufacturers for external frame chimney seal include the following:
 1. CCI Pipeline Systems – Wrapid Seal.
 2. Infi-Shield – Gator Wrap.
 3. Infi-Shield – Uniband.
- B. Install in accordance with manufacturer's recommendations.

2.09 GRADE RING LINER

- A. Grade ring liners shall be installed on all manholes in paved applications.
- B. Acceptable manufacturers for grade ring liners include the following:
 1. WaterLOK Grade Ring Liners as manufactured by A-LOK Products, Inc.
 2. I&I Barriers as manufactured by Strike Tool Inc.
- C. Install in accordance with manufacturer's recommendations.

- 2.10 FRAMES, COVERS AND GRATINGS FOR MANHOLES
- A. Shall conform to Section 05010 – Sanitary Sewer Manhole Castings.
- 2.11 NON-SHRINK GROUT
- A. Non-shrink grout shall conform to ASTM C1107, Grades B and C.
 - B. Non-shrink grout shall be a trowelable mix, in the plastic state and show no expansion after set (as tested per ASTM C827). Non-shrink grout shall develop a compressive strength not less than three thousand (3,000) psi within twenty-four (24) hours per ASTM C109. The placement time shall be not less than forty-five (45) minutes based on initial set per ASTM C191.
 - C. Non-shrink grout shall be ConShield Joint Set as manufactured by ConShield Technologies Inc. Mix and apply in accordance with the manufacturer's recommendations.
- 2.12 ANTIMICROBIAL ADDITIVE
- A. Unless otherwise specified in Section 01015 – Specific Project Requirements, an antimicrobial additive shall be included in the following:
 - 1. Precast concrete sections.
 - 2. Miscellaneous concrete placed in the interior of the manhole.
 - 3. Non-shrink grout placed in the interior of the manhole.
 - 4. Precast concrete base.
 - 5. Concrete used for cast-in-place concrete base.
 - B. Acceptable manufacturers include the following:
 - 1. ConShield HD® as manufactured by ConShield Technologies Inc.
 - 2. As specified in Section 01015 – Specific Project Requirements.
 - C. Admixture Identifier – Color tinting shall be included to identify that the concrete contains the antimicrobial admixture. The identifier shall be CONTINT and shall be brown in color.
- 2.13 WATERPROOFING ADDITIVE
- A. A waterproofing additive shall be included in the following:
 - 1. Precast concrete manholes and manhole bases.
 - 2. Non-shrink grout placed in the interior of a manhole
 - 3. Miscellaneous concrete placed in the interior of a manhole
 - 4. Concrete used for cast-in-place concrete base
 - B. Acceptable manufacturers include the following:
 - 1. Crystal-X as manufactured by ConShield Technologies.
 - 2. Xypex as manufactured by Xypex Chemical.
 - 3. As specified in Section 01015 – Specific Project Requirements.
- 2.14 GRANULAR BEDDING MATERIAL
- A. Granular bedding material shall be as specified in Section 02250 – Trenching, Pipe Embedment and Backfill.
- 2.15 MISCELLANEOUS CONCRETE
- A. Miscellaneous concrete shall conform to Section 03000 – Miscellaneous Concrete.

PART 3 - EXECUTION

3.01 EXCAVATION, BACKFILL AND COMPACTION

- A. Excavation, backfill and compaction for manholes shall be in accordance with Section 02200 – Earthwork.
- B. Excavation, backfill and compaction operation shall be achieved in a suitable and orderly manner providing a minimum disturbance to the general public.
- C. Depth of excavation shall be to that required for proper installation of the manhole or structure. Over-depth excavation may be required if the subgrade is unsuitable or unstable. Over-depth excavation due to unsuitable or unstable subgrades shall be backfilled as required by the City/Design Professional. Over-depth excavation occurring through an oversight by the Contractor shall be backfilled as required by the City/Design Professional at no additional cost to the City.
- D. Side clearance outside the manhole and/or structures shall be no greater than necessary to allow for forming, connection of piping, proper application of special coatings and access for inspection.

3.02 MANHOLE BASE

- A. Precast Concrete Bases:
 - 1. The bottom precast wall section shall not be used for supporting or leveling the other wall sections prior to pouring the base.
 - 2. The subgrade materials shall be excavated to undisturbed earth and a uniform elevation to allow for a minimum of 4 inches of granular bedding material. The surface of the granular material shall be carefully graded and the base section accurately set so that connecting pipes will be on the proper line and grade. The elevation of the granular material shall be adjusted as required until proper grade and alignment of the base section has been attained.
 - 3. No wedging or blocking under precast concrete bases is permitted.
- B. Cast-in-Place Concrete Bases:
 - 1. If a precast concrete base cannot be used, a poured concrete base may be used.
 - 2. The cast-in-place forming shall follow the design of the precast base as shown in Standard Drawing 03370-1 and as described herein.
 - 3. Cast-in-place concrete bases shall have a minimum thickness of eight (8) inches.
 - 4. Concrete shall be placed on undisturbed earth in accordance with requirements of Section 03000 – Miscellaneous Concrete.
 - 5. The bottom wall section shall be embedded in the base section a minimum of four (4) inches.
 - 6. Concrete blocks shall be used for supporting or leveling the bottom wall section prior to pouring the base. Use of Wood blocks will not be accepted.
 - 7. When resilient connectors are used with cast-in-place bases, granular bedding material shall be used instead of concrete fill under the connecting pipes. Granular bedding material shall be placed on undisturbed earth.

3.03 MANHOLE INVERTS

- A. In no case shall the invert section through a manhole be greater than that of the outgoing pipe.
- B. The shape of the invert shall conform exactly to the lower half of the pipe it connects.
- C. Side branches shall be connected with as large radius of curve as practicable.
- D. All inverts shall be troweled to a smooth, even surface.
- E. Inverts shall be constructed of concrete as specified in Section 03000 – Miscellaneous Concrete.

- F. Concrete shall be troweled (or formed if inverts are pre-cast) to produce a dense, smooth finish.
- G. The invert channel shall be “U” shaped in cross section and shall extend upward as shown in Standard Drawing 03370-1.
- H. Smooth transitions shall be formed for pipes of different sizes, elevation and bends.

3.04 RISER AND CONE SECTIONS

- A. Circular precast sections shall be provided with a double bead of preformed flexible joint sealant as specified in paragraph JOINT SEALANT between precast sections.
- B. All protruding flexible joint sealant shall be removed from inside of manhole and the joint shall be wiped with non-shrink grout - ConShield Joint Set (see paragraph 2.11).
- C. Internal or external manhole joint seals shall be installed per manufacturer’s recommendation.
- D. Lifting notches in manhole walls shall be filled with non-shrink grout - ConShield Joint Set (see paragraph 2.11).

3.05 PIPE CONNECTIONS

- A. Resilient Connectors:
 - 1. Resilient connectors shall be used for all pipe connections unless otherwise approved by the City.
 - 2. The connecting pipe shall be carefully adjusted to proper line and grade. Granular bedding material shall be compacted under the haunches and to the spring line of the pipe for a distance of at least 6 feet from the manhole wall and to the trench width.
 - 3. The pipe shall be installed in the resilient connector prior to backfilling outside the manhole and shall be resealed as required after completion of the manhole and backfill. All visible leakage shall be eliminated.
 - 4. The connecting pipe for installation with resilient connectors shall be plain end, square cut spigots and shall not protrude more than one inch inside the manhole wall.
 - 5. A clear distance of at least 1 inch from the end of each connecting pipe and around the pipe shall be provided when the concrete invert fill is installed or as recommended by the manufacturer of the resilient connector.
 - 6. After completion of the manhole installation, the box out shall be filled with mastic filler material, completely filling the space beneath the pipe and extending to at least the spring line. The filler material shall provide a smooth, uniform surface between the inside diameter of the pipe and manhole invert.
- B. Grouted Connections:
 - 1. Grouted connections are not allowed unless approved by the City.
 - 2. The space between connecting piping and the wall of the precast sections shall be completely filled with non-shrink grout.
 - 3. The maximum allowable pipe opening on a horizontal axis shall be the outside diameter of the pipe plus twelve (12) inches.
 - 4. The maximum allowable pipe opening on a vertical axis shall be the outside diameter plus 8 inches.
 - 5. The minimum clearance between the outside surface of the installed pipe and the concrete of the manhole shall be two (2) inches.
 - 6. The minimum distance between any two adjacent pipes shall be twelve (12) inches.
 - 7. For field alterations approved by the City/Design Professional, the walls shall be scored with a masonry saw to a depth sufficient to sever the reinforcing steel. A chipping hammer may then be used to remove the concrete.

3.06 MANHOLE TOP

- A. The finished top elevation of manhole castings shall conform to the following unless otherwise shown on the Drawings or directed by the City/Design Professional.
 - 1. In paved areas, the top of the casting shall conform to the slope of the pavement and shall match the finished pavement elevation as shown in Standard Drawing 03370-4.
 - 2. In non-pavement areas, the top of the casting shall be not more than one (1) inch above the surrounding ground.
 - 3. In remote non-paved areas such as along creeks, open fields or wooded areas, the top of the casting shall be eighteen (18) inches above finish grade. Place soil around the casting with a maximum slope of 2 feet vertical to 1 foot horizontal to protect the external manhole seal.

3.07 FRAMES AND CHIMNEYS

- A. All manholes shall be constructed with an external frame chimney seal as shown on Standard Drawing 03370-1 and as specified herein.

3.08 GRADE RING LINERS

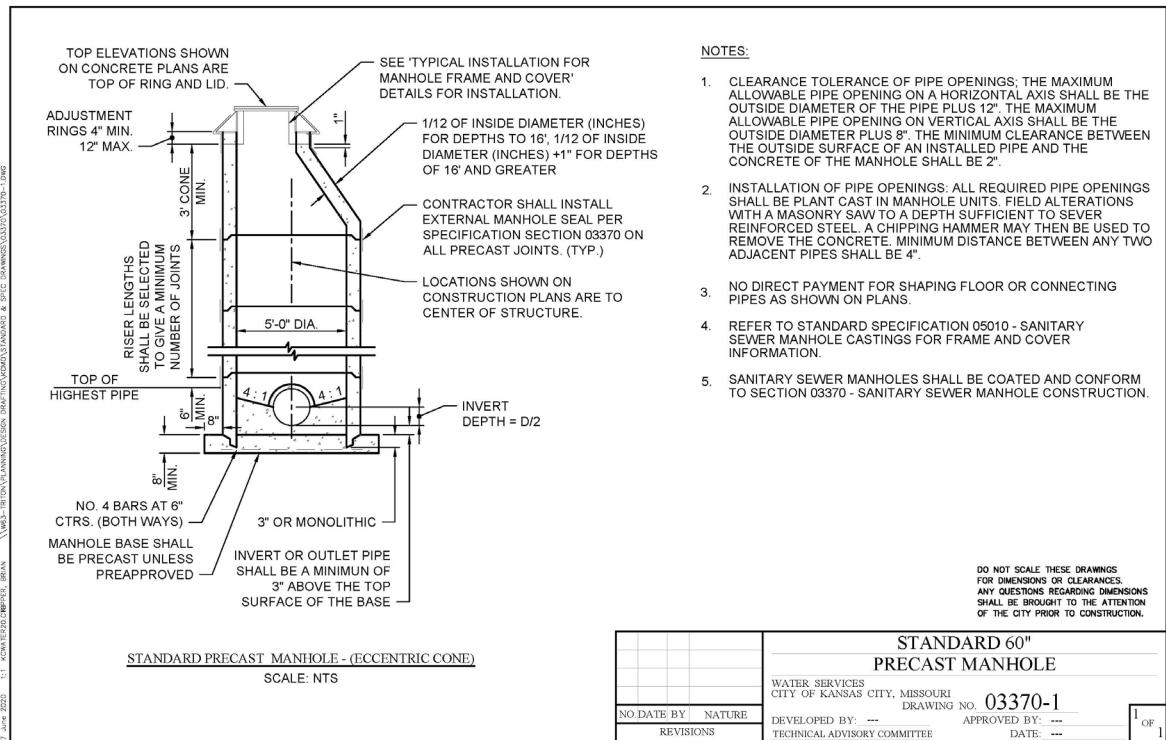
- A. All manholes constructed in paved areas shall be installed with a grade ring liner.

3.09 MANHOLE ADJUSTMENT

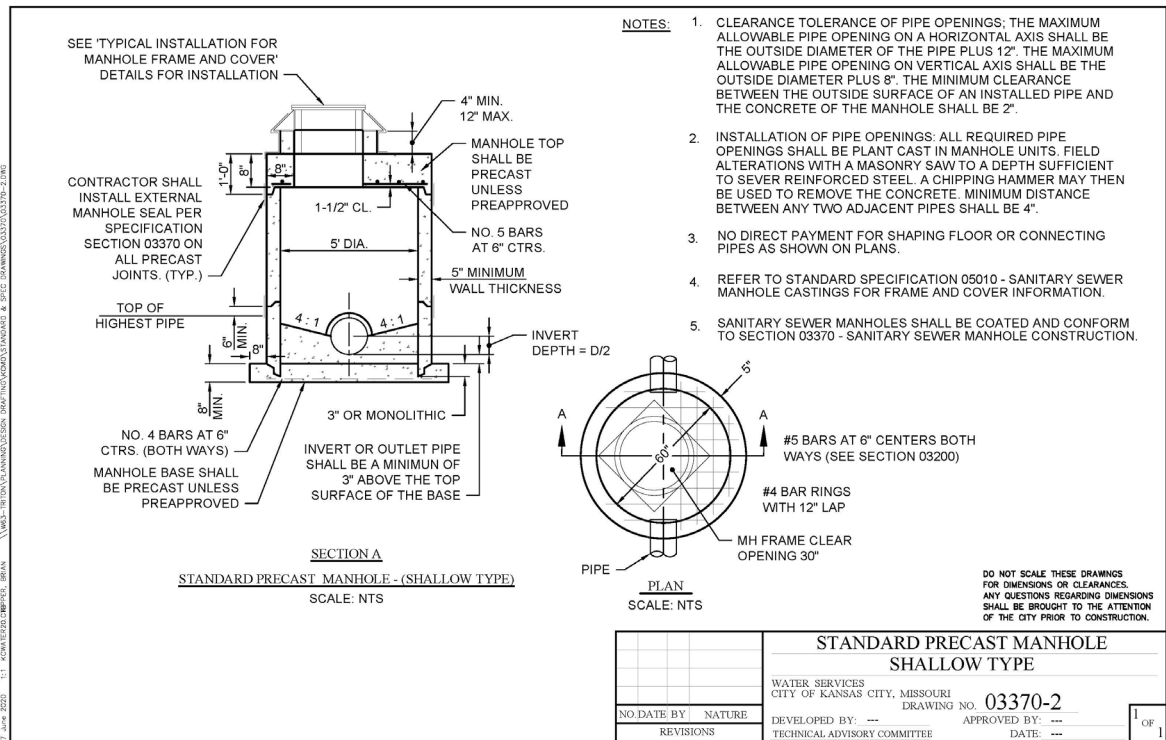
- A. Adjust as shown in Standard Drawing 03370-5.
- B. All manholes will shall be provided with adjustment ring(s) to facilitate adjustment:
 - 1. The manhole shall be provided with adjustment ring. The minimum adjustment for lowering the top of the manhole is 4 inches.
 - 2. The maximum adjustment for raising the top of the manhole is 12 inches.
- C. If the top of an existing manhole is required to be raised to an elevation which will exceed twelve (12) inches or lowered more than the adjustment rings will allow, all vertical adjustments shall be made to the barrel of the manhole.
- D. The joints shall be sealed with a double bead preformed flexible joint sealant as specified in 2.04.

3.10 MANHOLE TESTING.

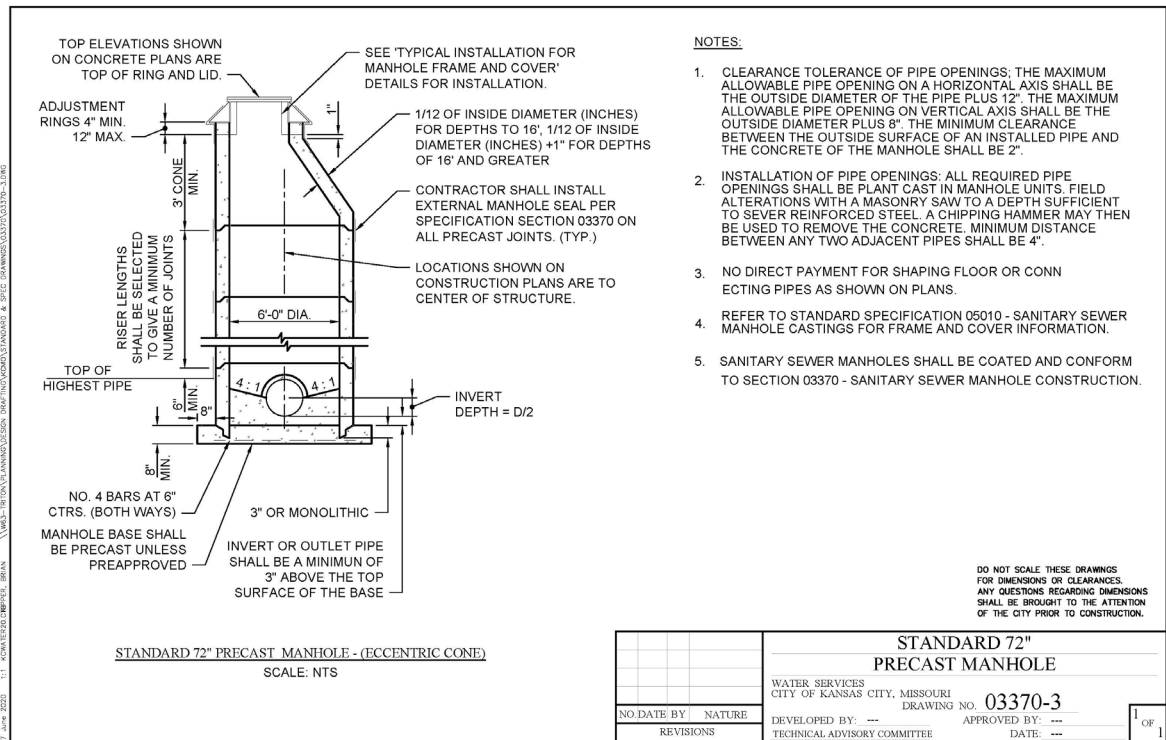
- A. The Contractor shall visually verify the absence of leaks and perform a vacuum test, on manholes that have inlet and outlet pipes of less than 42 inches in diameter, in accordance with Section 02702 -Sewer Pipe and Manhole Testing.



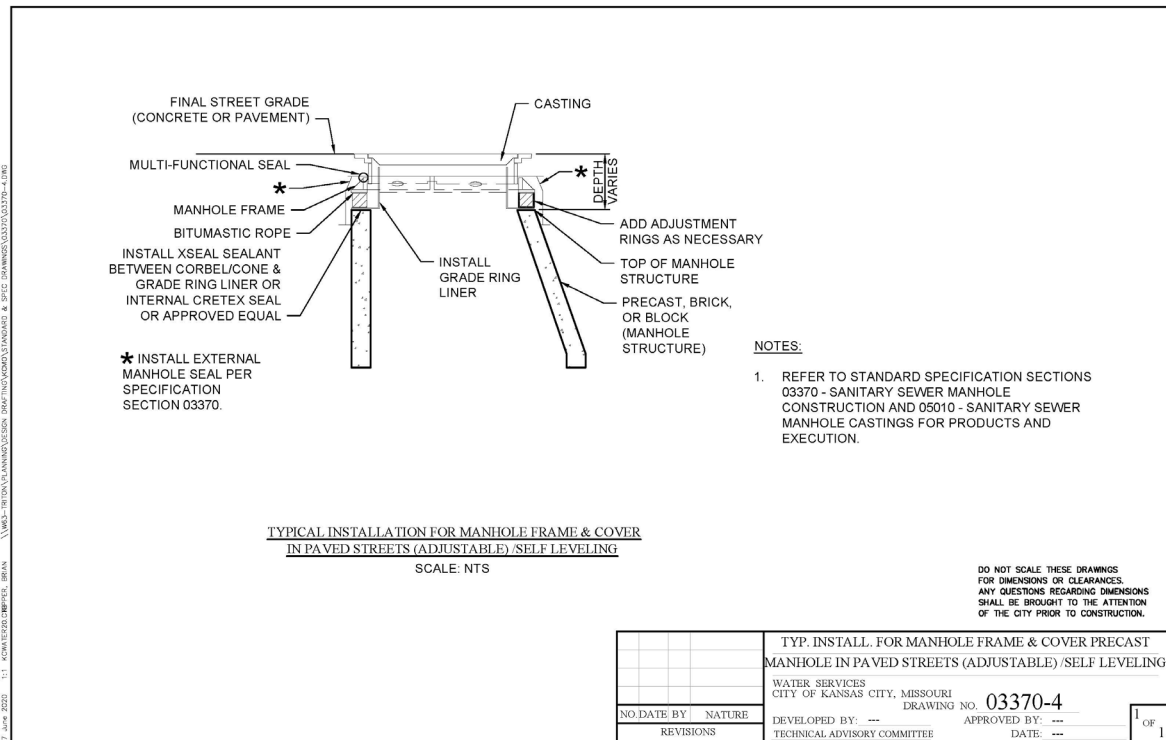
Standard Drawing 03370-1



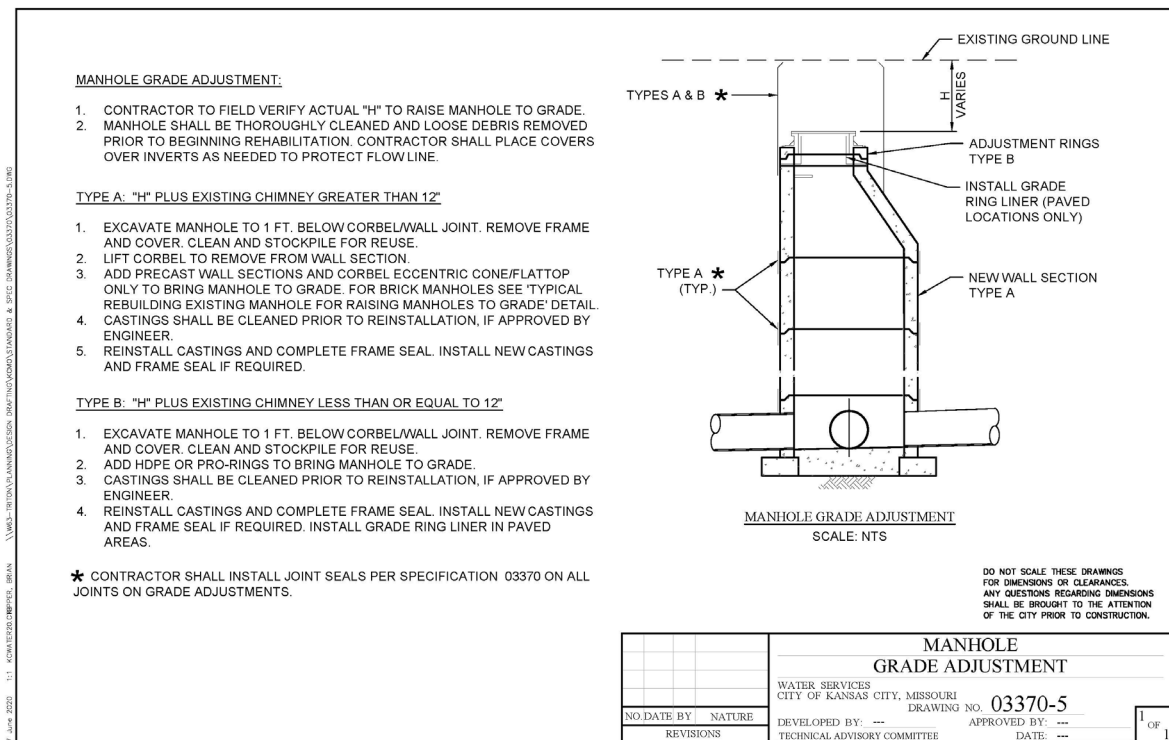
Standard Drawing 03370-2



Standard Drawing 03370-3



Standard Drawing 03370-4



Standard Drawing 03370-5

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