

San Antonio Water System Standard Specifications for Construction

ITEM NO. 857 Fiberglass Reinforced Pipe for Large Diameter Gravity Sanitary Sewer

857.1 DESCRIPTION: This item shall govern the designing, fabricating, furnishing, installing, and joining of large diameter (18-inch or greater) fiberglass sewer piping for gravity-flow conveyance of wastewater. The pipe size, centerline alignment, and grades are presented in the project Drawings. All materials and construction shall be in accordance with the Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewerage systems 30 TAC 217.1, 30 TAC 217.2, 30 TAC 217.3, and 30 TAC 217.13, or any revision thereto as applicable.

857.2 REFERENCED STANDARDS: Reference standards cited in this Specification Item No. 857 refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification Item No. 857, unless a date is specifically cited.

1. San Antonio Water System (SAWS):
 - a. Specifications for Water and Sanitary Sewer Construction
 - b. SAWS Materials Specifications
 - c. City of San Antonio (COSA) Specifications for Construction
2. Texas Commission of Environmental Quality (TCEQ)
 - a. Chapter 217 Design Criteria for Domestic Waste Water Systems
 - b. Chapter 213 Edwards Aquifer
 - c. Chapter 290 Rules and Regulations for Public Water Systems
3. American Society for Testing and Materials (ASTM) International:
 - a. D3236, Standard Test Method for Apparent Viscosity of Hot Melt Adhesives and Coating Materials
 - b. D3262, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
 - c. D3681, Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition
 - d. D4161, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
 - e. ASTM D 3839 Standard Practice for Underground Installation of "Fiberglass" Pipe
 - f. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
4. American Water Works Association (AWWA)
 - a. AWWA M45 Fiberglass Pipe Design
5. International Organization of Standardization (ISO)
 - a. ISO9001

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857.3 SUBMITTALS:

1. All submittals shall be in accordance with Owner's requirements and submittals shall be approved by the Engineer prior to delivery.
2. Shop Drawings:
 - a. Catalog Data Sheets for all materials.
 - b. Cut Sheets
 - c. Details of all piping system components confirming that the pipe and fittings conform to the specified requirements.
 - d. Fabrication drawings showing:
 - 1) Wall thickness.
 - 2) Pipe length.
 - 3) Pipe joint.
 - 4) Design of pipe and fittings.
 - 5) Gasket details.
 - e. Shop drawings shall include fittings and specials that are to be installed.
 - f. Pipeline layout and profile drawings showing location, station, and invert elevation of pipe sections, fittings, closure pieces and test closures. Test methods and results including certification that pipe exceeds the minimum requirements of ASTM D2412, ASTM D2992, and ASTM D3262 as appropriate and International Organization of Standardization (ISO) 9001 certification. Quality control test reports shall be supplied by the manufacturer and be representative of the pipe fabricated for this project. All testing results shall be signed and sealed by a Texas Registered Professional Engineer and shall be in full compliance with the Standards. Strain corrosion test annual reconfirmation tests reports (1000-hr test) shall be from the production facility providing pipe for the project and conducted within the previous 18 months, and shall be accompanied by the base-test report (10,000-hr test).
 - g. Design calculations to meet all loadings: In-situ, service, handling, and jacking pressure. Calculations confirming the pipe will handle anticipated loading signed and sealed by a Licensed Professional Engineer in Texas
 - h. Manufacturer shall verify that pipe stiffness provided meets conditions as represented in the Contract Documents. If computer calculations are used, include example calculations to show the logic employed.
 - i. Manufacturer shall provide a certificate of compliance to these specifications referencing project name and location. Manufacturer shall provide ISO 9001 certificate by a third party.
 - j. Test reports: Furnish an affidavit certifying that all Fiberglass Reinforced Pipe meets the provisions of this Section and has been tested and submit reports from tests in accordance with ASTM D3262 and ASTM D4161.
 - k. A copy of the full ASTM D3681 Strain Corrosion test report verifying that the proposed FRP meets the long-term corrosion resistance required for Septic Sanitary Sewer service when tested using 1N Sulfuric Acid.
 - l. The test report and all data shall be from sample production pipe from the plant which will be supplying pipe to this project.
 - m. Data from other sites, or report with mix data are subject to rejection by the Engineer.

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- n. Manufacturer shall provide a certificate confirming that it meets the required experience levels for years of production and footages and sizes as described in the specifications.
- o. Manufacturer's written instructions for handling, transporting, storage, and installation of pipe.
- p. Manufacturer shall provide as a Shop Drawing; recommendations for embedment, manhole connection details, encasement details, and any repair details.

857.4 MATERIALS:

- 1. General
 - a. The work to be performed in this section includes design calculations, detailing, and fabrication of FRP for the conveyance of raw sanitary sewage. Pipe design calculations will be required for open-trench and tunneling installation methods.
 - b. Other work performed under this section includes: shop testing;
 - c. Fabrication of fittings and appurtenances; handling, storage and protection; and loading and transportation of completed fittings and appurtenances to the construction site.
 - d. All pipes shall be manufactured specifically for this project and no pipe shall be furnished from stock unless approved by the Owner.
 - e. The internal liner shall be suitable for service in a sewer pipe and shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfuric gases. Liner shall meet or exceed requirements of ASTM D3681.
- 2. Pipe
 - a. Performance / Design Criteria
 - 1) Design in accordance with ASTM D3262 including the appendix and subsequent specifications, and in accordance with SAWS specifications. Depths shall comply with requirement of ASTM D3681.
 - 2) Design pipe for service loads that include:
 - i. External groundwater and earth loads
 - ii. Jacking/pushing loads (Acceptable Manufacturer only)
 - iii. The allowable jacking/pushing capacity shall not exceed 40 percent of the ultimate compressive strength or the maximum allowable compressive strength recommended by the manufacturer, whichever is less.
 - iv. Traffic loads
 - (a) Practical considerations for handling, shipping and other construction operations.
 - 3) Design is to be conducted under the supervision of a Professional Engineer licensed in the State of Texas, who shall seal and sign the design. Standard lay length of 20 feet, except for special fittings or closure pieces necessary to comply with the Plans.

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- 4) Design of pipe is to include the determination of design pressures up to 25 psi, stresses, external loads, pressure class (PN), and pipe stiffness class (SN).
 - 5) Stiffness (SN) class that satisfies design requirement on the Plans, or not less than SN 72 when used in direct bury operations.
 - 6) All lines must be able to withstand a high-velocity cleaning with a water jet capable of producing a minimum volume of 50 gpm with a pressure of 1500 psi at the nozzle. Install a gauge to indicate working pressure on the discharge of high-pressure water pumps. The jet angle of the outlet must be no greater than 30° relative to the pipe axis. A video of pipe before and after line cleaning must be submitted of all installed lines. No delamination should occur.
 - 7) In no case shall pipe be installed deeper than its design allows.
 - 8) Pipe markings shall meet the minimum requirements of ASTM 3236. Minimum pipe markings shall be as follows:
 - i. Manufacturer
 - ii. Manufacturer Number (identifies factory, location, date manufactured, shift and sequence)
 - iii. Nominal diameter
 - iv. Beam load
 - v. Laying length
 - vi. ASTM designation
3. Gaskets
- a. Supply from approved gasket manufacturer in accordance with ASTM F477 and suitable for service intended.
 - b. Affix gaskets to pipe by means of suitable adhesive or install in a manner so as to prevent gasket from rolling out of pre-cut groove in pipe or sleeve coupling.
 - c. Provide the following gaskets in potentially contaminated areas.
 - 1) Petroleum (diesel, gasoline) – Viton
 - 2) Other contaminants – Manufacturer recommendation
4. Joints
- a. Joints for pipe and fitting shall conform to the material and performance requirements of ASTM D4161. Depths shall comply with requirements of ASTM D3681.
 - b. Field connect pipe with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as sole means to maintain joint water tightness.
5. Fittings

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All bends exceeding a two-degree horizontal or vertical deflection shall consist of a manufacturer fabricated fitting meeting the same requirements as the pipe material. Provide tolerance of laying length of fittings to +/-2 inches. Use only manufactured fittings. Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber reinforced overlays. For pipe diameters 18 inches or larger, lateral openings 6 inch or greater in size shall be made using inserta-tee conforming to ASTM D3034 service connections, approved by Engineer.

6. Couplings
Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness. Elastomeric sealing gaskets shall be recommended by the manufacturer for application with sanitary sewage. Chemical grout, epoxy grout, or internal repair boots will not be accepted as long-term watertight seals. The joints must meet the performance requirements of ASTM D4161.
7. Structure Connections
Provide an FRP water stop flange (wall pipe) or raised rib for water-tight connection to a concrete cast-in-place structure/manhole.
8. Dimensional Tolerances
 - a. Inside diameter
Pipe shall not vary more than 1/8 inch from the nominal inside diameter.
 - b. Roundness
The difference between the major and minor outside diameters shall not exceed 0.1 percent of the nominal outside or 1/4 inch, whichever is less.
 - c. Wall thickness
Provide minimum single point thickness no less than 98 percent of stated design thickness.
 - d. End Squareness
Provide pipe ends square to pipe axis with maximum tolerance of 1/8 inch.
 - e. Fittings
 - 1) Provide tolerance of angle of elbow and angle between main and leg of wye or tee to ± 2 degrees.
 - 2) Provide tolerance of laying length of fitting to ± 2 inches.
9. Acceptable Manufacturer
 - a. Vendors must have approval through SAWS Standards Committee prior to product use and must meet all requirements set forth in this Specification Item No. 857.

857.5 CONSTRUCTION: All sanitary sewer mains shall be constructed in accordance with the specification herein outlined and in conformity with the required lines, grades, and details shown in the contract documents and as directed by the Engineer.

1. Quality Control
 - a. All project pipes shall be provided by a single manufacturer

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- b. Only the pipe and fittings that will be installed during a single work day will be allowed to be stored within the barricaded work area
 - c. Pipe manufacturing operations shall be performed under the control of the manufacturer.
 - d. All pipe furnished shall be in conformance with this Specification Item No. 857 and ASTM D3262.
2. Delivery of Materials
Provide adequate strutting during transport to prevent damage to the pipe, fittings and appurtenances in accordance with manufacturer's recommendations.
3. Storage Requirements
- a. Gravity pipe shall be stored and handled in accordance with the manufacturer's guidelines or Engineers recommendations.
 - b. All products shall be stored above the ground upon platforms, pallets, skids, or other supports supplied by the Contractor and approved by SAWS. Products shall be kept free from dirt and other foreign matter.
 - c. All products shall be stored to permit ready access for identification and inspection by the Inspector.
 - d. If new pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Inspector or Engineer at the Contractor's expense, before proceeding further. Deliver, store, and handle other materials as required to prevent damage.
 - a. Pipe laid directly on the ground shall be placed on an area free of loose stones or sharp objects in accordance with manufacturer's recommendations and approved by SAWS.
4. Pipe Handling
- a. The Contractor shall abide by the required handling techniques specified by the Manufacturer.
 - b. The Contractor shall provide suitable quantities of all lifting equipment to handle the pipe. In no case shall any equipment be used that is not rated to handle the intended loading or conditions of use to which it will be subjected, or which will damage or gouge the pipe.
 - c. Dragging or dropping the pipe shall not be allowed.
 - d. Haul and distribute pipe and fittings at the project site.
 - e. Handle piping with care to avoid damage.
 - f. Inspect each joint of pipe and reject or repair any damaged pipe prior to lowering into the trench.
 - g. Use only nylon ropes, slings or other lifting devices that will not damage the surface of the pipe for handling pipe.
5. Pipe Installation
- a. Engineer and/or Inspector may request to inspect pipe prior to installation.
 - b. Install pipe, fittings, specials and appurtenances as specified herein, and in accordance with the pipe manufacturer's recommendations or Engineers requirements.

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- c. Must follow manufacture recommendation for initial and bedding.
- d. Lay pipe to the lines and grades as indicated on the Plans. Clean ends of pipe and coupling components. Apply manufacturer approved joint lubricant to pipe ends and to the elastomeric seals of coupling. Use suitable equipment and end protection to push or pull the pipes together, applying a uniform seating force across the entire pipe and coupling circumference. Do not exceed forces recommended by the manufacturer for coupling pipe. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer, and not more than 2-degrees unless approved by the Engineer. Excavate and backfill trenches in accordance with the SAWS Standard Specification Item No. 804.
- e. Pipe Separation: Sewer pipe separation distances shall be maintained in accordance with TCEQ rules 30 §217.53.
- f. Laser Beams: The use of laser beams for vertical control shall be required.
- g. Contractor shall also make available to the Inspector, when requested, a level and rod, of sufficient sensitivity, to accurately determine differences in elevation between points 300 feet apart with one instrument set-up.
- h. Contractor shall provide a written summary to the Engineer and Inspector of all elevations that all installed, repaired, or replaced sewer main enter and exit a manhole or structure.
- i. No pipe shall be installed in tunnels except as noted in the contract documents or by approval of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not provided in the contract documents, he shall submit to the Engineer a detailed outline of procedures, methods, and use of materials depending on existing soil conditions. This information requires review and approval prior to the commencement of work. Only SAWS Product Standards Committee approved pipe manufacturer will be allowed for tunneling.
- j. No horizontal or vertical curves shall be permitted in conformance with appropriate regulatory agency requirements.
- k. Before leaving the work unattended, the upper ends of all pipelines shall be securely closed with a tight-fitting plug or closure in accordance with manufacturers recommendations and as approved by the Inspector.
- l. The interior of laid pipe shall be kept free from dirt, silt, gravel, or foreign material at all times.
- m. **All pipes in place must be approved by the Inspector before backfilling.**
- n. All fabricated bends shall be encased with reinforced concrete, with #4 Bars at 12-inches on center each way completely around pipe, approximately centered in the encasement thickness, and extending longitudinally one pipe diameter each direction along trench measured from the pipe interior bend point. Concrete encasement shall extend across the full width of the trench to both trench walls. Encasement requirement may be waived by the Engineer if manufacturer certifies that fabricated bends have been designed and constructed to withstand all static and dynamic loads imposed by the service conditions

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- o. When replacing an existing system in place, Contractor shall maintain screens to prevent the entrance of construction debris into the sewer system. Ensure properly temporarily connected or maintain continuous by-pass.
- p. At the close of each operating day:
 - 1) Keep the pipe clean and free of debris, dirt, animals and trash – during and after the laying operation. Effectively seal the open end of the pipe using a gasketed night cap. When not temporarily connected. Cap shall be in accordance with manufacturer’s recommendations and approved by the SAWS.

857.6 TESTING:

- 1. Successful passage of the air test and mandrel test as described under TCEQ Chapter 217 Criteria. Shall be required for acceptance of the mains.
- 2. The Contractor shall perform a low- pressure air test, or an infiltration/exfiltration test, and a mandrel test before the installed work shall be considered accepted. If a gravity collection main is composed of flexible pipe, a deflection test will also be required. Flexible pipe is defined as pipe that will deflect at least 2% without structural distress. Contractor shall insure that all testing is performed in the presence of the Inspector, with copies of all written test results made available to the Inspector. Tests shall conform to the following requirements:
 - a. Low-Pressure Air Test: For sections of pipe less than 27-inch average inside diameter the following procedure for the low-pressure air test shall apply and test shall conform to the procedures described in ASTM C828, ASTM C924, and ASTM F1417 (or other appropriate procedures), except for testing times. The test times shall be as outlined in this section. The pipe shall be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed from the following equation:

$$T = \frac{0.085 \times D \times K}{Q}$$

Where:

T = Time for pressure to drop 1.0 pound per square inch gauge in seconds;

K = 0.000419 x D x L, but not less than 1.0;

D = Average inside pipe diameter, in inches;

L = Length of line of same pipe size being tested, in feet;

Q = Rate of loss, 0.0015 cubic feet per minute per square foot

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internal surface shall be used since a K value of less than 1.0 shall not be used.

The minimum testing times for each pipe diameter is as follows:

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
Inches	Seconds	Feet	Seconds/Ft
18	1,020	133	7.693
21	1,190	114	10.471
24	1,360	100	13.676
27	1,530	88	17.309

* Note: Test time starts after the required 60 seconds of stabilization time has transpired.

- b. The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined above or until failure.
- c. Mains with a 27 inch average inside diameter and larger must be air tested at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

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- d. Infiltration/Exfiltration Test: The total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gallons per inch of diameter per mile of main per 24 hours, at a minimum test head of 2 feet above the crown of the main at an upstream manhole. The Contractor shall use an infiltration test in lieu of an exfiltration test when mains are installed below the ground water level. In such cases, the total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gallons per inch diameter per mile of main 24 hours at a minimum test head of 2 feet above the crown of the main at an upstream manhole, or at least 2 feet above the existing groundwater level, whichever is greater. For construction work occurring within a 25-year floodplain, the infiltration or exfiltration must not exceed 10 gallons per inch diameter per mile of main per 24 hours at the same minimum test head as stated in the previous sentence. If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, the Contractor shall propose to the Engineer, and receive approval therefrom, all necessary remedial action, solely at the Contractor's own cost, in order to reduce the infiltration or exfiltration to an amount within the limits specified herein.

- e. Deflection Testing: As stated in the 30 TAC § 217, deflection test shall be performed on all flexible pipe installed.
 - 1) For mains with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection.
 - 2) For main with an inside diameter 27 inches and greater, a method approved by the Engineer shall be used to test for vertical deflections. A manufacturers approved Go-No-Go deflection rod can be utilized for deflection testing.
 - 3) The deflection test must be accurate to within + 0.2% deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of five percent. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the failed areas final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices. The Engineer should recognize that this is a maximum deflection criterion for all pipes and a deflection test less than 5% may be more appropriate for specific types and sizes of pipe. Upon completion of construction, the Engineer or other Texas Registered Professional Engineer appointed by the owner shall certify to the Inspector, that the entire installation has passed the deflection test. This certification may be made in conjunction with the notice of completion required in 30 TAC § 217.14. (1) of this title (relating to General Provisions). This certification shall be provided for the Owner to consider the requirements of the approval have been met.

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- i. Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) not less than 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. All dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
 - ii. Mandrel Design: The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.
 - iii. Method Options: Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test.
- 4) Test Reports: Submit reports from tests in accordance with ASTM D3262 and ASTM D4161.

857.7 MEASUREMENT:

- 1 All fiberglass gravity sanitary sewer pipes will be measured from the inside (face of wall) of structure to the center of manhole or inside of structure per Linear Foot, complete-in-place along the horizontal centerline alignment. Measurement will be continuous through any fittings in the main including tee-base manholes.

857.8 PAYMENT:

1. Sewer pipe will be paid for at the contract bid price per linear foot complete in place for the types, size and depth constructed. Said price shall be full compensation for furnishing all materials, including pipe, stalling, temporary cap(s) or closures, protective measures, couplings, trenching, pumping, concrete, plugs, laying and jointing, backfilling, select bedding and initial backfill material, tamping, water, labor, tools, equipment, testing, temporary all weather surface in accordance with Specification Item No. 804 and other incidentals necessary to complete the work.
2. Any fittings required to connect to FRP will be incidental to pipe cost.
3. Pay cuts will be measured from the top of ground prior to the Contractor's operation and along the centerline of the pipe to the invert of the pipe.
4. Contractor to provide cut-sheets with centerline pay cuts for approval prior to installation.

End of Specification

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