

SECTION 33 05 13 MANHOLES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): M198, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
2. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A48/A48M, Standard Specification for Gray Iron Castings.
 - c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - d. A536, Standard Specification for Ductile Iron Castings.
 - e. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - f. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
 - g. C14, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
 - h. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - i. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - j. C150/C150M, Standard Specification for Portland Cement.
 - k. C192/C192M, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
 - l. C387/C387M, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
 - m. C443, Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
 - n. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - o. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
 - p. C990, Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants.
 - q. C1311, Standard Specification for Solvent Release Sealants.

- r. C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
- s. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- t. D4101, Standard Specification for Propylene Injection and Extrusion Materials.
- u. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- v. F594, Standard Specification for Stainless Steel Nuts.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings including details of construction, reinforcing and joints, anchors, lifting, external straps, erection inserts, and other items cast into members.
- 2. Product Data:
 - a. Concrete mix design.
 - b. Manhole frame to structure seals.
 - c. Manhole frame to structure anchor bolt.
 - d. Rubber gaskets and sealants.
 - e. External joint wrap.

B. Informational Submittals:

- 1. Experience Record:
 - a. Precast concrete production capabilities.
 - b. Evidence of current PCI plant certification.
- 2. Calculations: Proposed details and design calculations for stresses in precast concrete members for loading conditions including earth pressures and transportation, handling, and erection. Calculations shall be stamped by engineer registered in the same state as the Project.
- 3. Certificate of Compliance: Certify admixtures and concrete do not contain calcium chloride.
- 4. Test Reports: Precast manufacturer's concrete test cylinders.
- 5. Manufacturer's recommended installation instructions.
- 6. Field quality control report.

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.

PART 2 PRODUCTS

2.01 GENERAL

A. Characteristics listed below cover the materials of construction and service conditions for manholes:

1. Physical Characteristics:
 - a. Structures:
 - 1) Ring: Custom made with openings to meet indicated pipe alignment conditions and invert elevations.
 - 2) Floor: Minimum 4 inches below pipe to provide clearance for grouting channels.
 - 3) Joint:
 - a) Form joint contact services with machined castings.
 - b) Surfaces shall be parallel with nominal 1/16-inch clearing and tongue equipped with recess for installation of O-ring rubber gasket.
2. Functional Characteristics:
 - a. Gaskets:
 - 1) Internal and external seals shall be made of materials that have been proven to be resistant to the following exposures and conditions:
 - a) Sanitary sewage.
 - b) Corrosion or rotting under wet or dry conditions.
 - c) Gaseous environment in sanitary sewers and at road surfaces including common levels of ozone, carbon monoxide, and other trace gases at installation site.
 - d) Biological environment in soils and sanitary sewers.
 - e) Chemical attack by road salts, road oil, and common street spillages or solvents used in street construction or maintenance.
 - f) Temperature ranges, variations, and gradients in construction area.
 - g) Variations in moisture conditions and humidity.
 - h) Fatigue failure caused by a minimum of 30 freeze-thaw cycles per year.

- i) Vibrations because of traffic loading.
 - j) Fatigue failure because of repeated variations of tensile, compressive and shear stresses, and repeated elongation and compression. Material shall remain flexible allowing repeated movement.
- 3. Performance Characteristics:
 - a. General:
 - 1) Materials shall be compatible with each other and manhole materials.
 - 2) Designed to provide a 20-year service life.
 - b. Screws, Bolts, or Nuts: Type 304 stainless steel conforming to ASTM F593 and ASTM F594.
 - c. Structures:
 - 1) Shall meet requirements of ASTM C478, this specification and the following.
 - a) Loading: AASHTO HS-20.
 - b) Design: In accordance with ACI 301.
 - 2) Concrete:
 - a) Cement: Meet requirements of ASTM C150/C150M.
 - b) Compressive strength:
 - (1) Minimum 4,000 psi.
 - (2) Minimum strength shall be confirmed at 7 days by making two standard cylinders per manhole for testing.
 - c) Water/Cement Ratio by Weight:
 - (1) 0.5 maximum.
 - (2) 0.56 maximum, with addition of water reducing agent (in accordance with ASTM 494, Type A).
 - d) Reinforcement: Grade 60, unless otherwise specified.
 - e) Gasket: Meet requirements of ASTM C443.

2.02 PRECAST MANHOLES

A. Manufacturers and Products:

- 1. Joint Seal Manufacturers and Products:
 - a. Butyl Gaskets:
 - 1) Hamilton Kent, Sparks, NV; Kent-Seal No. 2.
 - 2) Or equal.
 - b. Confined Plastic or Rubber O-Ring:
 - 1) As recommended by precasting manufacturer.
 - 2) Meet requirements of ASTM C443.
 - c. External Wrap:
 - 1) Henry Company, Houston, TX; RU116 Rubr-Nek External Joint Wrap.
 - 2) Or equal.

B. Physical Characteristics:

1. Riser Sections:
 - a. Fabricate in accordance with ASTM C478.
 - b. Diameter: Minimum 36 inches.
 - c. Wall Thickness: Minimum 4 inches or 1/12 times inside diameter, whichever is greater.
 - d. Top and bottom surfaces shall be parallel.
 - e. Joints: O-ring with rubber gaskets meeting ASTM C443.
2. Cone Sections:
 - a. Eccentric.
 - b. Same wall thickness and reinforcement as riser section.
 - c. Top and bottom surfaces shall be parallel.
3. Base Sections and Base Slab:
 - a. Base slab integral with sidewalls.
 - b. Fabricate in accordance with ASTM C478.
4. Manhole Extensions:
 - a. Concrete grade rings; maximum 6 inches high.
 - b. Fabricate in accordance with ASTM C478.
5. Joint Seal Suppliers and Products:
 - a. Butyl Gaskets:
 - 1) Butyl rubber with dense polymer structure.
 - 2) Tacky outer surface.
 - 3) Flexible rope.
 - b. Confined Plastic or Rubber O-Ring: as recommended by precast manufacturer.
 - c. External Wrap:
 - 1) EPDM Rubber.
 - 2) Non-hardening butyl adhesive.

C. Functional Characteristics: None.

D. Performance Characteristics:

1. Riser Sections: Fabricate in accordance with ASTM C478.
2. Base Sections and Base Slab: Fabricate in accordance with ASTM C478.
3. Manhole Extensions: Fabricate in accordance with ASTM C478.
4. Joint Seal:
 - a. Butyl Gasket:
 - 1) Conforms to ASTM C990 and AASHTO M-198.
 - 2) Resists vapor permeation through the joint.
 - 3) Highly compressible, adhesive.
 - 4) Temperature and aging resistant.

- b. Confined Plastic or Rubber O-Ring:
 - 1) As recommended by precast manufacturer.
 - 2) Meet requirements of ASTM C443.
- c. External Wrap:
 - 1) Provides a water tight seal around manhole, catch basin, or concrete pipe joint.
 - 2) Meets requirements of ASTM C877, Type III and ASTM C923.

2.03 CAST-IN-PLACE MANHOLES

- A. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.
- B. Reinforcing Steel: As specified in Section 03 21 00, Steel Reinforcement.

2.04 MANHOLE FRAMES AND COVER

- A. Physical Characteristics: Plane or grind bearing surfaces to ensure flat, true surfaces.
 - 1. Castings:
 - 2. Cover: Contracting Officer's Standard. True and seat within ring at all points. With the word SEWER, STORM, or DRAIN in 2-inch raised letters.
- B. Functional Characteristics:
 - 1. Castings:
 - a. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
 - b. Cast Iron: ASTM A48/A48M Class 35B.
 - c. Ductile Iron: ASTM A536, Grade 60-40-12.
 - 2. Capscrews for Watertight Covers: High temper phosphor bronze with 60,000 psi minimum tensile strength meeting ASTM B139/B139M.
 - 3. Watertight Cover Gasket: Molded from high-quality rubber such as nitrile or EPDM.
- C. Performance Characteristics: None.

2.05 MANHOLE FRAME CONNECTION TO STRUCTURE

A. Manufacturers and Products:

1. Butyl Sealant:
 - a. Tremco Commercial Sealants and Waterproofing, Beachwood, OH; Tremco Butyl Sealant.
 - b. Or equal.
2. External Wrap:
 - a. Sealing Systems, Inc., Loretto, MN; Infi-Shield.
 - b. Or equal.
3. Internal Wrap or Sealing Membrane:
 - a. Sealing Systems, Inc., Loretto, MN; Flex-Seal Utility Sealant.
 - b. Or equal.
4. Frame to Structure Anchor Bolts:
 - a. Hilti; HVA Capsules Adhesive Anchoring System.
 - b. Or equal.

B. Physical Characteristics:

1. Butyl Sealant: Trowelable or cartridge applied.
2. External Wrap:
 - a. Thickness: minimum 60 mils.
 - b. Consist of a top and bottom section and be sealed to structure, frame top, and bottom with mastic as applicable.
 - c. Length: Extend from manhole frame and extension ring to cone section.
 - d. Bands: If required, constructed of minimum 16-gauge sheet of channeled, or 5/16-inch diameter if round.
3. Internal Wrap or Sealing Membrane:
 - a. Minimum internal thickness of 3/16 inch or as recommended by manufacturer for installation climate.
 - b. Width: Minimum 8 inches.
 - c. Bands: If required, constructed of minimum 16-gauge sheet if channeled, or 5/16-inch diameter if round.
 - d. Wrap shall not restrict access to manhole.
4. Frame to Structure Anchor Bolts: 3/4-inch-diameter HAS stainless steel bolts; minimum 6-5/8-inch embedment.

C. Functional Characteristics: None.

D. Performance Characteristics:

1. Butyl Sealant: Conform to ASTM C1311, or AASHTO M198 and ASTM C990.
2. External Wrap:
 - a. Meet requirements of ASTM C923.
 - b. Construct of high-quality rubber that will provide flexible watertight seal around joint.
3. Internal Wrap or Sealing Membrane:
 - a. Meet requirements of ASTM C923.
 - b. Designed for application and have a demonstrated history of accommodating differential expansion between frame and concrete.
 - c. Expansive type wraps shall be fabricated of high-quality rubber or urethane.

2.06 MORTAR

- A. 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.
- B. Admixtures:
 1. May be included; do not exceed the following percentages of weight of cement:
 - a. Hydrated Lime: 10 percent.
 - b. Diatomaceous Earth or Other Inert Material: 5 percent.
- C. Mix Consistency:
 1. Tongue-and-Groove Type Joint: Such that mortar will readily adhere to pipe.
 2. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove and support is not provided for section being placed.

2.07 BACKFILL AROUND AND UNDER MANHOLE

- A. Structural fill as specified in Section 31 23 23, Fill and Backfill.

2.08 FLEXIBLE JOINTS FOR SEALING PIPES IN MANHOLE

A. Manufacturers and Products:

1. General:
 - a. NPC, Inc., Milford, New Hampshire; Kor-N-Seal flexible rubber boot with stainless steel accessories.
 - b. Or equal.
2. Doghouse Manhole/Manhole Over Existing Pipe (where use of a boot is not possible):
 - a. Green Streak; hydrophilic waterstop CJ-0725-3k.
 - b. Or equal.

B. Physical Characteristics:

1. Stainless steel pipe clamp.
2. Reinforced nylon wedge or cast wedge.
3. EPDM or polyisoprene rubber connector.

C. Functional Characteristics: None.

D. Performance Characteristics: Conforms to ASTM C923 and ASTM A167.

2.09 SOURCE QUALITY CONTROL

A. Prior to delivery of precast manhole sections to Site, yard permeability tests may be required at point of manufacture. Contracting Officer will select precast sections not to exceed 5 percent of the total Project quantity to test from material which is to be supplied to Project. Test specimens shall be mat tested and meet permeability test requirements of ASTM C14.

B. Concrete Testing: Test two concrete test cylinders for each manhole. Compressive strength shall be tested in accordance with ASTM C31/C31M, ASTM C39/C39M, and ASTM C192/C192M.

C. Inspection:

1. Material Quality:
 - a. Manufacturing process and finished sections shall be subject to inspection and approval by Contracting Officer.
 - 1) Inspections may take place at manufacturer's plant, at Site after delivery, or at both.
 - 2) Sections not meeting requirements of this specification or that are determined to have defects which may affect durability of structure are subject to rejection.
 - 3) Sections rejected after delivery shall be removed and replaced.

- 4) Sections damaged after delivery will be rejected and if already installed shall be repaired to satisfaction of Contracting Officer.
 - 5) If structure cannot be repaired it shall be removed and replaced entirely at Contractor's expense.
2. At the time of inspection the sections will be carefully examined for compliance with ASTM C478 and with manufacturer's drawings. Sections will be inspected for general appearance, dimensions, scratch strength, blisters, cracks, roughness, and soundness. Surface shall be dense and close textured.
3. Imperfections may be repaired, subject to approval of Contracting Officer, after demonstration by manufacturer that strong and permanent repairs result.

PART 3 EXECUTION

3.01 GENERAL

- A. Prior to installation inspect materials:
 1. Sections not meeting requirements of this specification or that are determined to have defects which may affect durability of structure are subject to rejection.
 2. Sections damaged after delivery will be rejected and if already installed shall be repaired to satisfaction of Contracting Officer.
 3. Remove and replace structure that cannot be repaired.
- B. If needed, dewater excavation during construction and testing operations.

3.02 EXCAVATION AND BACKFILL

- A. Excavation: As specified in Section 31 23 16, Excavation.
- B. Backfill: As specified in Section 31 23 23, Fill and Backfill.

3.03 INSTALLATION OF PRECAST MANHOLES

- A. Concrete Base:
 1. Precast:
 - a. Place on compacted structural fill.
 - b. Properly locate, ensure firm bearing throughout, and plumb first section.
 2. Cast-in-Place:
 - a. Invert: Minimum 8 inches below lowest connecting pipe.
 - b. First section of manhole shall be cast in concrete base.

B. Sections:

1. Inspect precast manhole sections to be joined.
2. Clean ends of sections to be joined.
3. Do not use sections with chips or cracks in tongue.

C. Preformed Plastic Gaskets or Rubber O-Ring:

1. Use only pipe primer furnished by gasket manufacturer.
2. Install gasket material in accordance with manufacturer's instructions.
3. Completed Manhole: Rigid and watertight.

D. External Joint Wraps: Install in accordance with manufacturer's instructions.

E. Extensions:

1. Provide on manholes in streets or other locations where change in existing grade may be likely.
2. Install to height not exceeding 12 inches.
3. Lay grade rings in mortar with sides plumb and tops level.
4. Seal joints with mortar as specified for sections and make watertight.

3.04 MANHOLE INVERT

- A. Construct with smooth transitions to ensure unobstructed flow through manhole. Remove sharp edges or rough sections that tend to obstruct flow.
- B. Where full section of pipe is laid through manhole, break out top section and cover exposed edge of pipe completely with mortar. Trowel mortar surfaces smooth.

3.05 MANHOLE FRAMES AND COVERS

- A. Install concrete grade rings as required to set covers flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.
- B. Set frames in three equally spaced beads of butyl sealant that run full circumference of frame.
- C. Anchor frame to manhole with specified bolts.
- D. Install interior manhole frame to structure seals in accordance with manufacturer's instructions. Seal shall cover grade rings.

3.06 CAST-IN-PLACE MANHOLE

- A. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.
- B. Reinforcing Steel: As specified in Section 03 21 00, Steel Reinforcement.

3.07 MANHOLE PIPING

- A. Drop Assembly: See the Drawings for detail of installation requirements.
- B. Flexible Joints:
 - 1. Provide in pipe not more than 1-1/2 feet from manhole walls.
 - 2. Where last joint of pipe is between 1-1/2 feet and 6 feet from manhole wall, provide flexible joint in manhole wall.
- C. Stubouts for Future Connections:
 - 1. Provide same type and class of pipe as specified for use in service connection, lateral, main, or trunk sewer construction. Where there are two different classes of pipe at manhole use higher strength pipe.
 - 2. Grout pipe in precast walls or manhole base to provide watertight seal or use flexible joints as specified herein.
 - 3. Maximum Length: 1-1/2 feet outside manhole wall.
 - 4. Construct invert channels as shown.
 - 5. Test Plugs:
 - a. Install rubber-gasketed plugs in end of stubouts with gasket joints similar to sewer pipe being used.
 - b. Plugs shall withstand internal or external pressures without leakage.
 - c. Adequately brace plugs against hydrostatic or air test pressures.
- D. Permanent Plugs:
 - 1. Clean interior contact surfaces of pipes to be cut off or abandoned as shown, and construct plug as follows:
 - a. Pipe 18 Inches or Less in Diameter: Concrete plug in end, minimum 2 feet long.
 - b. Pipe 20 Inches and Larger: Concrete plug in end, minimum 4 feet long.
 - c. Plugs shall be watertight and capable of withstanding internal and external pressures without leakage.

3.08 MANHOLES OVER EXISTING PIPING

- A. Maintain flow through existing pipelines at all times.
- B. Concrete Pipe: Apply bonding agent on surfaces in contact with concrete.
- C. Construct base under existing piping.
- D. Where indicated on the Drawings, place doghouse manhole on existing base. Construct manhole as detailed on the Drawings.
- E. Apply minimum of two complete wraps of hydrophilic waterstop centered on pipe in wall.
- F. Place a minimum of 24 inches of concrete around each pipe penetration outside manhole against undisturbed soil or compacted aggregate unless otherwise detailed.
- G. Grout channel through manhole.
- H. Saw cut out or demolish existing pipe within new manhole using method approved by Contracting Officer.
- I. Protect new concrete or grout for 7 days after placing concrete.

3.09 CONNECTIONS TO EXISTING MANHOLES

- A. Core manhole bases and grouting as necessary.
- B. Seal pipe in manhole using flexible connector.
- C. Regrout to provide smooth flow into and through manholes.
- D. Provide diversion facilities and perform work necessary to maintain flow during connection.

3.10 FIELD QUALITY CONTROL

- A. Conduct negative air pressure (vacuum) test on all manholes in accordance with ASTM C1244.
- B. Hydrostatic Testing:
 - 1. When, in Contracting Officer's opinion, groundwater table is too low to permit visual detection of infiltration leaks, hydrostatically test all manholes.
 - 2. Procedure: Plug inlets and outlets and fill manhole with water to height determined by Contracting Officer.

3. Manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into pipe walls to take place.
4. Leakage in each manhole shall not exceed 0.1 gallon per hour per foot of head above invert.
5. Repair manholes that do not meet leakage test, or do not meet specified requirements from visual inspection.
6. If more than 25 percent of manholes tested fail the hydrostatic test, test all or as many manholes as Contracting Officer deems necessary.

END OF SECTION