STANDARD SPECIFICATIONS FOR PRECAST POLYMER CONCRETE MANHOLES AND TUNNEL SHAFTS

GENERAL

A. SCOPE

1. This specification covers the materials and testing of precast polymer manholes and tunnel shafts in sanitary sewer, storm sewers and water lines where corrosion resistance is required.

B. REFERENCES

1. ASTM C 478 (most current) Standard Specification for Precast Reinforced Concrete Manhole Sections
2. ASTM C 579 (most current) Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concrete
3. ASTM C-39 (most current) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C-307 (most current) Standard Test Methods for Tensile Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing
5. ASTM C-496 (most current) Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
6. ASTM C-580 (most current) Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concrete
7. ASTM C-443 (most current) Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets
8. ASTM C-857 (most current) Standard Practice for Minimum Structural Design Loading for Underground Utility Structures
9. ASTM C-78-07 (most current) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
10. ASTM D-543 (most current) Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
11. ASTM C-704 (most current) Standard Test Method for Abrasion Resistance of Refractory Materials at Room Temperature
12. ASTM C-1609-06 (most current) Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading)
13. ASTM E-1131-20 (most current) Standard Specifications for Compositional Analysis by Thermogravimetry
14. ASTM C-923 (most current) Standard Specifications for Resilient Connectors between Concrete Manhole Structures and Pipe
15. ASTM C-990 (most current) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections using Preformed Flexible Joint Sealants
16. ASTM C-497 (most current) Test Methods for Concrete Pipe, Manhole Sections, or Tile
17. ACI 350-06 Code Requirement for Environmental Engineering Concrete Structures & Commentary
18. ACI 440.1R-15 Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars

19. ACI 548.6R-96 Polymer Concrete-Structural Applications State-of-the-Art Report
20. Compliance with California Greenbook Standard Specification for Public Works Construction Section 211-2
21. Compliance with California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)

C. SUBMITTALS

1. Conform to bid document requirements.
2. Submit manufacturer's data and details of the following items for approval:
3. Shop drawings of precast polymer concrete manhole and tunnel shaft sections, base units and construction details, jointing methods, materials, and dimensions
4. Summary of criteria used in precast polymer concrete manhole and tunnel shaft design including, as minimum, material properties, loading criteria, and dimensions assumed. Certification from manufacturer that precast polymer concrete manhole and tunnel shaft design meets or exceeds the load and strength requirements of ASTM C-478 and ASTM C-857.
5. Precast polymer concrete manhole and tunnel shaft design, engineering, and quality control program shall meet or exceed industry standards and current ISO 9001-2015 guidelines.
6. Frames, grates, rings, and covers,
7. Independent chemical resistance testing conducted in accordance with the Standard Specifications for Public Works Construction (California Greenbook) Section 211-2

D. PRODUCTS

1. PRECAST POLYMER CONCRETE MANHOLES

i. Provide acid resistant precast polymer concrete manhole and tunnel shaft sections, base sections and related components referencing to ASTM C-478. ASTM C-478 material and manufacturing is allowed compositional and dimensional differences required by a precast polymer concrete product.

ii. Provide base riser section with floors, unless shown otherwise.

iii. Provide riser sections joined with bell and spigot/ship-lap design seamed with butyl mastic, or polymer mortar so that on assembly, manhole base, riser, and top section make a continuous and uniform manhole and tunnel shaft structure.

iv. Construct riser sections for precast polymer concrete manholes and tunnel shafts from standard precast polymer concrete manhole and tunnel shaft sections of the diameter indicated on drawings. Use various lengths of precast polymer concrete manhole and tunnel shaft sections in combination to provide correct height with the fewest joints.

v. Design wall sections for depth and loading conditions with wall thickness as designed by precast polymer concrete manufacturer.

vi. Provide tops to support AASHTO HS-20 or HL-93 or vehicle loading or leads as required and receiving cast iron frame, covers or hatches, as described on drawings.

2. DESIGN CRITERIA

i. Precast polymer concrete manhole and tunnel shaft risers, cones, flat lids, grade rings and manhole base sections shall be designed by manufacturer to meet the intent of ASTM C-478 with allowable compositional and sizing differences as modified to accept polymer construction in lieu of concrete.
ii. AASHTO HS-20 or HL-93 design or as required loading applied to manhole cover and transition and base slabs.
iii. Precast polymer concrete manholes and tunnel shafts will be designed based upon live and dead load criteria in ASTM C-857 and ACI-350-06.
iv. Unit soil weight of 120 pcf located above portions of manhole and tunnel shaft, including base slab projections.
v. Internal liquid pressure based on unit weight of 63 pcf.
vi. Dead load of manhole and tunnel shaft sections fully supported by precast polymer concrete manhole and tunnel shaft base.

3. DESIGN

i. Precast polymer concrete manhole risers, cones, flat lids, grade rings and manhole base sections are designed to meet loading requirements of ASTM C-478, ASTM C-857 and ACI 350-06 as modified for polymer concrete manhole design as follows:
ii. Precast polymer concrete matrix shall be comprised of a thermosetting resin system and inorganic aggregate.
iii. Resin System: The liquid thermosetting resins system shall consist of a mixture of base resin, curing agents to facilitate the exothermic/catalytic reaction along with various additives. The minimum resin content used shall not be less than 7% (by weight) in accordance with ASTM D-2584 (most current) – Standard Test Method for Ignition Loss of Cured Reinforced Resins. The thermosetting resin binder system shall be vinyl ester, containing no Hazardous Air Pollutants (H.A.P.), and no Volatile Organic Compounds (V.O.C.), such as styrene monomer.
iv. Aggregate System: The aggregate system shall consist of inorganic mineral fillers, such as quartz and silica and inert mineral media. All aggregates are specified to meet applicable requirements (excluding gradation) of ASTM C-117 and ASTM C-136 (most current) and are specified by producer to be clean of organic materials and dried. All fillers and aggregate shall be inert in an acidic environment.
v. The polymer concrete matrix shall not contain Portland cement.
vi. Reinforcement: FRP Bar in accordance with ACI-440.1R-06 (most current) or steel reinforcement in accordance with ACI 301 (most current) design practices based on specific project needs.

4. PHYSICAL PROPERTIES

i. The precast polymer concrete matrix shall meet the following minimum physical properties.
    1. Compressive Strength: ≥ 12,000 psi (ASTM C-39)
    2. Tensile Strength: ≥ 1,500 psi (ASTM C-496)
    3. Modulus of Elasticity: ≥ 2.4 x 10^6 (ASTM 1609-06)
    4. Density: 145-150 lbs./CF

5. Water Absorption: > 0.01%

ii. The wall thickness of precast polymer concrete structures shall not be less than that prescribed by the manufacturers design by less than 95% of stated design thickness.

iii. Each precast polymer concrete manhole and tunnel shaft component shall be free of all defects, including indentations, cracks, and foreign inclusions that, due to their nature and degree or extent, detrimentally affect the strength and serviceability of the component part. Cosmetic defect shall not be cause for rejection. The nominal internal diameter of manhole components shall not vary mor the 2%.

iv. Marking and Identification – Each manhole shall be marked with the following information – Manufacturer's name and/or trademark, and Production Date.

v. Joint sealing surfaces shall be free of dents, gouges and other surface irregularities that affect joint integrity.

vi. Minimum clearance between wall penetrations and joints shall be per manufacturer's design.

vii. Construct invert channels to provide smooth flow transition with minimal disruption of flow at pipe-manhole connections. Invert slope through manhole is as indicated on drawings. Polymer bench and channel shall be constructed with polymer concrete materials. Extended ballast slab requirement, if needed, for buoyancy concerns can be addressed with cementitious concrete material.

viii. Provide resilient connectors conforming to requirements of ASM C-923 or other options as available. All connectors are to be watertight. Install approved resilient connectors at each pipe entering and existing manholes and tunnel shafts in accordance with manufacturer's instructions.

E. **QUALITY ASSURANCE / QUALITY CONTROL**

1. Precast polymer concrete manufacturer shall maintain a documented Quality Control Program that meets or exceed industry standards. This may include documentation using an internet-based, Radio Frequency Identification (RFID) tracking solution with each component or by adhering to current ISO 9000 manufacturing guidelines.

F. GROUTING

1. All materials needed for grouting and/or patching shall be a vinyl ester mortar compound recommended and approved by polymer concrete manhole manufacturer.

G. MANUFACTURER

1. RockHardscp® Licensed Manufacturer (www.solidcastpolymer.com), 281-797-0457