Item No. 303
Polymer Concrete Manholes

303.1 Description

Provide labor, materials, equipment and incidentals necessary to construct manholes and cleanouts complete with covers, fittings, and other appurtenances, in accordance with the details and/or called out in the Drawings. Polymer Concrete Manholes are required for all wastewater mains 18 inches and larger.

303.2 Quality Assurance

Polymer Concrete Manholes:

A. Certification from manufacturer that polymer concrete manhole design meets or exceeds the load and strength requirements of ASTM C478 and ASTM C857, reinforced in accordance with ASTM C478 or ACI 440.1R.

B. Proof of independent chemical resistance testing conducted in accordance with ASTM C267.

C. Manufacturer must provide references of 10 previous polymer concrete projects including scope in the last 5 years performed with both the owner and contractor for reference and review.

303.3 Submittals

Submittals must be in accordance with the General Conditions and must include:

A. Shop Drawings:

1. Drawings and data covering manhole sections. These drawings must include manhole designation matching the plans, invert elevations and diameters for each manhole.

B. Product Data:

1. Manhole cover and ring.
2. Engineer to include other products as specified.
3. Certification from the manufacturer that polymer concrete manhole design meets or exceeds the load and strength requirements of ASTM C478 and ASTM C857, reinforced in accordance with ASTM C478 or ACI 440.1R.

303.4 Standards

The applicable provisions of the following standards shall apply as if written here in their entirety:

A. ASTM International (ASTM) Standards:

ASTM A48	Specification for Gray Iron Castings
ASTM C267	Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes using Rubber Gaskets
ASTM C478	Specification for Precast Reinforced Concrete Manhole Sections
ASTM C497	Test Methods for Concrete Pipe, Manhole Sections, or Tile
ASTM C579	Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic, Surfacing, and Polymer Concretes
ASTM C857	Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM D2240	Test Method for Rubber Property - Durometer Hardness
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C33	Concrete Aggregates
ASTM C990	Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections using Preformed Flexible Joint Sealants
ASTM C923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
ASTM D6783	Specification for Polymer Concrete Pipe

B. American Concrete Institute (ACI) Standards:

ACI 440-1R-15	Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars

C. American National Standards Institute (ANSI) Standards:

ANSI A21.10	American National Standard for Gray Iron and Ductile Iron Fittings, 3 through 48 Inches for Water and Other Liquids

D. Delivery and Storage

1. Inspect precast polymer concrete sections upon delivery and reject any cracked or otherwise visibly defective units.

303.5 Materials

A. General

1. Concrete and Mortar:

   a. Concrete, mortar and non-shrink grout for all cast-in-place bases must be as specified in TxDOT Standard Specification Item No. 421, “Hydraulic Cement Concrete”.

   b. The minimum compressive strength for concrete is 3000 psi.

B. Manufactured Products

1. Polymer Concrete Manholes:

   a. Riser Sections:

      Provide base riser section with monolithic floors, unless shown otherwise in the Drawings.

      i. Provide riser sections joined with bell and spigot/ship-lap design seamed with butyl mastic (ASTM C990) and or rubber gaskets (ASTM C443) so that on assembly, manhole base, riser and top section make a continuous and uniform manhole structure. Joints shall meet the testing requirements without the use of an external joint wrap.

      ii. Construct riser sections for polymer concrete manholes from standard polymer concrete manhole sections of the diameter indicated in the Drawings. Use various lengths of polymer concrete manhole sections in combination to provide the correct height with the fewest joints. Lifting inserts shall not fully penetrate the wall.

   b. Resin: The manufacturer must use only polyester or vinyl ester resin systems designed for use with this particular application. Resin additives such as curing agents, pigments, dyes, fillers and thixotropic agents, when used, must not be detrimental to the manhole. Minimum resin content shall not be less than 7 percent by weight.

   c. Aggregate: All aggregate, sand and quartz powder must meet the requirement of ASTM C33, where applicable. Limestone aggregates shall not be used.

   d. Polymer concrete must have a minimum compressive strength of 9000 psi when measured in accordance with ASTM C497.

   e. Elastomeric Gaskets: Gaskets must be suitable for the service intended and must meet the requirements of ASTM C443. Assembled joints shall meet the testing requirements of ASTM C443 without the use of an external joint wrap. Pipe to manhole connections shall be accomplished with connectors meeting ASTM C923 for both materials and performance requirements. Proof of connector testing can be requested from connector manufacturer.

   f. Marking and Identification: Each manhole must be marked with the manufacturer’s name and production date.

   g. Invert Channel: Construct invert channels to provide smooth flow transition with minimal disruption of flow at pipe to manhole connections. Polymer bench and channel are to be constructed with all polymer concrete material. Extended ballast slab for buoyancy concerns can be addressed with cementitious concrete material.

h. Manholes must be reinforced per ASTM C478 or ACI 440.1R and designed to withstand all live loads and dead loads as described in the Drawings. Manhole wall thickness must be designed to resist hydrostatic pressures with a minimum safety factor of 2.0 for full depth conditions from grade to invert.

i. Materials needed for grouting and patching must be a polyester mortar compound provided by the manufacturer or as approved by the manufacturer.

j. Approved Manufacturers:

   i. Armorock Polymer Concrete.

   ii. U.S. Composite Pipe, Inc. (a division of Thompson Pipe Group).

   iii. Approved equal.

2. Non-Metallic Manhole Rings and Covers

   a. All rings and covers must be made from high strength nonmetallic fiber reinforced polymer/composite materials. The material must be a resin thermoset matrix that can be reinforced with continuous filament engineered fabrics, fiber rovings, short fiber filaments, or equivalent nonmetallic reinforcing structure(s). Sealing gaskets must be bonded to the frame continuously at the interface with the cover to reduce wear, shock, noise, malodors and infiltration.

   b. Rings and covers intended for traffic service must be capable of withstanding AASHTO M306: Proof Testing (includes items such as frames, covers, etc.).

   c. Fabricate rings and covers to conform to shapes, dimensions, and with wording or logos shown in the Drawings.

   d. Molding Process:

      i. Before the moldings are removed from the molding operation, they must be thoroughly de-flashed and cleaned at the parting lines, holes, notches and all exposed edges.

      ii. If using a lock or latch, these must be independent of the method used to open the cover to ensure the cover can be opened in the event of lock or latch failure.

      iii. Covers and frames must be compression molded under high pressures (>0.5 tons/sq. inch of x-y surface area) and high temperatures (>200 deg F).

      iv. Metal reinforcements or metal hinges molded within the composite will not be permitted. Small non-stress bearing pieces of metal may be encapsulated or attached.

   e. All rings and covers must be molded and assembled in the United States in accordance with the requirements of AASHTO M306.

   f. Covers must be provided with a positive sealing mechanism utilizing 316 stainless steel hardware with nuts molded in or attached at pre-molded designated points of the frame and must be Teflon coated. Other equivalent locking mechanisms must be approved by the Engineer.

   g. Composite covers must be detectable by metal detectors.

h. Composite covers must be furnished with two concealed pick holes molded with 316 stainless steel inserts. An additional 316 stainless steel lifting clip must be molded into the top of the cover to facilitate removal and replacement.

i. Composite covers must have provisions for 316 stainless steel threaded inserts molded into the bottom surface to accommodate monitoring and remote transmission sensors and antenna utilized by the utility. Antenna placed on the bottom side must have the capability to transmit through the cover without the need to drill and install antenna on the upper surface.

j. Markings: Covers and frames must have the following molded into the substrate of the cover:

   i. Name (or abbreviation) of molder.

   ii. Country of origin.

   iii. Molding date.

   iv. Indication that material is non-metallic.

k. Approved Manufacturers:

   i. Composite Access Products, L.P.

   ii. Approved equal.

3. Manhole Grade Adjustment Rings

   a. Grade adjustment rings must be made of high-density polyethylene (HDPE) meeting ASTM D4976 or expanded polypropylene meeting ASTM D3575 and ASTM D4819-13.

   b. Provide adhesive/sealant between each ring per the manufacturer's requirements.

   c. Approved Manufacturers:

      i. Ladtech, Inc.

      ii. PRO-RING by Cretex Specialty Products.

      iii. Approved equal.

4. Pipe Connections:

   a. Field connections to manholes must use a compression fit into the cored wall and use stainless steel bands to secure the gasketed connection to the pipe.

   b. Approved Manufacturers:

      i. ADS – Insert-a-Tee.

      ii. Trelleborg – Kor-N-Seal.

      iii. Approved equal.

5. Manhole Vent:

   a. Vent is to be constructed of ductile iron per NBU standard details. Vent is to include #16 316 stainless steel screen. All hardware is to be 316 stainless steel.

   b. As indicated in the Drawings, provide vents equipped with an inverted check valve. Check valve must automatically seal the vent pipe to prevent inflow of water into the

lines when submerged and automatically reset when not submerged. Float must be constructed of 316 stainless steel.

c. As indicated in the Drawings, provide vents equipped with odor control canisters equipped with filter media designed to scrub H2S odors.

d. Ductile iron pipe and fittings must be lined with factory installed Protecto 401 Ceramic Epoxy Lining by Enduron or American Polybond Plus (fusion bonded epoxy and fusion bonded polyethylene) or approved equal.

e. Coat vents, valves, and above grade ductile iron pipe and fittings per Item 530 “High Performance Coatings.”

f. Approved Manufacturers:

i. Wager Company.

ii. Approved equal.

303.6 Construction Methods

A. Installation

1. Manhole Sizing: Manhole diameters are to be as indicated in the Drawings and as indicated below. If there is a conflict between the Drawings and these requirements, the larger manhole diameter will be required.

a. Pipe Diameters 18 Inches and Smaller: Provide 48-inch inside diameter manholes.

b. Pipe Diameters 24 to 27 Inches: Provide 60-inch inside diameter manholes.

c. Pipe Diameters 30 Inches and Larger: Provide 72-inch inside diameter manholes.

2. Foundation Support: Manholes must be founded on stable subgrade. Precast base units must be founded on a minimum 6-inch-thick layer of compacted course aggregate bedding. A pipe section with a prefabricated tee manhole and half the length of the adjoining pipe sections on each side must be founded on a minimum 6-inch layer of Class A concrete. The cradle is to extend to the trench walls and to the spring line of the pipe.

3. Manhole Base:

Note to Specifier: Choose which manhole base or bases will be used as part of your Project and include appropriate details in the Drawings.

a. Tee Manhole Base: The applicable details as indicated in the Drawings apply. Form and place the base of the manholes under and around the existing carrier pipe to form a flat platform above the top of the pipe to receive the pre-cast circular manhole sections. After the manhole has been completed, entry to the pipe area must be made by saw-cutting a section from the top of the pipe. Any debris resulting from this operation must be completely removed from the interior of the pipe.

b. Precast Manhole Base: The applicable details as indicated in the Drawings apply. Place the manhole base at an elevation that allows the invert to match the pipe flowline.

i. The precast manhole base must form a watertight seal with the bottom of the manhole. This may be accomplished by **[placing a continuous 1-inch ring**

of epoxy grout or using a rubber gasket] at the joint of the manhole and manhole base or other pre-approved methods.

c. Cast-in-place Manhole Base: The applicable details as indicated in the Drawings apply. Form and place the manhole base at an elevation that allows the invert to match the pipe flowline.

i. The cast-in-place manhole base must form a watertight seal with the bottom of the manhole. This may be accomplished by **[placing a continuous 1-inch ring of epoxy grout or using a rubber gasket]** at the joint of the manhole and manhole base or other pre-approved methods.

d. Give the concrete portion of all inverts within the manholes a smooth steel trowel finish.

e. The first section of pipe extending out a minimum of 24 inches from each side of the manhole base must be supported by lean concrete as part of the manhole base. No additional payment will be made for this concrete cradle; the sum must be included in the bid price for the manhole.

4. For precast manholes, the tops of the manholes will be set to proper elevation by using a predetermined length of the bottom section of the manhole riser and using standard lengths for the other sections of the riser pipe.

5. Inverts: Construct invert channels to provide a smooth waterway with no disruption of flow at the connection between the pipe and manhole. The channel depth at the point where a pipe connects to the manhole wall, for pipes 24 inches in diameter and smaller, must be a minimum of 3/4 of the diameter of the pipe, with the top of the channel being a smooth transition between the inlet and outlet pipe connections. For manholes connecting to larger pipe diameters, the channel depth must be equal to the full pipe diameter. Changes in flow direction must be constructed using smooth, long radius sweeps. Inlet and outlet pipe grades must be carried through the centerline of the manhole with a minimum slope of 2.5 percent between the inlet and outlet pipe inverts or 0.10 feet, whichever is greater. Where wastewater lines enter the manhole above the outlet flowline, the invert must be filleted to the flowline of the manhole.

6. Non-Metallic Manhole Rings and Covers: Install composite frames and covers according to approved Shop Drawings, instructions in related specifications and details, and written installation instructions from manufacturer. Set units accurately at required locations to proper alignment and elevation. Keep units plumb, level, true, and free of trash. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.

7. All adjustments to the manhole lid and cover must be completed prior to the placement of final roadway surface and/or final grading.

8. Cleanouts: Provide a cleanout at the ends of all sewer lines unless a manhole is provided at that point. Construct cleanouts in accordance with the details shown in the Drawings.

9. Drop Manholes: Install a drop manhole piping assembly in all cases where the distance between the incoming pipe and the floor of the manhole is 2 feet or more. External drop assemblies must be encased in concrete as indicated in the Drawings.

B. Grouting

1. Use the polyester mortar for grouting within 20 minutes after mixing. Discard mortar which has begun to take an initial set. Do not mix mortar with additional cement or new mortar.

C. Corrosion Protection

1. All exposed concrete surfaces on the interior of the manhole must be coated as indicated in the Contract Documents.
2. Seal all joints with an external Cretex Wrap, or approved equal, as indicated on the standard details to prevent infiltration.

303.7 Acceptance Testing for Wastewater Manholes

The Contractor shall notify the Inspector and Engineer 48 hours prior to beginning of manhole testing. The Contractor shall perform the testing for all sanitary sewer manholes in accordance with the following:

A. All manholes must pass the leakage test.

B. The Contractor shall test each manhole (after assembly and backfilling) for leakage, separate and independent of all other sanitary sewer piping, by means of either a hydrostatic test, vacuum test, or other methods approved by the Engineer.

C. The Contractor is hereby instructed to conduct either Vacuum Testing or Hydrostatic Testing in the following manner:

1. Vacuum Testing: Manholes shall be tested after construction/installation and backfilling with all connections (existing and/or proposed) in place.
    a. Drop-connections and gas sealing connections shall be installed prior to testing.
    b. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole.
    c. The plugs shall be installed in the lines beyond drop connections, gas sealing connections, etc.
    d. Prior to performing the test, the Contractor shall plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering the manhole.
    e. Only a cementitious coating may be applied.
    f. Contractor shall use a minimum 60 inch-lb. torque wrench to tighten the external clamps that secure the test cover to the top of the manhole.
    g. The test head shall be inflated in accordance with the manufacturer's recommendations.
    h. A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump will be turned off.
    i. With the valve closed, the level vacuum shall be read after the required test time.

j. If the drop in the level is less than 1 inch of mercury (final vacuum greater than 9 inches of mercury), the manhole will have passed the vacuum test.

k. The required test time is 2 minutes.

2. Hydrostatic Testing shall be conducted by utilizing approved plugs to seal all influent and effluent pipes in the manhole and filling the manhole to the top of the cone with water.

   a. Additional water may be added over a 24-hour period to compensate for absorption and evaporation losses.

   b. At the conclusion of the 24-hour saturation period, the manhole shall be filled to the top and observed.

   c. Any measurable loss within a 30-minute period shall be considered an unsuccessful test and thus require the Contractor to assess the needed repairs, perform such repairs (subject to the approval of the Engineer), and notify the Inspector when the retest will be performed.

   d. All effort, materials, or other costs shall be solely at the Contractor's expense.

3. Acceptance: Any manhole which fails the initial test must be repaired with a polyester mortar compound per manufacturer's specifications or other suitable material based on the material of which the manhole is constructed.

4. The manhole shall be retested as described above until a successful test is attained.

5. After a successful test, the temporary plugs will be removed.

6. To ensure that the plugs have been removed, Contractor shall only do so in the presence of the Inspector.

   a. Repairs to Existing Manholes: Any existing manhole which fails to pass the hydrostatic/vacuum test shall be closely examined by the Inspector and the Contractor to determine if the manhole can be repaired.

7. Thereafter, the Contractor shall either repair or remove and replace the manhole as directed.

8. Any manhole excavated for repairs or excavated for tie in, shall be backfilled with a minimum of 12 inches thickness of flowable fill to one foot above the top of the cone section to allow for the concrete ring encasement.

9. After abrading and cleaning, additional protective coating material shall be applied to the repair area.

10. All touch-up repair procedures shall follow the protective coating manufacturer's recommendations.

D. If a sanitary manhole fails to pass one of the above tests, it shall be repaired in accordance with the manufacturer's recommendations and re-tested. Should the test fail a second time, Contractor shall perform another leak test utilizing the other testing option in this specification Should the test fail the third time, Contractor shall remove and replace the manhole and perform all the necessary test at no additional cost to NBU. Manholes shall not be accepted until it passes all tests.

E. Engineer of Record must witness all tests over the Edwards Aquifer Recharge Zone (EARZ).

F. Inspection.

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection shall determine the completeness of the. manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

303.8 Measurement

Polymer Concrete Manhole Structures will be measured as each structure complete in place.

303.9 Payment

Payment for completed manholes of the type indicated shall be made at the unit bid price for each. The unit bid price shall include all labor, equipment, materials, testing, time and incidentals necessary to complete the work.

Payment when included as a contract pay item, will be made under the following:

Pay Item: Polymer Concrete Manhole __ Dia, Per Each

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