



SECTION 02530
MANHOLES

PART 1. GENERAL

1.01 SCOPE

- A. This specification details the materials, products and performance requirements of sanitary sewer manholes and appurtenances.
- B. See Specification 02547, Manhole Rehabilitation, for manhole rehabilitation requirements.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Cast-in-Place Manholes: Details of construction including concrete mix design and all items cast into manhole.
 - b. Precast Manholes: Details of construction including all precast bases, cones, and top slab sections.
 - c. See Specification 02542 Sewer Flow Control for submittals and requirements.
 - 2. Product Data:
 - a. Manhole frames and covers
 - b. Gaskets, sealants, and external joint wraps
 - c. Anchor bolts
 - d. Hydraulic cement
- B. Informational Submittals:
 - 1. Certificate from manufacturer of castings indicating they meet applicable requirements of these Specifications.
 - 2. Proposed curing method for cast-in-place concrete structures.
 - 3. Precast Manhole Sections: Manufacturer's results of recent testing performed on representative sections to be furnished.
 - 4. Experience Record:
 - a. Precast concrete production capabilities.
 - b. Current PCI plant certification.
 - 5. Recent Test Reports:
 - a. Precast manufacturer's concrete test cylinders.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Precast Concrete and Precast Prestressed Concrete: Product of manufacturer with 3 years experience producing precast concrete products of quality specified.
 - 2. Precast Plant: PCI certified plant with current certification.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacture to prevent damages. Materials shall be made safe from theft, vandalism, and damage.
- B. All products and materials specified herein shall be inspected at the request of OWNER or RESIDENT PROJECT REPRESENTATIVE. All materials that fail to conform to these Specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the CONTRACTOR at no cost to the OWNER.

PART 2. PRODUCTS

2.01 MANHOLE FRAMES AND COVERS

- A. Castings:
 - 1. Shall be cast iron Class 35B ASTM A48/A48M or Ductile Iron ASTM A536, Grade 60-40-12 and conforming to the Standard Drawings; made accurately to the required dimensions; sound, smooth, clean, and free from blisters and other defects; not plugged or otherwise treated to remedy defects; machined so that covers rest securely in the frames with no rocking, and such that they are in contact with frame flanges for the entire perimeter of the contact surfaces.
- B. Covers:
 - 1. In accordance of KUB standard detail.
 - 2. Watertight Cover Gasket: Circular and molded from high-quality rubber such as nitrile or EPDM.
- C. Manufacturers:
 - 1. John Bouchard & Sons Co.
 - 2. Neenah Enterprises Inc. – Neenah Foundry
 - 3. OWNER approved equal

- D. Bolts, nuts, and washers shall be stainless steel, Type 304 and conforming to ASTM F593.

2.02 GRADE RINGS

- A. Concrete grade rings shall be 4 inches or 6 inches in height and in conformance with the Standard Drawings contained within this section and all other applicable sections.
 - 1. Concrete grade rings shall be fabricated in accordance with ASTM C478.
- B. Composite grade rings shall be not less than 0.5-inches or greater than 3-inches in height and in conformance with the Standard Drawings within this section and all other applicable sections.
 - 1. Products and Materials: East Jordan Iron Works; Infra-Riser or approved equivalent.

2.03 MORTAR

- 1. Standard premixed in accordance with ASTM C387/C387M, or proportion one part Portland cement to two parts clean, well-graded sand that will pass a 1/8-inch screen.
- 2. Admixtures: May be included; do not exceed the following percentages of weight of cement:
- 3. Hydrated Lime: 10 percent.
- 4. Diatomaceous Earth or Other Inert Material: 5 percent.
- 5. Mix Consistency:
 - a. Tongue-and-Groove Type Joint: Such that mortar will readily adhere to pipe.
- 6. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove and support is not provided for section being placed.

2.04 HYDRAULIC CEMENT

- A. Rapid setting, fiber-reinforced, high-early-strength, corrosion-resistant material formulated for filling voids and repairing inverts in concrete, brick, or other masonry constructed structures
- B. Manufacturers and Products:
 - 1. Strong Systems, Inc; Strong-Seal QSR.
 - 2. Quadex; Hyperform.
 - 3. Improved Construction Methods (ICM); ThoRoc Patch.
 - 4. IPA; Octocrete.

2.05 BUTYL MASTIC SEALANT

- A. The sealant shall be used when joining the casting frame to the precast manhole and for all manhole adjustments to provide a watertight structure. The sealing compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes, or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space. Use two complete ropes at each joint. The sealing compound shall be protected by a suitable removable two-piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. The sealant shall also meet the requirements of the following table:

Composition	Test Method	Minimum	Maximum
Bitumen (Petroleum Plastic Content)	ASTM D4	50	70
Ash Inert Mineral Matter	AASHTO T11	30	50
Volatile Matter	ASTM D6	---	2.0
Property	Test Method	Minimum	Maximum
Specific Gravity at 77 degrees F	ASTM D71	1.2	1.3
Ductility at 77 degrees F(cm)	ASTM D113	5.0	---
Softening Point	ASTM D36	320 degrees F	---
Penetration 77 degrees F (150 gms) 5 sec.	ASTM D217	50	120

2.06 PRECAST MANHOLES

- A. All components shall meet the requirements of the Standard Drawings and ASTM C478.
- B. Cement shall meet requirements of ASTM C150/C150M with a minimum 7 day compressive strength of 4,000 psi.
- C. Concrete mix design shall include Xypex C-500 or C-1000 based upon mix design at dosage recommended by manufacturer for installation.

- D. The circumferential reinforcement for the manhole sections shall consist of welded wire fabric per ASTM C478.
- E. Manholes shall be constructed with the minimum number of sections possible that the precaster can provide, to minimize the number of joints in the manhole. Minimum manhole section shall be 16 inches deep.
- F. Lifting holes through the manhole structure shall not be permitted.
- G. Each joint shall be a tongue and groove with two layers of butyl mastic sealant.
- H. Polypropylene Steps:
 - 1. Fabricate from minimum 1/2 inch, Grade 60, steel bar meeting ASTM A615/A615M.
 - 2. Polypropylene encasement shall conform to ASTM D4101.
 - 3. Minimum Width: 13 inches, center-to-center of legs.
 - 4. Embedment: 3-1/2-inch minimum and 4-1/2-inch minimum projection from face of concrete at point of embedment to center of step.
 - 5. Cast in manhole sections by manufacturer.
 - 6. Load Test: Capable of withstanding ASTM C478 vertical and horizontal load tests.
- I. Manhole Pipe Connections
 - 1. A-LOK Products, Inc: A-LOK or Z-LOK flexible connectors
 - 2. Trelleborg: Kor-N-Seal flexible connector
- J. Channels and benches in precast manholes shall be factory grouted only. There shall be no field grouting of channels or benches.

2.07 FIBERGLASS MANHOLES

- A. Manholes shall be one piece units manufactured from commercial grade resins and Grade E glass reinforcement. The inner surface shall be resin rich, free of crazing and delamination. Maximum blister shall be 1/2 inch in diameter, and the maximum wrinkle depth shall be 1/8 inch. Maximum surface pits shall be 3/4 inch in diameter and 1/16 inch deep. Voids which cannot be broken with finger pressure can be a maximum of 1/2 inch in diameter and 1/16-inch deep.
- B. Manholes shall meet the following ASTM requirements:
 - 1. 16,000 foot-pound dynamic load rating, ASTM 3753, 8.5, Note 1.
 - 2. ASTM 3753, 8.5, Note 1 for Pipe Stiffness:

Manhole Length	PSI
3'-6'	0.72
7'-12'	1.26

Manhole Length	PSI
3'-6'	0.72
13'-20'	2.01
21'-25'	3.02
26'-35'	5.24

3. Structural Capacities:
 - a. Tensile Strength (psi): 18,000 hoop; 5,000 axial.
 - b. Tensile Modulus (psi): 600,000 hoop; 700,000 axial.
 - c. Flexural Strength (psi): 26,000 hoop; 4,500 axial.
 - d. Flexural Modulus (psi): 1,400,000 hoop; 700,000 axial.
 - e. Compression Strength (psi): 18,000 hoop; 10,000 axial.

2.08 CAST-IN-PLACE MANHOLES

- A. Construct cast-in-place manholes according to the requirements shown in the Project Drawings and in accordance with appropriate specifications governing concrete, concrete formwork, and concrete reinforcement contained in the specification documents.
- B. Wherever water is encountered at the construction site, CONTRACTOR shall eliminate ground water influence to prevent any movement of water into fresh concrete of cast-in-place manholes.

2.09 MANHOLE LINING

- A. Lining for manholes, as specified on the drawings or requested by the OWNER, shall be HDPE (studded) liner as manufactured by AGRU, or PVC Duraplate 100 Liner System as manufactured by ALOK.
 1. HDPE Liner:
 - a. Sheets shall be studded and have a minimum design thickness of 2 mm (0.079 inch).
 - b. Provide minimum of 39 anchoring studs per square foot of liner.
 - 1) Minimum Stud Height: Minimum 9 mm (0.39 inch) with a minimum length of 14 mm (0.55 inch).
 - 2) Capable of resisting continuous hydraulic backpressure, to a minimum of 40 feet of hydraulic head, exerted between interior wall of concrete structure and anchoring stud side of protective liner.
 2. PVC Liner, Channel Joints, H-joints and Corner Joints:
 - a. Manufactured from polyvinyl chloride resin.
 - b. White in color to assist in providing a light reflective environment.

- c. All sheet compounds shall result in a semi-rigid material for thermoforming to the contour of the structure and shall maintain a minimum wall thickness of 1.7mm (0.065 inch).
 - 3. Lined manholes shall have a flat top that is lined with same type of protective liner as manhole.
 - 4. Provide a rubber gasket between structures for a watertight seal. Gasket shall be DURA-Plate-Lok-Sealant MT-320 measuring 0.5 inch by 1.5 inches to be placed on the return. When the two sections are coupled, the butyl-lok will displace over the return on the bell and tongue ends of the liner.
- B. Linings shall be installed by certified lining manhole precaster, while constructing the manhole, in strict conformance with the manufacturer's requirements.

2.10 MANHOLE EXTERNAL JOINT SEALS

- A. External joint seal shall be made of EPDM rubber with a minimum thickness of 65 mils. Each unit shall have a 2-inch wide mastic strip on the top and bottom edge of the rubber wrap. The mastic shall be nonhardening butyl rubber sealant, with a minimum thickness of 250 mils.
- B. Manufacturer and Products:
 - 1. Sealing Systems, Inc., Loretto, MN; Gator Wrap.
 - 2. Henry Company, Houston, TX; RU116 Rubr-Nek External Joint Wrap.
 - 3. Trelleborg Engineered Solutions, Park Hills, MO; NPC External Joint Wrap.
 - 4. Cretex Specialty Products, Waukesha, WI; Cretex Wrap.

PART 3. EXECUTION

3.01 GENERAL

- A. Locate existing manholes not visible at the surface using metal detectors or other means of detection.
- B. Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation.
- C. Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well-graded granular material, by tightening with coarse rock, or by such other means as provided for foundation preparation of the connected sewers or as directed by the OWNER.
- D. Unless otherwise noted on the project drawings, a minimum drop of 0.1 foot shall be provided across new manholes.

- E. Mortar joints of manholes to be lined with a spray liner
 - 1. Thoroughly wet joint with water prior to placing mortar.
 - 2. Place mortar on groove of lower section prior to section installation.
 - 3. Fill joint completely with mortar of proper consistency.
 - 4. Trowel interior and exterior surfaces smooth on standard tongue-and-groove joint.
 - 5. Prevent mortar from drying out and cure by applying approved curing compound or comparable approved method.
 - 6. Do not use mortar mixed for longer than 30 minutes.
 - 7. Chip out and replace cracked or defective mortar.
 - 8. Completed Manhole: Rigid and watertight.

3.02 MANHOLES PIPE CONNECTIONS

- A. New Precast Concrete Manhole Connections:
 - 1. Manhole connections to newly installed pipe shall be with A-LOK cast-in-place gaskets or Z-LOK cast-in-place boot connectors
 - a. Z-LOK cast-in-place boot connector shall be used for all pipes connections to new precast concrete manholes with slopes in excess of 18% and less than 45%.
 - b. Pipe connections shall be installed in accordance with the manufacture's recommendations. If required, on the interior of the manhole, mortar only the bottom ½ of pipe when installing the manhole invert.
 - 2. Manhole connections to existing pipes and to existing cured-in-place pipe shall be with Kor-N-SEAL flexible connectors. Proper torque shall be applied to Kor-N-SEAL flexible connectors with a torque wrench per manufacturer's specifications.
 - a. Existing pipes shall be tied-in using a pipe stub extension (minimum 4-foot length) from the newly installed manhole with a steel shielded transition coupling as specified in Section 02532, Sanitary Sewers.

3.03 MANHOLE DIAMETERS

- A. Unless otherwise noted on the drawings, the internal diameter of manholes shall be 4 feet for lines less than 18 inches in size. Lines from 18 inches to 24 inches shall have 5-foot diameter manholes, and lines larger than 24 inches shall have 6-foot diameter manholes.
- B. Manhole diameter sizing, however, is contingent upon limitations of manufacturer due to the number of pipes, pipe locations, pipe diameters and pipe deflections at manhole. CONTRACTOR shall verify proper manhole diameter is provided based on proposed manhole pipe configuration and pipe sizes indicated. Manhole sizing shall be approved by the OWNER.

3.04 MANHOLE ADJUSTMENTS

- A. Manholes shall be adjusted to the final grade in a watertight manner with no more than two grade rings. Two rings of butyl mastic sealant shall be used for all grade rings unless the manufacturer recommends otherwise.
- B. Manholes in non-traffic areas requiring adjustments between 0.5 and 3 inches may be adjusted with a composite material grade ring. Composite grade rings shall be installed in accordance with the manufacturer's instructions.
- C. Testing must be repeated following any manhole adjustments.

3.05 DROP MANHOLES

- A. Where the difference in invert elevation of two intersecting sewers in a manhole is 2 feet or more, a drop connection shall be constructed unless otherwise noted on the design drawings or approved by the OWNER.
- B. Drop connections shall be external to the manhole and be precast or field fabricated with pipe and fittings that comply with applicable mainline sewer pipe material specifications. The fabricated drop assembly shall be constructed in accordance with the standard detail and Project Drawings.
- C. Use of internal manhole drop connections shall be indicated on the Project Drawings or directed and approved by the OWNER.

3.06 FRAMES AND COVERS

- A. Frames and covers shall be set at the required elevation and properly bonded to the masonry with two rings of butyl mastic sealant and stainless-steel anchor bolts. Grout shall be placed around the frame to manhole joint connection.
- B. Manhole rim elevations shall be set at grade in traffic and finished landscaped areas. In non-traffic and non-landscaped areas the manhole rim elevation shall be set at 2 feet or more above finished grade.
- C. In paved areas, the top surface of the frame and cover shall conform to the exact slope, crown, and grade of the existing adjacent pavement.
- D. Watertight Frames and Covers
 - 1. Shall be installed on manholes noted on the drawings or at the request of the OWNER in accordance with KUB's standard detail.
 - 2. A hinged cover with a 90-degree blocking system to prevent accidental closure shall be installed on manholes elevated more than 12-inches above finished grade.

3.07 MANHOLE ABANDONMENT PROCEDURES

- A. Brick and mortar pipe openings inside manhole, including drop connections and laterals.
- B. Remove the manhole frame, cover, and grade rings. Remove precast cones and risers if they are exposed. Proper disposal to be off site by the CONTRACTOR.
- C. Fill abandoned manholes with backfill material as specified in Section 02321, Excavation, Bedding, and Backfill for Utilities unless otherwise indicated on the Project Drawings or directed by the OWNER.

3.08 EXTERNAL JOINT SEALS

- A. External joint seals shall be installed on all new manholes to prevent infiltration by providing a water-tight seal.
- B. Install in accordance with manufacturer's instructions.

3.09 CHIMNEY LINER

- A. Refer to Section 02547, Manhole Rehabilitation.

3.10 BYPASS PUMPING

- A. A. By-pass pumping shall be conducted in accordance with Section 02540, Sewer Flow Control, and other requirements of the OWNER or regulatory agency having jurisdiction. The most stringent requirements shall apply.

3.11 MANHOLE VACUUM TESTING

- A. All manholes shall be negative air pressure (vacuum) tested in accordance with ASTM C1244.
- B. The complete manhole including the frame and cover assembly shall be installed prior to testing. The testing system shall be equipped with an inflatable bladder to effect the seal to the manhole, an air pressure gauge, a safety valve for filling the bladder, a 30-inch Hg liquid-filled vacuum gauge, a double air exhaust manifold with quarter turn ball valves, three bolt-on feet, and a bridge assembly with height adjustment rod.
- C. The CONTRACTOR shall plug all pipe openings, taking care to securely brace the plugs and the pipe. The plugs shall be placed a minimum of 6" beyond the manhole wall.

- D. The vacuum tester shall be placed on the manhole casting and operated in accordance with the manufacture's recommendation to evacuate the manhole to 10" Hg and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1" Hg over the specified time period, the manhole is considered acceptable and passes the test. If the manhole fails the test, identify the leaking areas by removing the head assembly, coating the interior surfaces of the manhole with a soap and water solution, and repeating the vacuum test for approximately thirty seconds. Once the leaks have been identified, complete all necessary repairs with an OWNER approved method, and repeat test procedures until satisfactory results are obtained.

- E. Upon the approval of the OWNER, the CONTRACTOR may test manholes 72-inches and greater in diameter at a reduced negative pressure.

- F. The OWNER reserves the right to reject any and all manholes that do not pass vacuum testing requirements, and replacement shall be at the CONTRACTOR's expense.

VACUUM TEST TIMETABLE			
Manhole Diameter - Inches			
Depth - Feet	48"	60"	72"
4'	10 sec.	13 sec.	16 sec.
6'	15 sec.	20 sec.	25 sec.
8'	20 sec.	26 sec.	32 sec.
10'	25 sec.	33 sec.	41 sec.
12'	30 sec.	39 sec.	48 sec.
14'	35 sec.	46 sec.	57 sec.
16'	40 sec.	52 sec.	64 sec.
18'	45 sec.	59 sec.	73 sec.
20'	50 sec.	65 sec.	80 sec.
22'	55 sec.	72 sec.	89 sec.
24'	60 sec.	78 sec.	97 sec.
26'	64 sec.	85 sec.	105 sec.
28'	69 sec.	91 sec.	113 sec.
30'	74 sec.	98 sec.	121 sec.

END OF SECTION