

**SECTION 803  
SEWER MANHOLES**

**803-1 DESCRIPTION:** This Work consists of removal and disposal of existing manholes, if necessary, and furnishing and constructing new precast concrete sanitary sewer manholes, drop lines, and adjusting existing manholes. Manholes shall be constructed of specified material to the sizes, shapes and dimensions and at the locations and elevations shown on the Drawings. The expectation is that all new manholes will be completely sealed, thereby, eliminating infiltration and exfiltration from the manhole.

**803-2 MATERIALS:**

a. Materials shall conform to the following Sections and Subsections:

Precast Concrete Riser Rings	806-3.1a
Cast Iron Riser Rings	806-3.1b
Stainless Steel Insert	806-3.4
Portland Cement Concrete	1005
Reinforcing Steel	1006-1
Frames and Covers	1011-5
Precast Concrete Manhole Units	1017-2

b. Manhole walls, transitions, conical sections, and base shall conform to the requirements of ASTM C 478 for the depths indicated on the Contract Documents. Conical sections shall be designed to support cast iron frames and covers under an AASHTO HS-20 loading. Axial length of sections shall be selected to provide the correct total height required with the fewest joints.

c. Riser rings shall be precast concrete or cast iron.

1. Concrete riser rings shall be free from cracks, voids and other defects and shall conform to ASTM C 478. Concrete riser rings shall be of a nominal thickness of not less than four (4) inches and not more than six (6) inches for reconstruction and/or adjustment of the manhole frame and cover. Joints shall also be externally wrapped with an external seal wrap as specified in Section 803-4.7.

2. Cast iron riser rings shall conform to the latest edition of AASHTO M306. Cast iron riser rings shall be used for adjustment of the manhole frame and cover of less than four (4) inches. Joints shall also be externally wrapped with an external seal wrap as specified in Section 803-4.7.

d. Manhole joint types may be either tongue and groove, confined groove, or single offset joint, and shall be sealed accordingly with either a flexible soil-tight butyl mastic gasket or flexible watertight rubber gaskets conforming to ASTM C 990 or C 443 respectively.

e. Prior to backfilling, rubber external seal wraps shall be applied to each manhole section joint, riser rings and frame in accordance with Subsection 803-4.7.

f. Conical sections shall be concentric, unless otherwise specified. Where the manhole barrel diameter is greater than 48 inches, a flat slab transition, concentric unless otherwise specified, may be used to transition to 48 inch diameter riser sections. Underside of the transition shall be at least 7 feet above the top of the bench.

g. Sewer pipe to manhole barrel section connections shall be sealed with resilient connectors complying with ASTM C 923. Mechanical devices shall be stainless steel.

h. Concrete manholes shall include the following protective admixtures:

1. Crystalline Waterproofing Additive:

- i. Concrete waterproofing system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete. The system shall cause the concrete to become sealed against the penetration of liquids from any direction, and shall protect the concrete from deterioration due to harsh environmental conditions.
- ii. Crystalline waterproofing additive shall include an approved coloring that will tint the finished concrete as proof of additive. Coloring must be provided by the additive manufacturer.
- iii. Installer of crystalline waterproofing additive shall be approved by the manufacturer or manufacturer's representative in writing.
- iv. Crystalline waterproofing additive shall be added to concrete mix at time of batching, and dosage rates and installation shall be in accordance with manufacturer's recommendations.
- v. Crystalline waterproofing additive shall be as manufactured by Xypex Chemical Corporation or approved equal.

2. Anti-microbial Additive:

- i. Antimicrobial additive shall provide long term prevention of bacterial corrosion if concrete in Microbial Induced Corrosive (MIC) sanitary sewer environments. It shall render the concrete uninhabitable for bacteria growth.
- ii. The liquid antibacterial additive shall be an EPA registered material. Product must include an approved coloring that will tint the finished concrete as proof of additive. Coloring must be provided by the additive manufacturer.
- iii. Installer of anti-microbial additive shall be certified by the manufacturer or manufacturer's representative in writing.
- iv. The additive shall be added into the concrete mix water to insure even distribution throughout the concrete mixture. The amount to be used shall be as recommended by the manufacturer of the antibacterial additive. This amount shall be included in the total water content of the concrete mix design.
- v. The anti-microbial additive shall have successfully demonstrated prevention of MIC in sanitary sewers for ten or more years. Anti-microbial additive shall be as manufactured by Conshield Technologies or approved equal.

Any patching or grout materials used on the interior of the manhole after casting must also include the both admixtures.

- i. All interior surfaces (including benches) of new sanitary sewer manholes at force main entry locations, one manhole upstream and downstream of force main entry locations, and other locations shown in the Drawings, shall be given an interior protective coating in accordance with Section 822.
- j. Cast-iron frames, covers, and riser rings shall be completely coated with an environmentally safe, water-based asphaltic coating which is non-toxic, non-flammable, colorless, and dries to a hard black finish. This coating shall be applied to the casting

prior to the installation of the external seal wrap.

### **803-3 SUBMITTALS:**

- a. Complete product data on all standard manhole bottoms, riser sections (concrete and steel), cone sections, frames and covers, concrete and steel riser rings, rubber boots and external seal wrap shall be submitted.
- b. The precast concrete producer shall submit a mix design for each strength and type of concrete that will be used, regardless of whether listed on the QPL or not. Submitted mix designs shall include the quantity, type, brand and applicable data sheets for all mix design constituents as well as documentation indicating conformance with this specification.
- c. If required by the Contract Documents, the manhole epoxy liner system manufacturer's literature (cut sheets) describing the system, material/chemical properties, material handling and storage requirements, mixing and proportioning requirements, maximum pot life, MSDS sheets, environmental requirements for application and worker safety requirements shall be submitted.
- d. Written certification by the protective admixture manufacturers stating the precast manufacturer is approved to install the admixtures specified shall be submitted.
- e. Written certification by the manhole liner system manufacturer stating the installation Contractor is approved to install the liner system specified shall be submitted.
- f. Written certification from the liner product manufacturer that each of the proposed liner and patching products are compatible with each other shall be submitted.
- g. Detailed instructions and methodology for finishing all pipe and manhole connections to prevent infiltration and exfiltration shall be submitted.
- h. Detailed methodology and materials for repairing surface imperfections or minor chipping of manhole structures shall be submitted
- i. Wastewater Flow Control/Bypassing Plan shall be submitted.
- j. Traffic Control Plan with site Contractor's telephone numbers for emergencies and copies of any necessary permits for lane closures shall be submitted.
- k. Epoxy liner and vacuum test results shall be submitted to Engineer.

### **803-4 CONSTRUCTION:**

**803-4.1 Excavation, Bedding, and Backfill:** Excavation, bedding, backfill, and compaction required for the installation of manholes shall be in accordance with Section 801 and as shown in the Contract Documents.

#### **803-4.2 Precast Concrete Manholes:**

- a. Base for precast manholes may be either precast or cast-in-place. Cast-in-place bases shall be used for manholes built over existing sewer lines only. If base is cast-in-place, lowermost precast unit shall be set in place at the time base is poured; additional precast units shall not be placed until 24 hours after base is poured. Cast-in-place reinforced concrete manhole bases shall be constructed in accordance with Section 601 Concrete Structures. Concrete for base and channel formation shall be 6A4000 concrete conforming to Section 1005 and shall include admixtures described in subsection 803-2h. If required for the manhole, interior of cast-in-place base must field

coated in accordance with Section 822.

- b. Precast manhole structures shall have a normal plant-run finish produced in forms that impart a smooth finish to concrete. Surface holes smaller than 1 inch caused by air bubbles, form joint marks, and minor chips are acceptable. Fill air holes greater than 1 inch in width or 1/4 inch in width that occur in high concentration (more than one per 2 sq. inch). Major or unsightly imperfections, honeycombs, exposed reinforcing steel, exposed aggregate, or structural defects are not permitted.
- c. Protective admixture tint shall be uniform in color and appearance throughout wall thickness of precast concrete structure. If cross-sectional views of precast concrete structure, such as pipe cutouts or across joints, are not available for visual inspection or do not provide satisfactory evidence of color uniformity, at the request of the Engineer, the Contractor shall have the structure cored to provide evidence. Coring and repair shall be at no cost to the Owner. Any unapproved coatings or paints applied to the manhole structure may be cause for rejection of the manhole by the Engineer.
- d. For manholes requiring an epoxy protective coating on the interior surface: surface preparation and protective coating shall be in accordance with Section 822. Manholes may be coated "in the shop" prior to delivery to project site. Any damage to the protective coating during shipping or installation shall be repaired by the Contractor in accordance with the manufacturer's recommendations at no additional cost to the Owner. Upon completion of manhole and pipe installation the protective coating shall be free of bugholes, pinholes, and continuous across the section joints. Coating shall extend over the top rim of the cone opening by one inch.
- e. Manholes shall be constructed such that their walls are plumb. The spigot end of the precast sections shall be set at the top of each section.
- f. Gaskets and gasket seats shall be cleaned of dirt and debris just prior to placing precast units.
- g. If holes must be cut in precast units, they shall be cored or drilled for proposed mains 18 inches in diameter or smaller. Manholes requiring larger pipe connections may be enlarged using a jack hammer, but must be neatly grouted to provide an airtight seal.
- h. There shall be at least 12" horizontal clearance between adjacent pipes.

All inverts shall be of 4000 psi concrete meeting the requirements of Section 1005 of these specifications and include the anti-microbial additive. The invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in directions of flow through the inlet shall be made to a true curve with as large a radius as the size of the inlet will permit.

**803-4.3 Manhole Drop Connections:** If inlet pipe enters the manhole 2 feet above the manhole invert or higher, an external drop line is required and shall comply with details in the Contract Documents. The drop line shall be of the same material as that of the inlet pipe and one nominal pipe size smaller (minimum 8 inch diameter). Backfill drop assembly with #610 Stone Backfill material. Extend the bedding material a minimum of 4 inches outside bells.

**803-4.4 Adjusting Sewer Manholes:** If grade adjustments of existing manholes are required, frames and covers shall be removed and manhole shall be adjusted to new grade as specified for new Work. Adjustment shall be made using precast concrete riser rings or cast iron riser rings in accordance with Section 806-6.1. Frames and covers shall be handled in accordance with Section 806-6.3.

After removal of existing manhole cover, a suitable temporary cover shall be placed over manhole to prevent debris from entering manhole and to provide for safety of workmen and the public until new

manhole cover is in place. If rubble or debris falls into a "live" manhole during adjustment operations, the Contractor shall remove and dispose of debris at no cost to the Owner. Upon completion of the manhole adjustment an external seal wrap shall be install in accordance with Section 803-4.7.

#### **803-4.5 Riser Rings, Frames and Covers:**

- a. The top of the manhole frame will be at the finished grade of the pavement or 3-inches above the ground surface in accordance with the details of the Contract Documents.
- b. In paved areas the frame and cover should match the slope and crown of the finished pavement.
- c. Concrete riser rings shall be set in a full bed of mortar. Mortar shall be struck smooth on the inside of the manhole using a hard trowel followed by a sponge float. An epoxy system designed for metal-to-metal adhesion shall be used to connect individual cast iron riser rings and the cast iron riser rings to the frame.

**803-4.6 Stainless Steel Insert:** A stainless steel insert shall be installed in manholes located in areas below the base flood elevation as shown on the Contract Documents.

#### **803-4.7 External Seal Wrap:**

- a. Riser Rings and Frame: The sewer manhole riser rings and frame shall be externally sealed with rubber seal wraps or mechanically locked corrugated rubber seals.
  1. Rubber seal wraps:
    - i. Rubber seal wraps and required band widths shall conform to ASTM C 877 (Type I – Rubber and Mastic Bands).
    - ii. The number of bands required will depend on the number of adjusting rings needed. A minimum 3 inch overlap below the cone-riser ring joint shall be required. A 2 inch overlap shall be required to fold over the frame base to seal the frame-riser ring joint. If there are more adjusting rings per installation there will be a requirement for an additional band. Each additional band will overlap the upper band by two inches.
  2. Mechanically locked corrugated rubber seals:
    - i. The frame seal shall remain flexible throughout a 25 year design life. The sleeve portion of the seal shall be corrugated with a minimum unexpanded vertical height of 10 inches and be capable of being mechanically locked to the base flange of the manhole frame casting.
    - ii. The sleeve and any extension shall be made from high quality EPDM rubber suitable for both above and below grade applications. Minimum thickness of rubber sleeve and extension shall be 0.085 inches. Rubber material shall conform to the applicable material requirements of ASTM C 923 and have a hardness (durometer) of 45±5.
    - iii. The sealing area that compresses against the base flange of the manhole frame casting and the chimney or cone shall have a series of sealing fins to facilitate a watertight seal. The top compression band shall be "C" shaped to uniformly compress and mechanically lock the sleeve into the base flange of the manhole frame casting. Both the top and bottom compression bands shall have a take-up mechanism capable of developing a minimum of 400 lbs. of torque.
  3. The external seal shall be installed after the adjusting rings are set and all

castings are coated.

b. Riser Section Joints:

1. Each manhole section joint shall be sealed with an external rubber seal wrap conforming to ASTM C 877 (Type I – Rubber and Mastic Bands, Type II – Plastic Film and Mesh Reinforced Mastic Bands, or Type III – Chemically-Bonded Adhesive Butyl Bands).
2. The seal shall be designed to prevent leakage of water through the joint sections of a manhole.
3. Any excess joint sealant material or gaskets that protrudes on the outside of the manhole section joint shall be removed prior to the installation of the external rubber seal wrap.

c. The external seal wrap shall be installed in accordance with the details of the Contract Documents and the manufacturer's recommendations.

**803-4.8 Abandoning Manholes:** The Contractor shall clean the manhole to be abandoned in accordance with Section 812 to remove and dispose of all sewage and debris. Contractor shall permanently plug both upstream and downstream pipes at the manhole, and thoroughly crack or drill holes in the manhole bottom to allow any water to drain out. Plug shall consist concrete or flowable fill extending a minimum of 18" into the pipe end. Finally the Contractor shall completely remove the manhole structure down to a minimum three (3) feet below natural ground and fill and compact with an approved backfill sand. Removed material shall become property of the Contractor and shall be disposed of at no additional cost to the Owner.

**803-5 ACCEPTANCE TESTING:**

**803-5.1 Air Vacuum Test:** After completion of manhole construction, wall sealing, and backfilling, the Contractor shall conduct a vacuum test as follows:

- a. All manholes are to be vacuum tested following backfill and compaction. The ring and lid casting assembly shall be installed prior to testing. The testing equipment shall consist of a gasoline-powered vacuum pump with sufficient vacuum hose length and a test head of proper size to fit the inside opening of the manhole. The test head shall be equipped with an inflatable rubber bladder to affect the seal to the manhole, an air pressure gauge, and 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.
- b. 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 inches beyond the manhole wall.
- c. With the vacuum tester in place, inflate the compression to affect a seal between the vacuum base and the structure. Connect the vacuum pump to the outlet port with the valve open and evacuate the manhole to 10 inches Hg (0.3 bar) for 48-inch diameter manholes and 5 inches Hg (0.15 bar) for 60-inch and greater diameter manholes.
- d. Close vacuum inlet/outlet ball valve, disconnect the vacuum pump, and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1-inch Hg over the specified time period, the manhole is considered acceptable 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 by sealing the leaks of the manhole to the satisfaction of the Engineer, and repeat test procedures until satisfactory results are

obtained.

Vacuum Test Timetable			
Depth (Feet)	Manhole Diameter (Inches)		
	48"	60"	72"
4'	10 sec.	13 sec.	16 sec.
8'	20 sec.	26 sec.	32 sec.
12'	30 sec.	39 sec.	48 sec.
16'	40 sec.	52 sec.	64 sec.
20'	50 sec.	65 sec.	80 sec.
24'	60 sec.	78 sec.	96 sec.
*T	5.0 sec.	6.5 sec.	8.0 sec.

\*Add extra testing time "T", for each additional 2-foot depth. (The values listed above have been extrapolated for ASTM designation C924-85.)

- e. 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. A significant number of leaks on a single manhole or significant number of manholes leaking shall be considered as a basis for rejection and replacement of manholes.

**803-5.2 Epoxy Liner Test:**

- a. Wet Film Thickness Gage: During application a wet film thickness gage, meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to check coating thickness.
- b. Holiday Detection: After a minimum of 24 hours following completion, the lining system shall be spark tested to assure a pinhole-free lining. Defects shall be marked and repaired per the manufacturer's instructions. The holiday detector shall be a Tinker Razor Model AP/W or an approved equal. Reference NACE RPO 188-99 for performing holiday detection. Manhole repair shall not be measured for payment when required as surface preparation for a manhole lining rehabilitation operation.
- c. Adhesion Test: A minimum of 10% of the manholes coated shall be tested for adhesion/bond of the coating to the substrate. Testing shall be conducted in accordance with ASTM D7342-05.

**803-6 MEASUREMENT:**

- a. **Sanitary Sewer Manholes:** Manholes constructed will be measured as a unit by manhole diameter and depth.
- b. **Adjusting Sewer Manholes:** This item will be measured as a unit.
- c. **Manhole Drop Lines:** Drop lines will be measured by line diameter per vertical foot of drop from the invert of the main line entering the manhole.
- d. **Abandon Sewer Manholes:** Manholes to be abandoned shall be measured as a unit.
- e. **New Manhole Protective Coating:** Measurement for payment of this Item shall be based on the actual number of vertical feet of manhole wall rehabilitated for a standard four-foot diameter manhole. Where manhole diameter is significantly different from the standard (i.e., 5' or 6') then the vertical footage shall be adjusted for pay purposes accordingly, to account for the additional square footage of area requiring rehabilitation (i.e., 5' diameter = 1.25 x vertical footage of standard; 6' diameter = 1.50 x vertical

footage of standard, etc.). In like manner, structures that are discovered to have geometric shapes other than circular shall be adjusted as above to provide a consistent method of accounting for the actual square footage of area requiring rehabilitation of walls. All other aspects of measurement shall remain as indicated. All measurements shall be as specified or made by conventional means with accuracies consistent with field conditions and common practice. Should a discrepancy in measurement exist which is greater than ten percent (10%), the Item in question shall be re-measured by both the Contractor and the Engineer for verification.

**803-7 PAYMENT:**

- a. **Sanitary Sewer Manholes:** Payment for new manholes include materials, labor, excavation, bedding, backfill, compaction, removal and disposal of existing manhole (if required), new manhole, geotextile fabric, rings, frames, covers (frame and cover type as shown on drawings), external seals, venting pipes (as required by the drawings), concrete admixtures, connections with pipe, and testing.
- b. **Adjusting Sewer Manholes:** Payment for adjusted sewer manholes shall include materials, labor, excavation, bedding, backfill, compaction, riser rings, removal and replacement of existing frame and cover, external seals, and testing.
- c. **Manhole Drop Lines:** Payment for drop lines shall include all material, labor, pipe, fittings, hardware, removal and disposal of existing manhole drop line (if required), and bedding material.
- d. **Abandon Sewer Manholes:** Payment for abandoned manholes include materials, labor, excavation, backfill, compaction, pipe plug(s), drilling of manhole base, removal and disposal of existing manhole, manhole frame and cover 3 foot minimum below grade.
- e. **New Manhole Protective Coating:** Payment of the unit price amount bid for this Item shall be full compensation for all labor, materials, equipment, surface cleaning and preparation, patching and/or grouting, cementitious underlayment, sewer flow control, traffic control, and testing.

**803-8 PAY ITEMS:**

Drop Line Inner (I.D.)  
Diameter Schedule

Pipe Depth Schedule

A =	4" Pipe	0 =	0	-	6	Feet
B =	6" Pipe	1 =	6.1	-	8	Feet
C =	8" Pipe	2 =	8.1	-	10	Feet
D =	10" Pipe	3 =	10.1	-	12	Feet
E =	12" Pipe	4 =	12.1	-	16	Feet
F =	14" Pipe	5 =	16.1	-	20	Feet
G =	15" Pipe	6 =	20.1	-	24	Feet
H =	16" Pipe	7 =	24.1	-	28	Feet
I =	18" Pipe	8 =	28.1	-	32	Feet
		9 =	32.1	-	36	Feet

<u>Item No.</u>	<u>Item</u>	<u>Unit</u>
803148_	48" Sanitary Sewer Manhole (depth)	Each
803160_	60" Sanitary Sewer Manhole (depth)	Each
803172_	72" Sanitary Sewer Manhole (depth)	Each



803200_	Sanitary Sewer Drop Line (diameter)	Vertical Foot
8033000	Adjusting Sewer Manhole	Each
8034000	Abandon Sewer Manhole	Each
8035000	New Manhole Protective Coating	Vertical Foot