ITEM NO. 850

Polymer Concrete Sanitary Sewer Structures

850.1 DESCRIPTION: This item shall govern for the construction of all polymer concrete sanitary sewer structures other than standard sanitary sewer structures (Specification Item No. 852). Structures shall be required for all sewer main larger than 24 inches. Structures are defined as greater than 4 ft. in diameter.

850.2 REFERENCED STANDARDS: Reference standards cited in this Specification Item No. 850 refer to the current reference standard published at the time of the latest revision date:

1. San Antonio Water System (SAWS):
   a. Specifications for Water and Sanitary Sewer Construction
   b. SAWS Materials Specifications
2. City of San Antonio (COSA) Standard Specification for Construction
3. Texas Commission of Environmental Quality (TCEQ)
   a. 217 Design Criteria for Domestic Wastewater Systems
   b. 213 ("Edwards Aquifer Recharge Zone")
4. ASTM – American Society for Testing and Materials:
   a. ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
   b. A536: Standard Specification for Ductile Iron Castings.
   c. ASTM A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   d. ASTM C 33 Standard specification for concrete aggregates
   e. ASTM C 443 Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
   f. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections
   g. ASTM C 497 Test Methods for Concrete Pipe, Manhole Sections, or Tile.
   h. ASTM C 579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic, Surfacing, and Polymer Concretes
   i. ASTM C 580 Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
   j. ASTM C 857 Standard Practice for Minimum Structural Design Loading for Underground Utility Structures.

k. ASTM C 890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
l. ASTM C 913 Standard Specifications for Precast Concrete Water and Wastewater Structures.
m. ASTM C 923 Standard Specifications for Resilient Connectors between Concrete Manholes Structures and Pipe.
n. ASTM C 990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
o. ASTM D 638 Test Method for Tensile Properties of Plastics.
p. ASTM D 648 Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edgewise Position.
q. ASTM D 698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft.)
r. ASTM D 790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
s. ASTM D 1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
t. ASTM D 1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique.
u. ASTM D 1693 Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
v. ASTM D 2584 Test Method for Ignition Loss of Cured Reinforced Resins.
w. ASTM D 2665 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
x. ASTM D 2996 Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
y. ASTM D 2997 Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
z. ASTM D 6783 Standard Specification for Polymer Concrete Pipe.

5. American Concrete Institute
   a. ACI 350-06 Code Requirements for Environmental Engineering Concrete Structures & Commentary
   b. ACI 440.1R-15 Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars
   c. ACI 548.6R-96 Polymer Concrete-Structural Applications State-of-the-Art Report
6. American Society of Mechanical Engineers
   a. ASME B 16.1 Cast Iron Pipe Flanges and Flanged Fittings

850.3 SUBMITTALS: Contractor shall submit manufacturer's product data, instructions, recommendations, shop drawings, and certifications. All submittals shall be in accordance with Engineer's requirements and submittals shall be approved by the Engineer prior to delivery.

1. Submit shop drawings for each structure.
2. Drawings shall include station number, location, rim and invert elevations, dimensions, reinforcing details, joint details, and component parts, base units and construction details, jointing methods, materials, and dimensions.
3. Summary of criteria used in structure design including, as minimum, material properties, loading criteria, and dimensions.
4. Include certification from manufacturer that polymer concrete structure design meets or exceeds the load and strength requirements and are manufactured in accordance with ASTM C 478, ASTM C 857, and ASTM D 6783, and when applicable reinforced in accordance with ACI 440.1R-15.
5. Submit calculations signed by a Professional Engineer Registered in the State of Texas demonstrating the structures meets the design criteria established in plans.
6. Structures shop drawings shall be sealed by a licensed Professional Engineer Registered in the State of Texas.
7. Submit Manufacturer's certification for each type of cast iron frame, grate, cover, or hatch.
8. Materials to be used in fabricating pipe drop connections (must be approved by Director of Engineering).
9. Materials to be used for pipe connections.
10. Materials to be used for stubs and stub plugs, if required.
11. Proof of independent chemical resistance testing conducted in accordance with the standard specifications.
12. Current ISO 9001 Certification or SAWS approved certification.
13. Submit proposed methods, equipment, materials and sequence of operations for sewer construction.
14. Submit all test reports and pre and post sewer television inspection video.
15. Videos become property of SAWS.

850.4 MATERIALS:

1. All fabrication will take place in an all polymer concrete fabrication facility.
2. All structures shall be watertight and polymer concrete manufacturer must be listed in SAWS current Approved Products List (APL).
3. Structure covers shall be watertight. Depending upon their specific location, Design Plans and Specifications shall designate locations of vented structures/structures.
4. Every structure cover located in the Edward's Aquifer Recharge Zone, shall be watertight.
5. Sewer structure ring and cover castings shall meet the current requirements of

AASHTO Designation M306-10 and must be listed in most current SAWS APL.

6. Compressive strength: Polymer concrete shall have a minimum unconfined compressive strength of 9,000 psi when measured in accordance with ASTM C 497.
7. Polymer Concrete Mix Design shall consist of thermosetting resin, sand, and aggregate.
    a. All aggregate, sand, and quartz powder shall meet the requirements of ASTM C 33, where applicable.
    b. No Portland cement shall be allowed as part of the mix design matrix.
    c. All sand and aggregate shall be inert in an acidic environment.
8. Reinforcement – Shall use steel reinforcement or acid resistant reinforcement (FRP Bar in accordance with ACI 440.1R) for polymer concrete design.
9. Thermosetting Resin - The resin shall have a minimum deflection temperature of 158° F when tested at 264 psi following Test Method D 648.
    a. The manufacturer shall use only polyester or vinyl ester resin systems designed for use with this particular application.
    b. The resin content shall not be less than 7% of the weight of the sample as determined by test method D 2584.
    c. Resin selection shall be suitable for applications in the corrosive conditions to which the polymer concrete manhole structures will be exposed.
    d. Resin additives, such as curing agents, pigments, dyes, fillers and thixotropic agents, when used, shall not be detrimental to the structure.
10. Provide resilient connectors conforming to requirements of ASTM C 923 or other options as available.
    a. All connectors are to be water tight.
    b. Install approved resilient connectors at each pipe entering and exiting structures in accordance with manufacturer's instructions
11. Elastomeric Gaskets shall be suitable for the service intended. All gaskets shall meet the requirement of ASTM C 443.
12. Round structures shall utilize spigot and bell type joints incorporating either a confined o-ring or single step profile joint.
13. Square and rectangular structures shall utilize a ship-lap joint and be sealed with a butyl rope sealant per ASTM C990 as recommended by the structure manufacturer.
14. Pipe to Structure Connections: Pipes shall be directly connected to all structures using resilient flexible pipe to structure connector per ASTM C923.
15. In cases where cold joint pipe stubs are shown, they shall be grouted using a corrosion resistant grout and rubber water stop grout ring.
16. Cones, reducer slabs, base slabs, and adjusting rings shall be of the same material as adjoining riser sections.
17. Structures shall be designed to withstand all live loads and dead loads as described in project plans and specifications.

a. Dead loads shall include overburden load, soil side pressure and hydrostatic loading conditions.
b. Structures wall thickness shall be designed to resist hydrostatic pressures with a minimum safety factor of 2.0 for full depth conditions from grade to invert.
c. In no cases shall the wall thickness be less than manufacturer recommended thicknesses.
d. Design wall sections for depth and loading conditions with wall thickness as designed by polymer concrete manufacturer
e. Polymer structures will be designed based upon live and dead load criteria in ASTM C 857 and ACI 350
f. Polymer Concrete structures shall be designed by manufacturer to meet loading requirements

18. Structures shall be designed with sufficient bottom anchorage and side friction to resist buoyancy.
19. Field cast floatation collars are acceptable.
20. Joints shall meet the requirements of ASTM C 443.
21. All materials needed for grouting and patching will be a compound provided by the manufacturer or as recommended by the manufacturer.
22. The structure ring and cover shall be of ductile iron construction.
23. The cover shall be solid with no vent or pick holes; hinged with underlying special hinge area leakage protection; the cover secured with four (4) stainless steel bolts; and shall have a recessed "pick bar" for cover opening.
    a. Cam lock type covers <u>shall not be allowed</u>.
    b. Approved manufacturers, are listed in the SAWS APL, have previously completed required inflow leakage shop testing.
    c. The nominal cover diameter shall be 32 inches, with a 30 inch clear opening, as required by TCEQ
    d. Vented structure covers will be specified by the engineer.
24. "Throat/grade rings" shall be made of HDPE and have a maximum thickness of 2 inches.
    a. No concrete throat/grade rings shall be used.
    b. The internal diameter shall match that of the ring and cover's opening.
    c. HDPE "throat/grade rings" are to be used in conjunction with a UV stabilized internal polyethylene liner for the purpose of providing an infiltration/inflow (I/I) barrier.
    d. Approved I/I barrier is listed in SAWS APL.
    e. Note of Clarification: A minimum of two and a maximum of six "throat/grade rings" may be used at each adjusted existing structure.
    f. "Throat/grade rings" are limited to a minimum of two and a maximum of four rings for new structure construction.
    g. Bitumastic Joint Sealant, flat tops, and between the ductile iron ring (frame)

and the uppermost adjustment ring or flat top: See approved APL.

850.5 CONSTRUCTION: All polymer concrete sanitary sewer structures shall be constructed in accordance with these specifications and in conformity with the required lines, grades, sections, and details shown in the contract documents or as directed by the Engineer.

1. Plan operations so as to minimize disruption of utilities to occupied facilities or adjacent property.
2. Construction methods shall conform to manufacturer's recommendations.
3. Where portions of structures are shown in the contract document details, such portions shall be constructed in accordance with applicable provisions of Specification Item No. 850, "Polymer Concrete Sanitary Sewer Structures."
4. Sanitary sewer structures constructed to function as structures or maintenance access appurtenances to gravity sewer systems shall be constructed to accommodate influent and effluent pipes greater than 24 inches in diameter as shown in Standard Drawing DD-850 Series.
5. Structure components shall be manufactured by the vibratory vertical casting process resulting in a dense, non-porous, corrosion-resistant, homogeneous, composite structure.
6. Each polymer concrete structure component shall be free of all defects, including indentations, cracks, foreign inclusions and resin starved areas that, due to their nature and degree or extent, detrimentally affect the strength and serviceability of the component part.
7. The nominal internal diameter of structures components shall not vary more than 2%.
8. Marking and Identification: Each piece or component of the manholes and structures shall be marked in letters no less than 1 inch in height with the following information. Markings shall be legible and located in a place within the manhole or structure.
    - Tag and/or stamp shall be placed in a location that can clearly be seen within the manhole or structure.
    - Manufacturer's name or trademark;
    - Manufacturer's factory location;
    - Manufacturer's serial number;
    - Production date
    - Manhole length;
    - ASTM Designation;
    - Installation assist marks (vertical lines 90^{o} apart at base of manhole).
9. Minimum clearance between wall penetrations and joints shall be per manufacturer's design

10. Construct invert channels to provide smooth flow transition with minimal disruption of flow at pipe-manhole connections.
11. Invert slope through structure as indicated on drawings.
12. All precast base sections to be cast monolithically.
13. Polymer bench and channel are to be constructed with all polymer concrete material.
14. Extended ballast slab requirements for buoyancy concerns can be addressed with cementitious concrete material.
15. Structures shall have engineered and rated lifting devices that shall not penetrate through the wall.
16. Handling and shipping shall be performed in accordance with the manufacturer's instructions.
17. Installation: The installation of structures shall be in accordance with the project plans and specifications and the manufacturer's recommended practices.
18. Handling: Properly rated slings and spreader bar shall be used for lifting.
19. The type of rigging used shall be per the manufacturer's recommendation.
20. Sealing surfaces and joint components shall be inspected for damage and cleaned of all debris.
21. Apply joint lubricant to elastomeric seals. Use only lubricants approved by the manufacturer.
22. Use suitable equipment handle and set structure.
23. Placement and compaction of surrounding backfill material shall be as per Specification Item No. 804 "Excavation, Trenching and Backfill."

850.6 TESTING: The Contractor shall notify Inspector and Engineer 48 hours prior to beginning of structure testing.

1. The Contractor shall perform the testing for all sanitary sewer structures in accordance with the following:
2. All structures must pass a leakage test.
3. The Contractor shall test each structure (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.
4. The Contractor is hereby instructed to conduct either of the two identified tests in the following manner:
    a. Hydrostatic testing shall be conducted by utilizing approved plugs to seal all influent and effluent pipes in the structure and filling the structure to the top of the cone with water.
        (1) Additional water may be added over a 24-hour period to compensate for absorption and evaporation losses.
        (2) At the conclusion of the 24-hour saturation period, the structure shall be filled to the top and observed.

(3) 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.

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

b. Vacuum Testing: Structures shall be tested after construction/installation and backfilling with all connections (existing and/or proposed) in place.

(1) Drop-connections and gas sealing connections shall be installed prior to testing.

(2) The lines entering the structure shall be temporarily plugged with the plugs braced to prevent them from being drawn into the structure.

(3) The plugs shall be installed in the lines beyond drop connections, gas sealing connections, etc.

(4) 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 structure.

(5) No grout shall be placed in horizontal joints prior to testing.

(6) 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 structure.

(7) The test head shall be inflated in accordance with the manufacturer's recommendations.

(8) A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump will be turned off.

(9) With the valve closed, the level vacuum shall be read after the required test time.

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

(11) The required test time is 2 minutes.

c. Acceptance: Any structure which fails the initial test must be repaired per manufacturer's recommendation with a suitable material based on the material of which the structure is constructed.

d. The structure shall be retested as described above until a successful test is attained.

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

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

g. The Owner may elect to simply remove and replace the existing structure

with a new one.

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

i. The Contractor also has the option of backfilling with approved secondary materials, subject to the provisions of Specification Item No. 804, "Excavation, Trenching and Backfill."

5. If a sanitary structure fails to pass one of the above tests, it shall be repaired in accordance with the manufacturer's recommendations and re-tested.

6. It shall not be accepted until it passes all tests.

7. All repairs and re-testing shall be at no additional cost to SAWS.

850.7 MEASUREMENT: Polymer Concrete Sanitary Sewer Structures will be measured as each structure complete in place.

850.8 PAYMENT: The work, as prescribed by this item, will be paid for at a Lump Sum unit price bid for each "Polymer Concrete Sanitary Sewer Structures,"

1. Sanitary sewer structures shall be paid at the contract lump sum unit price bid for each such structure. Percentages for completion shall be as outlined below and will be based on the completion of the following milestones:

a. Milestone 1: 40% of LS - Structure setting to include for each such structure, excavation, compaction, setting structure base setting to include concrete base encasement with reinforcements, saw cutting of surfaces as required and connection of new or existing sewer pipes to the structure as described in this specification. After curing the structure flowline elevation shall be verified by Licensed Surveyor in the State of Texas and a certified report furnished to Inspector, prior to payment and uploaded to CPMS. Furnishing and placing all materials necessary to complete the work is included in Milestone 1 and must be completed prior to payment (40%).

b. Milestone 2: 40% of LS – Structure Riser Installation and Flowable fill (up to 1 foot above cone section), drop pipes, reinforced concrete, fittings, labor, tools, equipment, tees, wyes, I&I barrier, and incidentals trench protection, and disposal of material excavated backfilling and compaction. Furnishing and placing all materials necessary to complete the work is included in Milestone 2 and must be completed prior to payment (40%).

c. Milestone 3: 20% of LS - Sanitary Sewer Structure Encasement and Testing. This pay item includes: structure concrete encasement, rebar, HDPE throat/grade rings, ring and cover, surface restoration, includes all structure testing in accordance for leakage, separate and independent of the all other sanitary sewer piping. Furnishing and placing all materials necessary to complete the work is included in Milestone 3 and must be

completed prior to payment (20%).

2. Materials paid on site will be in accordance with Table 1 of Specification Item No. 100, “Mobilization.”
3. Concrete cradles for pipes shall be measured and paid for at the contract unit price bid as provided for in Specification Item No. 858, "Concrete Encasement, Cradles, Saddles and Collars."
4. Gravel subgrade filler for structures shall not be measured separately for payment.

Pay Item	Description	Units
	Polymer Concrete Structure	Lump Sum
850.6.1.a	Milestone 1: Structure setting	40% of LS
850.6.1.b	Milestone 2: Structure Riser Installation and Flowable Fill	40% of LS
850.6.1.c	Milestone 3: Sanitary Sewer Structure Encasement and Testing	20% of LS

-End of Specification-