SECTION 02601

MANHOLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place and precast concrete manholes.

1.02 RELATED SECTIONS

A. Trenching, Backfilling and Compacting: Section 02221.

B. Gravity Wastewater Sewer: Section 02731.

C. Division 3 - Concrete.

1.03 QUALITY ASSURANCE

A. Shop Inspection:
   1. All materials furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the supplier or the Contractor.

B. Field Inspection:
   1. All materials shall be furnished and installed and tested for defects in material and/or workmanship in the manner specified and in the presence of and as approved by the Authority.

C. Source Quality Control:
   1. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast reinforced concrete manholes.
   2. Obtain certificate of construction compliance with ASTM C478 from the precast reinforced concrete manhole manufacturer. Submit same certificate as part of required submittals.
   3. Obtain certificate of material compliance with ASTM A48, Class 30 tensile strength from the manhole frame and cover manufacturer. Furnish certification that tensile test bars were from same pour as castings. Submit same certificates as part of required submittals.

4. All products installed within PennDOT (PDT) right-of-way shall be certified in accordance with PDT Publication 35 (Bulletin 15).

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A48, Gray Iron Castings, Spec. for.
   2. ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes, Spec. for.
   3. ASTM A307, Carbon Steel Externally Threaded Standard Fasteners, Spec. for.
   4. ASTM A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Spec. for.
   5. ASTM C270, Mortar for Unit Masonry, Spec. for.
   6. ASTM C361, Reinforced Concrete Low-Head Pressure Pipe, Spec. for.
   7. ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, Spec. for.
   8. ASTM C478, Precast Reinforced Concrete Manhole Sections, Spec. for.
   9. ASTM C923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
   10. ASTM D2240, Rubber Property-Durometer Hardness, Test Method for.
   11. ASTM D4101, Plastic Injection and Extrusion Materials, Spec. for.

B. American Association of State Highway and Transportation Officials (AASHTO) Standards as referenced throughout these Specifications.

C. American Water Works Association (AWWA):
   1. AWWA C302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.

D. Federal Specifications:
   1. Fed. Spec. SS-S-210A, Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints (Type 1 Rope Form).

1.05 SUBMITTALS

A. Shop Drawings and Product Data:
   1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Contractor prepared drawings as applicable.
   2. Manufacturer's descriptive literature and specifications covering the product specified. Include installation information.

B. Certificates:
   1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.

2. Manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components and products.
3. Manufacturer's sworn certification that manhole frame and cover tensile test bars were poured from the same iron as castings they represent.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport and handle precast reinforced concrete manhole components and other Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects. Through-wall lifting holes not permitted in manhole component construction.

B. Store precast reinforced concrete manhole components in accordance with manufacturer's recommendations to prevent joint damage and contamination. Exercise such care in storage of other specified Products as recommended by the respective manufacturers.

1.07 SITE CONDITIONS

A. Environmental Requirements:
1. In no instance set or construct manhole bases on subgrade containing frost.

PART 2 - PRODUCTS

2.01 BASIC MATERIALS

A. Cast-In-Place Concrete Products: Formwork, Reinforcement, and Cast-In-Place Concrete conforming to requirements of Division 3 - Concrete.

B. Waterproofed Mortar: Material composition meeting requirements of ASTM C270, Type M with waterproofing admixture included.
1. Medusa Cement Company; Medusa Waterproofing Paste or Powder.
2. Grace Construction Materials; Hydratite
3. Chem-Master Corporation; Hydrolox.
4. Or Equal.

C. Epoxy Bonding Compound: Use product such as A. C. Horn EPOXTITE BINDER; Sika Chemical SIKADUR-HI-MOD or equal.

D. Manhole Steps: Spacing as indicated on Drawings.
   1. Reinforced Plastic Step: Composed of a 1/2 inch Grade 60, ASTM A615 deformed steel reinforcing bar completely encapsulated in copolymer polypropylene compound conforming to ASTM D4101.
      a. Acceptable Manufacturers:
         1) M. A. Industries, Inc.
         2) Lane Manhole Steps.
         3) Or Equal.

E. Manhole Frame and Cover: Gray iron castings conforming to ASTM A48, Class No. 35, designed for AASHTO Highway Loading Class HS-25. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. All castings shall clearly display the manufacturer's name, product number, date of pour, and country of origin. Frame and cover design and dimensions equal to Product No. 104510 (frame) and 104116 (cover), manufactured by East Jordan Iron Works.
   1. Finish: Bearing and exposed surfaces machined to prevent rocking and rattling under traffic.
   2. Identification: Cast the words "SANITARY SEWER" and "BTMA" integrally on cover in 2-inch size raised letters.
   3. Frame Hold-down Bolts: ASTM A307. Provide four (4) per manhole.
   4. Cover Gasket: One-piece 0-ring gasket factory installed in a machined rectangular or dovetail groove in the cover bearing surface.
      a. Gasket material of neoprene composition having good abrasion resistance low compression set, Type D 40 durometer hardness determined in accordance with ASTM D2240 and suited for use in sanitary sewer manholes.
      b. Gluing of gasket is not permitted.
   5. If required the cover shall be milled to accommodate installation of 1/8" thick manhole insert such that top of cover is flush with top of frame.

F. Watertight Manhole Frame and Cover: Gray iron castings conforming to previously specified requirements for Manhole Frame and Cover with the addition of cover hold-down bolts. No manhole insert required for watertight manholes. Frame and cover design and dimensions equal to East Jordan Iron Works Product No. 104517.
   1. Cover Hold-down Bolts: Type 316 stainless steel, ASTM A276, bolts and washers; or manufacturer's standard bronze bolts and washers.

G. Preformed Plastic Sealing Compound: Fed. Spec. SS-S-210A, Type 1, Rope Form, of either bitumastic base compound or butyl rubber base compound, and shipped protected in a removable two-piece wrapper. Size cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference when joint is completed.
   1. Henry Sealants Division; RUB'R-NEK.
   2. Press-Seal; EZ-STIK.
   3. Conseal: CS-102B.
   4. Or equal.

H. Waterstop: Gasket type waterstop composed of EPDM or polyisoprene compound, ASTM C923 with stainless steel take-up clamps.
   1. Acceptable Manufacturer:
      a. Kor-N-Seal I
      b. Press-Seal Gasket Corporation.
      c. Dual Seal II

I. Manhole Inserts
   1. General: The manhole insert shall be manufactured from corrosion proof material suitable for atmospheres associated with wastewater collection systems.
   2. Materials: The insert shall be made from High Density Polyethylene Copolymer material that meets ASTM Specification Designation D 1248 Glass A, Category 5, Type III. (The insert shall have a minimum impact brittleness temperature of 105^{o} F or less.) The thickness shall be a uniform 1/8 inch or greater. The insert shall be manufactured to the dimensions as shown on the Drawings to allow easy installation within the manhole frame. The insert shall be fit with a nylon lifting strap for removal.
   3. Venting: The insert shall have a system of relieving pressure from the manhole or relieving a vacuum in the manhole. The venting system shall contain NO moving parts which could be affected by grit accumulations nor have any parts subject to corrosion. The venting system shall not allow water to completely fill the insert, which during freezing weather could freeze and lift the manhole cover.
   4. Manufacturer: The insert shall be manufacture by Parson Environmental Products, Inc., P.O. Box 4474, Reading, PA 19606, or equal.

2.02 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

A. Materials and Construction: Conforming to requirements specified in ASTM C478 except as follows:
   1. Concrete: Composition and compressive strength conforming to ASTM C478 except use Type II cement in manhole components and increase compressive strength to 4500 psi (at 28 days) in precast bases.
   2. Casting and Curing: Wet cast and steam curing process in accordance with Section 3.6.11 and 3.7.2 of AWWA C302.
   3. Manhole Steps: Factory installed in manhole components, prealigned vertically, spaced on equal centers, and located the minimum distance from ends of risers and top sections as indicated on the Standard Details.
   4. Manhole Component Seals: Manhole component joints factory formed for self-centering concrete-to-concrete bearing employing preformed plastic sealing compound. Preformed Plastic Sealing Compound: As specified previously.
   5. Manhole Component Design: Base, tapered and straight riser section, and top section dimensions and diameters, not consistent with ASTM C478, are as indicated on the Standard Details.

B. Pipe Openings: Custom preformed during manufacturing in each base and riser section requiring such, to accommodate type of pipe and pipe opening seal provided.
   1. Pipe Opening Seals: Resilient gasket type, cast integrally with manhole component conforming to requirements specified in ASTM C923 and of the following acceptable manufacturers:
      a. Press-Seal Gasket Corporation.
      b. A-LOK Products Corporation; A LOK Manhole Pipe Seal.
      c. Thunderline Corporation; LOCK-SEAL Modular Wall and Casing Seal.
      d. Dual Seal Gaskets Inc.; DUAL SEAL II.
      e. NPC, Inc., Kor-N-Seal I Flexible Pipe to Manhole Connector

C. Precast Top Sections: Designs as required by the Standard Details, of materials and construction as specified previously except additional and differing requirements as follows:
   1. Hold Down Bolt Inserts: Factory cast in top section no less than two 3/4-inch threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Threaded inserts of 3-inches depth. Both insert types designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.
   2. Flat Slab Tops: Tops factory formed to properly accept and support required manhole frame and cover and formed to join riser section in a matching joint.
   3. Eccentric Cone Tops: Manufacture to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.

D. Precast Grade Rings: Leveling and adjusting units of 3-inches or 4-inches thickness of materials and construction as specified previously. Factory cast grade rings with hold down bolt holes matching location of same in manhole frame. Design must provide for full bearing of manhole frame.

E. Coatings:
   1. Prepare surfaces to be coated in accordance with the written instructions of the coating manufacturer, including cleaning, sandblasting or acid etching as necessary.
   2. Coat precast components at the factory.
   3. Interior and Exterior Surface Coating: Use NSF approved epoxy, 20-mil dry film thickness. Interior color shall be white and exterior color shall be beige (or other color approved by Engineer).
      a. Coating shall be specifically designed for the use on precast concrete manholes.
      b. Coating shall be Tnemec Hi-Build Epoxoline, Sherwin Williams Macropoxy 646, or equal.
   4. Interior Liner: Use on force main discharge manholes and the first four manholes downstream of the discharge manhole, or where otherwise directed by the Authority or Engineer.

a. Liner shall provide a continuous impermeable lining to shield precast concrete against deterioration caused by corrosive atmosphere.
b. Liner shall be factory installed on all new manholes so designated.
c. Channels, benches, and all penetrations through liner shall receive factory-applied corrosion-resistant coating.
d. Liner shall be Terre Hill AGRU Sure Grip Liner and GU base liner, A-LOK Dura Plate 100 or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect precast reinforced concrete manhole components in accordance with requirements of ASTM C478 regarding repairable defects and defects subject to rejection by the Authority.

B. All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Authority. All defective materials furnished by the Contractor shall be promptly removed from the site.

3.02 PREPARATION

A. Keep pipe and manhole interiors cleared of debris as construction progresses.

B. Earthwork: Perform earthwork for manhole installation as previously specified in Trenching, Backfilling and Compacting: Section 02221.

3.03 MANHOLE CONSTRUCTION METHODS

A. Cast-In-Place Concrete Manhole Base: Construct in accordance with design and dimensions indicated on the Standard Details. When necessary to construct wider or deeper manhole bases than indicated or specified, build such bases as required by the Engineer.
   1. Form and pour concrete in accordance with requirements of Division 3 - Concrete. Additional requirements as follows:
      a. Vibrate poured concrete using mechanical vibrator of a type and design approved by Authority. Use vibrators of type capable of transmitting vibration to concrete in frequencies of not less than five thousand impulses per minute.
      b. Form and pour joint monolithically in manhole base top to match joint of adjoining precast riser section. Use template as obtained from precast concrete manhole component manufacturer of manhole components used in the Project.

c. Do not place precast riser sections on cast-in-place bases for a minimum of 48 hours after pour.

2. Install sewer piping in cast-in-place manhole bases prior to pouring the concrete.
   a. Apply Epoxy Bonding Compound in accordance with manufacturer's instructions to pipe at base connection prior to pouring the concrete.
   b. Install PVC Waterstop on pipes entering and leaving manhole base prior to pouring concrete. Install PVC Waterstop in accordance with manufacturer's written instructions.
3. Use 4000 psi concrete as specified in Section 03300, unless indicated otherwise on Drawings.
4. Coat bases in accordance with the requirements for precast manhole components.

B. Precast Concrete Bases: Install bases on a 6-inch deep compacted layer of aggregate meeting requirements of Pipe Bedding as specified previously in Section 02221.
   1. When using prefabricated pipe opening seals for connecting pipes into manholes, and such seals create an annular space on interior and exterior of manhole wall after pipe connection is made, fill such annular spaces with and/or apply non-shrink grout.
      a. Tightly caulk sealing compound into annular spaces, completely filling the spaces, and render the installation watertight.
      b. Following sealing compound or grout installation, surface will be smooth and flush with interior face of manhole.

C. Concrete Channel Fill: Field pour concrete channel fill for each manhole base.
   1. Form inverts directly in concrete channel fill.
   2. Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
   3. Make changes in size and grade gradually.
   4. Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.
   5. Make slopes gradual outside the invert channels.
   6. Use 3000 psi concrete as specified in Section 03300.
   7. Precast concrete channels are acceptable if they meet the above requirements.

D. Manhole Wall Erection: Provide precast reinforced concrete straight riser, tapered riser and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.
   1. Install preformed plastic sealing compound in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.
      a. Prime joint surfaces if required by preformed sealing compound manufacturer.
      b. If sealing compound is installed in advance of section joining leave exposed half of two-piece protective wrapper in place until just prior to section joining.

c. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
d. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
e. Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

E. Lifting Hole Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into holes in such manner to render holes completely water and air tight. Sealing of lifting holes with grout not permitted.

F. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using the following:
1. Precast Grade Rings:
a. Set precast grade rings in Water-Proof Mortar. Mortar thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Wet, but do not saturate precast grade rings immediately before laying.
b. Pre-set grade rings to proper plane and elevation using wedges or blocks of cementitious material not exceeding one square inch wide on all sides. No more than four wedges or blocks per grade ring permitted. Incorporate wedges or blocks in fresh mortar in a manner to completely encase each. Crown fresh mortar to produce squeeze-out between grade rings. Tool exposed joints with appropriately shaped tool and compact mortar edge into joints. Clean off excess mortar prior to initial mortar set.
2. Bolt manhole frames in place on manhole top section, or on leveling units if required, after installing 1/2-inch thick preformed plastic sealing compound on bearing surface of manhole frame. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.
3. Use bolts of sufficient length to properly pass through leveling units, if any, engage full depth of manhole top section inserts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after mortar has cured.
4. Install plastic insert. After installation of the insert, the top of manhole cover shall be flush with the top of the frame.

G. Plugging Pipe Openings: Plug pipe openings in manholes where such openings are required for future pipe connections.
1. Use masonry units and waterproofed mortar laid up to prevent deterioration.
2. Install such materials to meet testing limits and to allow future removal without damage to manhole.

H. Drop Manholes: Construct in accordance with Type indicated in the Standard Details. Use same type pipe and fittings in drop connection as used in sewer line from which drop connection is made.

3.04 INTERFACING EXISTING CONSTRUCTION

A. Connections To Existing Sewers: Where new manholes are constructed on existing sewers, the Contractor shall have the option to use cast-in-place manhole bases or precast bases, both as specified previously.
   1. Replace broken or damaged pipe resulting from this work with new pipe. New pipe material shall match existing. Use compatible joint materials or solid sleeve repair couplings, wherever possible. Flexible pipe coupling shall be used only as necessary.
   2. Connect new pipe to new manhole bases or new in-line structures as specified previously.
   3. If precast manhole bases are used, replace existing sewer pipe with new pipe to first joint outside the manhole base.
   4. Maintain flow in existing sewer both during construction operations and until concrete is cured both in the case of cast-in-place work and formed inverts.
   5. Cut piping to be removed with a saw. Chipping or breaking pipe with a hammer not permitted.

B. Connection to Existing Sewer Manholes: Where new sewers connect to existing manholes, Contractor shall connect to the existing manhole in such a manner as to not damage the existing manhole or existing sewer pipes and obtain a watertight connection.
   1. Contractor shall core bore an opening in the wall of the manhole. Chipping or breaking manhole with a hammer not permitted. Diameter of opening shall be sufficient to accommodate the outside diameter of the new pipe and waterstop.
   2. Install a waterstop in the opening in accordance with the manufacturer's instructions.
   3. Insert the new pipe in the opening and tighten the clamps on the waterstop around the pipe.
   4. Form a flow channel inside the manhole for the new pipe. Flow channel shall match the existing flow channel inside the manhole. Form the channel as previously specified.

3.05 FIELD QUALITY CONTROL

A. General: Test each manhole constructed in the Project by one of the methods specified herein. If the manhole is constructed on an existing sewer where sewage flow must be maintained, the test may be waived at the discretion of Authority.
   1. Conduct tests in presence of and to complete satisfaction of the Authority.
   2. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until such manhole does test satisfactorily.
   3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing specified herein.
      a. Vacuum Testing Equipment:

1) Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from manhole and to monitor vacuum.
2) Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
3) Vacuum testing equipment and associated testing apparatus subject to Engineer's approval.
4) Provide seal plate with vacuum piping connections for inserting in manhole frame.

4. Prior to testing manholes, thoroughly clean such and seal openings, both to complete satisfaction of the Authority. Seal openings using properly sized plugs.
5. Perform testing with frames installed. The joint between the manhole and the manhole frame shall be included in the test.
6. The Contractor may elect to make a test prior to backfilling for his own purposes; however, the tests of the manholes for acceptance shall be conducted after the backfilling and base course paving (if applicable) have been completed.

B. Vacuum Test Procedure:
1. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.
2. Draw a vacuum of 10 inches of mercury and close the valves.
3. Consider manhole acceptable when vacuum does not drop below 9 inches of mercury for the following manhole sizes and times:
   a. 4 foot diameter - 60 seconds.
   b. 5 foot diameter - 75 seconds.
   c. 6 foot diameter - 90 seconds.

C. Repair and Retest: Determine source(s) of leak(s) in manholes failing acceptable limits.
1. Repair or replace defective materials and workmanship, and conduct such additional Manhole Acceptance Tests and such subsequent repairs and retesting as required until manholes meet test requirements.
2. Materials and methods used to make manhole repairs must meet with Authority's approval prior to use.

END OF SECTION