

DIVISION 33 – UTILITIES
SECTION 33 39 13 – SANITARY UTILITY SEWERAGE MANHOLES, FRAMES AND COVERS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Sanitary Sewer Manholes
 - 2. Sanitary Sewer Manhole Frames and Covers
 - 3. Cleanout Frames and Covers
 - 4. Sanitary Sewer Manhole Accessories
 - 5. Connections to Existing Infrastructure
 - 6. Manhole Cover Adjustment

1.02 REFERENCES

- A. American Society for Testing and Materials.
 - 1. ASTM A48, Gray Iron Castings.
 - 2. ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes.
 - 3. ASTM A307, Carbon Steel Externally Threaded Standard Fasteners.
 - 4. ASTM A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM C270, Mortar for Unit Masonry.
 - 6. ASTM C361, Reinforced Concrete Low-Head Pressure Pipe.
 - 7. ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 8. ASTM C478, Precast Reinforced Concrete Manhole Sections.
 - 9. ASTM C923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 - 10. ASTM D2146, Polypropylene Plastic Molding and Extrusion Materials.
 - 11. ASTM D2240, Rubber Property-Durometer Hardness, Test Method.
- B. American Association of State Highway and Transportation Officials (AASHTO) Standards as referenced throughout these Specifications.
- C. American Water Works Association:
 - 1. AWWA C 302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.
- D. Federal Specifications:

1. Federal Specification SS-S-210A, Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints (Type 1 Rope Form).
- E. PennDOT Publication 408, latest edition.
- F. PennDOT Publication 72 – Standards for Roadway Construction (RC's), latest edition, as referenced throughout these Specifications.

1.03 SYSTEM DESCRIPTION

- A. Concrete Compressive Strength (ASTM C39): 5,000 psi minimum at 28 days.
- B. Water Resistive: No water intrusion through wall, base or top sections.
- C. Concrete shall be designed to be resistant to sulfate.
- D. Manhole inside diameter shall be based on the quantity, size and configuration of inlet and outlet sewers. Minimum inside diameter shall be forty-eight (48) inches.
- E. Top section opening shall be thirty (30) inches and contain four (4) anchoring devices, equally spaced to receive $\frac{3}{4}$ inch frame anchor bolts. Coordinate with frame pattern.
- F. Design standard precast concrete units to withstand design load conditions in accordance with applicable industry standards. Design must consider stressed induced during handling, shipping, and installation to avoid cracking or other handling damage.
- G. Exterior of all manholes to receive two coats of a high build coal tar epoxy.
- H. Force Main Discharge Manholes: Manholes directly receiving pumped flow shall be lined with an HDPE liner.
- I. Watertight manhole frames and covers shall be required where cover submergence is possible or where directed by the Authority.
- J. All manholes and frames and covers shall be designed to withstand H-20 AASHTO loading.
- K. Manholes greater than 20' deep shall be 5'-0" (or greater) in diameter and contain intermediate platforms. Maximum distance between platforms shall be 15' vertically (minimum distance shall be 10' vertically).

1.04 SUBMITTALS

- A. Comply with Section 01 33 00.
- B. Product Data:
 1. Manufacturer's data
 2. Manufacturer's standard storage, handling, and installation instructions
- C. Shop Drawings:
 1. Plans, elevations, sections, and details of base, wall and top components.
 2. Project manhole list including all applicable data not limited to base elevation, in and out pipe size, in and out invert elevations, manhole wall and top section data, height of grade adjustment required/proposed, top of casting elevation.
 3. Where manholes do not strictly conform to applicable details, provide manhole specific detailed drawings.

4. Joint details illustrating sealant.
 5. Pipe penetration details illustrating size, location and type of seal.
 6. Manhole frame anchorage bolt pattern layout.
- D. Calculations: Submit calculations for manholes required to be larger than 48 inches inside diameter. Calculations shall be sealed by a Professional Engineer registered with the Pennsylvania State Registration Board and shall include.
1. Buoyancy calculations assuming ground water elevation is equal to the top of concrete elevation provided on the Contract Drawings.
 2. Structural calculations.
- E. Quality Assurance/Control Submittals
1. Design date
 2. Test Reports
 - a. Upon request, the precast concrete producer shall supply copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for Portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.
 - b. Upon request, the precast concrete producer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, plastic air content, temperature of freshly mixed concrete, and slump of freshly mixed concrete.
 - c. Concrete Testing
 - i. Slump: A slump test shall be performed at least once per day per mix design used. Slump tests shall be performed in accordance with ASTM C 1611 for self-consolidating concrete.
 - ii. Temperature: The temperature of fresh concrete shall be measured each time a slump, air content, or compressive strength tests are made. Temperature shall be measured in accordance with ASTM C 1064.
 - iii. Compressive Strength: At least four compressive strength specimens shall be made each day for each mix design unless otherwise specified. In accordance with ASTM C 31, C 39, C 192.
 3. Qualification Statements
 - a. Upon request, the precast concrete producer shall supply copies of in-plant QA/QC inspection reports.

1.05 QUALITY ASSURANCE

- A. Initial Sanitary Sewer Manholes: Construct first sanitary sewer manholes in the Project to demonstrate the following, and serve as the minimum acceptable conditions of

construction throughout the Project. No additional compensation allowed for initial manhole requirement.

1. Demonstrate manhole base construction methods.
2. Demonstrate manhole component sealing in the case of precast reinforced concrete manholes.
3. Demonstrate manhole step alignment.
4. Demonstrate pipe opening sealing.
5. Demonstrate method of adjustment of manhole frame and cover to grade and manhole frame and cover attachment.

B. 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.

C. Field Inspection:

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

D. Source Quality Control:

1. Precast concrete unit manufacturer shall be listed in PennDOT Bulletin 15.
2. Precast concrete supplier plant shall be registered and certified under either the Prestressed Concrete Institute (PCI) or the National Precast Concrete Association (NPCA) plant certification program.
3. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast reinforced concrete structures.
4. Obtain certificate of construction compliance with ASTM C478 from the precast reinforced concrete structure manufacturer.
5. Obtain sworn certification from manufacturer that sanitary sewer manholes were constructed using Type II Portland cement. No payment for sanitary sewer manholes will be approved until such certificate has been submitted.
6. 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.
7. Obtain certification from manufacturer that manhole frame and cover meets or exceeds AASHTO HS-20 highway loading requirements.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport and handle precast reinforced concrete structure components and other Products specified herein in a manner recommended by the respective manufacturer to prevent damage. Through-wall lifting holes and cast-in lifting cables are not permitted in manhole component construction.

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

1.07 PROJECT/SITE CONDITIONS

- A. Access and Inspection:
 - 1. All work in this section is subject to inspection by the Authority or its representative. Inspectors shall be granted full access to the project site.

- B. Environmental Requirements:
 - 1. In no instance set or construct manhole on subgrade containing frost.
 - 2. To improve workability of Preformed Plastic Sealing Compound during cold weather, store such at temperature above 70° F or artificially warm compound in a manner satisfactory to the Engineer.

PART 2 – PRODUCTS

2.01 PRECAST REINFORCED CONCRETE SANITARY SEWER MANHOLE COMPONENTS

- A. Materials and Construction:
 - 1. Concrete: Composition conforming to ASTM C478, with minimum compressive strength as specified.
 - a. Provide Type II sulfate resistant Portland cement in sanitary sewer precast manhole and force main valve vault components.
 - 2. Reinforcing bars in accordance with ASTM A615 Grade 60.
 - 3. Casting and Curing: Wet cast and steam curing process in accordance with Section 3.6.11 and 3.7.2 of AWWA C302.
 - 4. Joints between manhole components/sections shall be precast tongue and groove design to incorporate a mastic seal.

- B. Precast Riser Sections:
1. Riser sections shall be manufactured in conformance with the requirements of ASTM C-478. Riser sections shall have a minimum wall thickness in accordance with applicable details and design requirements.
- C. Precast Concrete Bases:
1. All manhole bases shall be pre-cast unless otherwise agreed to in writing by the Authority. Contractor shall submit a written request for deviation from this requirement with justification for why a pre-cast base cannot be used.
 2. Precast bases shall be constructed in accordance with ASTM C-478.
 3. Precast bases shall have factor installed pipe openings with integrally cast pipe seals.
- D. Precast Top Sections:
1. Top sections shall be manufactured in conformance with the requirements of ASTM C-478.
 2. 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.
 3. Flat Slab Tops: Flat slab tops shall have a minimum thickness of six (6) inches and shall be reinforced with steel in accordance with the design requirements.
 4. Eccentric Cone Tops: Manufactured to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.
- E. Invert Channels:
1. Invert channels can be precast or field poured. If field poured, refer to Part 3.
 2. Precast invert channels shall be smooth and accurately shaped to a semi-circular bottom conforming to the outside of the adjacent sewer section. Changes in direction of the sewer and entering branches shall have a true curve of as large a radius as constructible based on the manhole inside diameter. Slope channel in accordance with applicable details. Allow for 6 inches of pipe insertion into the manhole. Field apply hydraulic cement around pipe in accordance with applicable detail.
- F. Manufacturers:
1. Terre Hill Concrete Products
 2. By-Crete

3. Monarch Precast Concrete Corporation

2.02 MANHOLE FRAME AND COVER

A. Standard Manhole Frame and Cover:

1. Castings for manhole frames and covers shall be gray iron conforming to ASTM A48, Class No. 30, designed for AASHTO Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects.
 - a. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Entire frame and cover shall be sandblasted clean and then coated with one coat of asphaltum paint.
 - b. Cast the letters "SANITARY" integrally in the center of cover in raised letters.
 - c. Covers shall contain two non-penetrating pick holes.
Frame Hold-down Bolts: $\frac{3}{4}$ " diameter Type 316 stainless steel bolts and washers.

B. Watertight Manhole Frame and Cover

1. Castings for manhole frames and covers shall be gray iron conforming to ASTM A48, designed for AASHTO Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects.
 - a. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Entire frame and cover shall be sandblasted clean and then coated with one coat of asphaltum paint.
 - b. Cast the letters "SANITARY SEWER" integrally in the center of cover in raised letters.
 - c. Covers shall contain two non-penetrating pick holes.
Frame Hold-down Bolts: $\frac{3}{4}$ " diameter Type 316 stainless steel bolts and washers.
 - d. Cover Gasket: One piece gasket factory installed in a machined rectangular or dovetail groove in the cover bearing surface.
 - 1) Gasket material of neoprene composition having good abrasion resistance, low compression set, Type D 40 durometer hardness determine in accordance with ASTM D 2240 and suite for use in sanitary and storm sewer manholes.
 - e. Castings shall be drilled and tapped with stainless steel hold-down bolts.

C. Manufacturers (consult with the Authority for updated model information):

1. Refer to Appendix A

2.03 CLEANOUT FRAME AND COVER

- A. Sanitary Sewer Cleanout Frame and Cover
 - 1. Castings for cleanout frames and covers shall be gray iron conforming to ASTM A48 Class 35 designed for load requirements specified in AASHTO M-306 and Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects.
 - 2. Sized appropriate to accommodate size of cleanout riser pipe.
 - 3. Cover shall be marked "SEWER"
- B. Manufacturers:
 - 1. Vestal Manufacturing Enterprises, Inc.: Model No. LH-10
 - 2. Bingham & Taylor: Lamphole
 - 3. Or Equal with Authority Approval

2.04 ACCESSORIES

- A. Reinforced Plastic Manhole Steps
 - 1. Composed of a 0.5 inch Grade 60, ASTM A615 deformed steel reinforcing bar completely encapsulated a polypropylene copolymer compound conforming to ASTM D4101.
 - 2. Manhole step dimensions shall meet requirements of OSHA standard 1910.27 for fixed ladders.
 - 3. Factory installed in manhole components, pre-aligned vertically, spaced on equal centers, and located as indicated on applicable details.
- B. Grade Rings:
 - 1. Precast Concrete: Leveling and adjusting units of 2-inch, 3-inch or 4-inch thickness conforming to ASTM C-478. Grade rings shall have a minimum opening of thirty (30) inches and shall have precast bolt holes matching frame pattern. Design must provide for full bearing of manhole frame.
- C. Pipe to Manhole Connector
 - 1. Custom preformed during manufacturing in each base and riser section, as required, accommodating type and size of pipe specified.
 - 2. Resilient Gasket Type Connector:

- a. Manufacturers:
 - 1) A Lok Products Corporation; A-LOK X-Cel Connectors.
 - 2) Press-Seal Gasket Corporation; Econoseal
 - 3) Hamilton Kent; Tylox Dual Seal II Series.
 - 4) Or equal.
 - b. Cast integrally with manhole component conforming to requirements of ASTM C-923.
 - c. Connector shall provide a flexible, watertight seal between the pipe and concrete structure (13 psig water-tight sealing in straight alignment and 10 psig water-tight sealing at 7° axial deflection).
- D. Preformed Plastic Sealing Compound
- 1. Sealing compound shall be a butyl rubber base flexible gasket-type sealant meeting or exceeding the requirements of Federal Specification SS-S-210 (210-A), AASHTO M-198-B, and ASTM C-990-91). Material shall be in rope form, supplied with a two-piece cover to preclude adhesion until use. Cross sectional of rope shall be sized to provide squeeze-out of material around entire interior and exterior circumference when joint is completed. Compound shall not require primer to be effective.
 - 2. Manufacturers:
 - a. Henry: RUBR-NEK LTM
 - b. ConSeal: CS-102/202.
 - c. Hamilton Kent Manufacturing Company: KENT-SEAL NO. 2.
 - d. Or equal.
- E. Bituminous Coating
- 1. High build coal tar epoxy for protection of concrete in two-coat applications. Color to be black.
 - 2. Manufacturers:
 - a. Carboline: Bitumastic 300
 - b. Koppers: Super Service Black
 - c. Royston: Roskote 201
- F. Hydraulic Cement
- 1. Portland-cement based quick-setting, non-shrinking mortar with a compressive strength of 4,000 psi after 24 hours. Hydraulic cement shall be completely waterproof and suitable for immersion service. Dry time shall be 3 to 5 minutes.
 - 2. Manufacturers:
 - a. Thoro: Waterplug

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Inspect precast reinforced concrete structure components in accordance with requirements of ASTM C-478 and PennDOT Publication 408 and PennDOT Publication 72 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 precast structure interiors cleared of debris as construction progresses.
- B. Earthwork: Perform earthwork as specified in Section 31 23 33.

3.03 MANHOLE INSTALLATION

- A. Precast Concrete Bases: Install manhole and chamber bases on an 8-inch deep compacted layer of AASHTO No. 57 aggregate.
- B. Length of Pipe Connections into Manholes:
 - 1. Where possible utilize a full stick length of pipe when connection to manholes. In no case install a joint within five (5) feet of the manhole outside wall.
- 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 3,000 psi 28-day compressive strength as specified for Class A Concrete in PennDOT Publication 408, Section 704, unless indicated otherwise on Drawings. Type II Portland cement shall be used for concrete in sanitary sewer structures.
- 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 sealing compound in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.
 - a. 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.
 - b. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
 - c. To improve workability of Preformed Plastic Sealing Compound during cold weather, store such at temperature above 70°F or artificially warm compound in a manner satisfactory to the Authority.
 - d. During warm weather stiffen Preformed Plastic Sealing Compound by placing under cold water or by other means as recommended by the compound manufacturer.
 - e. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
 - f. Make pipe connections into manhole walls as specified for pipes connecting into manhole bases.
 - g. Remove all interior excessive plastic sealing compound after all manhole sections have been set.
- E. Lifting Recess Sealing: Seal with hydraulic cement.
- F. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using precast grade rings (maximum adjustment of 12 inches). Frame and Covers installed within paved areas shall be set at 1/8" below final pavement elevation. Frame and Covers installed in all other areas shall be set within 1/8" of final grade elevations, with exception of manholes with rim elevations identified above final grade elevations.
 1. Set precast grade rings:
 - a. Waterproof Mortar/Portland Cement - Silica Sand. 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.
 2. Preset 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 only 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.

3. When using brick or concrete masonry units for adjustment, set units in full mortar bed, with staggered joints. Strike all joints inside and out.
4. 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.
5. 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.
6. Parge exterior surface of grade rings or masonry units with a minimum 1/2 inch of waterproof mortar or rapid setting concrete. Apply waterproof mortar or rapid setting concrete over frame as shown on applicable details. Paint exterior with bituminous coating.

G. Drop Manholes:

1. A drop connection is required to be installed when the sewer entering a manhole is at an elevation of two (2) feet or more above the invert out of the manhole.
2. Construct drop manholes in accordance with applicable details. Pre-cast manhole sections shall have openings with integrally cast pipe seals to fit design elevations for new installations.
3. Support drop assembly with a concrete cradle as detail. Entire configuration of piping shall be bedded in AASHTO NO. 8 clean stone.

3.04 CONNECTION TO EXISTING INFRASTRUCTURE

A. Connections to Existing Manholes

1. Cut required opening by core boring; prevent cracking and spalling. Make openings of sufficient size to accommodate pipe and annular seal.
2. Install a modular seal (Link-Seal by GPT) and apply hydraulic cement to the interior and exterior of seal.
3. Form a new flow channel in the existing manhole base.
4. During all aspects of work, prevent ground water, surface water, and/or debris from entering the existing infrastructure. Maintain all existing flow during construction.

- B. Connection to Existing Manhole that Cannot be Cored
1. Make openings of sufficient size to accommodate pipe and annular seal.
 2. Install a modular seal (Link-Seal by GPT) and apply hydraulic cement to the interior and exterior of seal.
 3. Form a new flow channel in the existing manhole base.
 4. During all aspects of work, prevent ground water, surface water, and/or debris from entering the existing infrastructure. Maintain all existing flow during construction.
- C. Connections to Existing Sewers:
1. New sewers shall be constructed at a uniform grade to meet the existing sewer at a slightly higher invert elevation than the invert of the existing sewer at the point of proposed connection.
 2. For proposed sewers of a diameter equal to the existing sewer, a new manhole shall be constructed in-line, with the new sewer invert 0.2 ft higher than the upstream invert.
 3. Replace broken or damaged pipe with new pipe. New pipe material shall comply with the Authority's specifications. Use solid sleeve couplings.
 4. Connect new pipe to new manhole bases or new in-line structures as specified.
 5. Replace existing sewer pipe with new pipe to a joint outside the manhole at least five (5) from the manhole outside wall.
 6. Maintain flow in existing sewer both during construction operations and until field poured concrete is cured.

3.05 MANHOLE FRAME AND COVER ADJUSTMENT

- A. Raising of Existing Manhole Frame and Cover
1. An adjustment to within 12 inches of the manhole top section shall be performed in accordance with Section 3.03, Paragraph F.
 2. Adjustments in excess of 12 inches from the existing manhole top section shall be made by removing the top section of each manhole and inserting precast sections to meet required elevation. Each increment of one (1) foot shall contain a manhole step set in alignment with the existing steps. Manhole steps shall comply with the Authority's specifications.
 3. When elevation changes require removal of an existing manhole section(s), the Authority shall be consulted in advance of the work to determine the best method to accomplish the work. All work will be inspected by the Authority.

4. If the distance from the top of cone to the first step is more than 12 inches, then an additional step shall be installed.
- B. Lowering of Existing Manhole Frame and Cover
1. Adjust frame and cover in accordance with Section 3.03, Paragraph F. Remove all existing grade adjustment components down to the top of the manhole and replace with new materials.

3.06 FUTURE PIPE OPENINGS IN MANHOLES

- A. When a future pipe connection(s) have been planned for a manhole, pipe opening shall be plugged to prevent exfiltration/infiltration.
1. Install a short piece of pvc with a watertight plug.

3.07 FIELD QUALITY CONTROL

- A. General: Each manhole shall be tested as specified.
1. Conduct tests in the presence of and to the complete satisfaction of the Authority.
 2. Should a manhole not satisfactorily pass testing, discontinue manhole construction on the Project until the failed manhole does test satisfactorily.
 3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing as specified.
 4. Prior to testing manholes, thoroughly clean the manhole and seal all openings to satisfaction of the Authority. Seal openings using properly sized plugs.
 5. Perform manhole testing with frames installed. The joints between the manhole, any grade rings, and the manhole frame shall be included in the test.
 6. The tests of the manholes for acceptance shall be conducted after the backfilling has been completed.
- B. Sanitary sewer manholes must pass a vacuum test in accordance with the requirements identified in this Section. If the sanitary sewer manhole is constructed on an existing sewer where sewage flow must be maintained, the test will be visual.
- C. The Authority shall conduct visual inspection of force main chambers.
- D. Vacuum Testing of Sanitary Sewer Manholes
1. Vacuum Testing Equipment:

- a. Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from manhole and to monitor vacuum.
 - b. Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
 - c. Vacuum testing equipment and associated testing apparatus subject to Engineer's approval.
 - d. Provide seal plate with vacuum piping connections for inserting in manhole frame.
2. Vacuum Test Procedure:
- a. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.
 - b. Draw a vacuum of ten inches of mercury and close the valves.
 - c. A passing test is documented when the vacuum does not drop below nine inches of mercury for the following manhole sizes and times.
 - 1) Four foot diameter: 60 seconds.
 - 2) Five foot diameter: 75 seconds.
 - 3) Six foot diameter: 90 seconds.
- E. Repair and Retest: Manhole test failures shall require the determination of the leakage source(s) and subsequent correction.
1. Repair or replace defective materials and workmanship, as is the case, and conduct additional tests and any subsequent repairs and retesting as required until manholes meet test requirements.
 2. Materials and methods used to make manhole repairs must be approved by the Authority.
 3. Make repairs, replacements and retests at no expense to the Authority.
 4. Contractor shall be responsible for all costs for additional inspection of tests.

3.08 BACKFILLING

- A. Backfill and Compact in accordance with the requirements of Section 31 23 33.

END OF SECTION