

San Antonio Water System Specifications for Construction

ITEM NO. 849

Sanitary Sewer Testing

849.1 DESCRIPTION: This item shall consist of air, infiltration/exfiltration, pipe deflection, and settlement tests in accordance with this specification and as directed by the Engineer.

849.2 REFERENCED STANDARDS: Reference standards cited in this Specification Item No. 849 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
4. American Society for Testing and Materials (ASTM) International:
 - a. ASTM C 828 – Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.
 - b. ASTM C 924 – Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
 - c. ASTM D 3034 – Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - d. ASTM F 794 – Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
 - e. ASTM F 1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.
 - f. ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

849.3 SUBMITTALS: Contractor shall submit manufacturer's product data instructions, recommendations, shop drawings, and certifications.

1. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare, and submit test plan for approval by Engineer.
2. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
3. Submit test reports for each test on each segment of sanitary sewer.

849.4 MATERIALS: The materials installed for air and deflection tests shall conform to the appropriate specifications contained within the latest revision of SAWS' Material Specifications.

San Antonio Water System Specifications for Construction

849.5 TESTING OF INSTALLED PIPE: The Contractor shall perform a low-pressure air test or an infiltration/exfiltration test, and, for pipe installed by open cut method, a settlement 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:

1. Low-Pressure Air Test: The procedure for the low-pressure air 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. For sections of pipe less than 36-inch average inside diameter, the following procedure shall apply. 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:

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

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

K = $0.000419 \times D \times L$, 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 internal surface shall be used since a K value of less than 1.0 shall not be used.

San Antonio Water System Specifications for Construction

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
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1,020	133	7.693
21	1,190	114	10.471
24	1,360	100	13.676
27	1,530	88	17.309
30	1,700	80	21.369
33	1,870	72	25.856

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

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.

Mains with a 27-inch or larger average inside diameter may be air tested at each joint instead of air testing entire pipe.

Mains with a 36-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.

2. Infiltration/Exfiltration Test: The total exfiltration, as determined by a hydrostatic head test, must not exceed 10 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

San Antonio Water System Specifications for Construction

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 10 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.

3. Deflection Testing: As stated in the 30 TAC § 217, deflection test shall be performed on all flexible pipe installed.
 - a. For mains with inside diameters less than 36 inches, a rigid mandrel shall be used to measure deflection.
 - b. For mains with an inside diameter 36 inches and greater, a method approved by the Engineer shall be used to test for vertical deflections.
 - c. For rigid pipe, a manufacturer approved "Go, No Go" deflection rod may be used to test deflection, but must be approved by Engineer or Inspector prior to testing.
 - d. The deflection test must be accurate to within $\pm 0.2\%$ 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 area's 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.
 - e. Contractor shall provide 24 hr. notice to Engineer and Inspector prior to any testing.
 - f. Engineer of Record must witness all tests over the EARZ.
 - g. 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.
 - h. The inside diameter of the pipe, for the purpose of determining the outside

San Antonio Water System Specifications for Construction

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.

- i. Mandrel Design: The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed.
 - ii. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number.
 - iii. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe.
 - iv. A proving ring shall be provided and used for each size mandrel in use.
 - v. Method Options: Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test.
 - i. Test Reports: Submit reports from tests in accordance with relevant standards.
4. Settlement Testing: For all gravity sanitary sewer pipe installed by open-cut method the Contractor shall conduct settlement testing of the newly installed sewer to determine whether excessive sagging of the pipe has occurred. This test does **not** identify the precise threshold at which pipe is properly installed. Rather, it provides a simple, easily interpretable means to identify grossly unacceptable installation of gravity sewer pipe. As such, passing this test shall not excuse poor workmanship identified by other means. Contractor shall follow construction QC/QA program established for the specified project per SAWS Standard Specification 903 and follow best practices to maintain horizontal and vertical alignment control.
- a. This test involves television inspection. Requirement for televising, video format, and submittals shall be governed by SAWS Standard Specification 866. If suitable to the project in question the settlement test televising efforts can be combined with but are in addition to and do not in any way replace or nullify, the efforts or requirements associated with SAWS Standard Specification 866.
 - b. Unless otherwise directed by Engineer or Owner, no sewer flow should be introduced into the system when performing settlement test.
 - c. This test shall be conducted no earlier than 30 days after installation of the sanitary sewer pipe and final backfill.
 - d. For the purpose of this test the term "**segment**" is defined as all pipe between two manholes and/or structures and "**pipe section**" is defined as a single piece of pipe up to and including where it joins adjacent pipe(s).
 - e. Segment must be isolated and cleaned to ensure no flow through pipe and

San Antonio Water System Specifications for Construction

- that it is free of dirt, rocks, scale, mud, silt, and any other foreign matter prior to performing this test.
- f. Contact the Inspector prior to testing so that they may witness flooding of the system and testing.
 - g. Water shall be introduced into the pipe to provide meaningful observations. To accomplish this, after cleaning, and immediately before performing this test, contractor shall flood system with an amount of water sufficient to flow from the upstream manhole through the segment to be tested and be observed flowing into the downstream manhole. Introduction of water will then be stopped and any standing water allowed to remain in the segment being tested. Testing shall commence when flow is no longer observed in downstream manhole. The established unit cost for settlement testing shall be inclusive of any and all water and work necessary to deliver water to test site and shall thus be provided by contractor at no additional cost to Owner.
 - h. Settlement testing varies by pipe diameter:
 - i. **For pipes from 8 to 42 inches in diameter:** After advancing television unit through pipe to be tested, connect golf ball with rigid wire and string as necessary for golf ball to be fully visible within CCTV footage and maintain contact with bottom of pipe as golf ball is pulled back through each segment. The golf ball shall have a diameter of 1.68 inches or 42.7 mm. Any and all points along the pipe segment at which the golf ball becomes fully submerged in standing water shall be defined as excessive sag.
 - ii. **For pipes 48 inches in diameter and larger:** Manned entry to the pipe will be made. A rigid steel ruler with zero (0) inch mark at the extreme end shall be placed in all areas of standing water in the pipe such that it is in contact with the lowest portion of the pipe's circumference and a reading of the depth of standing water shall be taken. All such readings shall be documented, including, at a minimum, the depth of water and location (STA or upstream or downstream distance from manhole/structure) of each reading taken. Any and all points along the pipe segment at which the measured depth of standing water exceeds 4.0% of the nominal diameter of the pipe in question shall be defined as excessive sag.
 - i. Any and all pipe section(s) of gravity sanitary sewer in which excessive sag is identified shall be rejected. Contractor shall correct each and every such pipe section, including as many upstream or downstream sections or segments as necessary to eliminate excessive sag(s) while maintaining grade required by the contract documents.

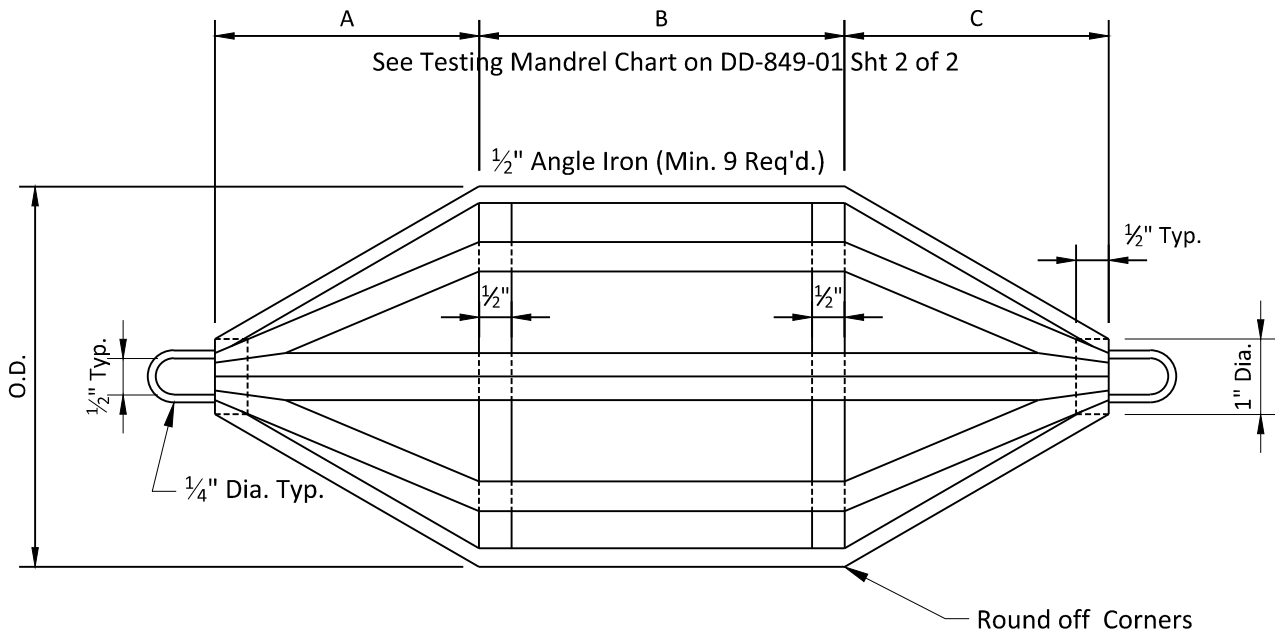
San Antonio Water System Specifications for Construction

- j. No segment, regardless of length, shall have more than three (3) excessive sags. Identification of more than three (3) excessive sags in a segment of pipe shall be cause for rejection and Contractor shall reinstall the segment in its entirety at no cost to Owner.
- k. All corrected sections and/or segments of pipe shall be retested at no additional cost to Owner until all pipe segments pass this and other tests required by SAWS Standard Specifications and contract documents for the project in question.
- l. Excessive sags shall be documented in video and shall be in accordance with NASSCO-(PACP) requirements per SAWS Specification Item No. 866.
- m. Provide televising and associated reports documenting the occurrence of the test and its results to Owner no later than 3 days following the test.

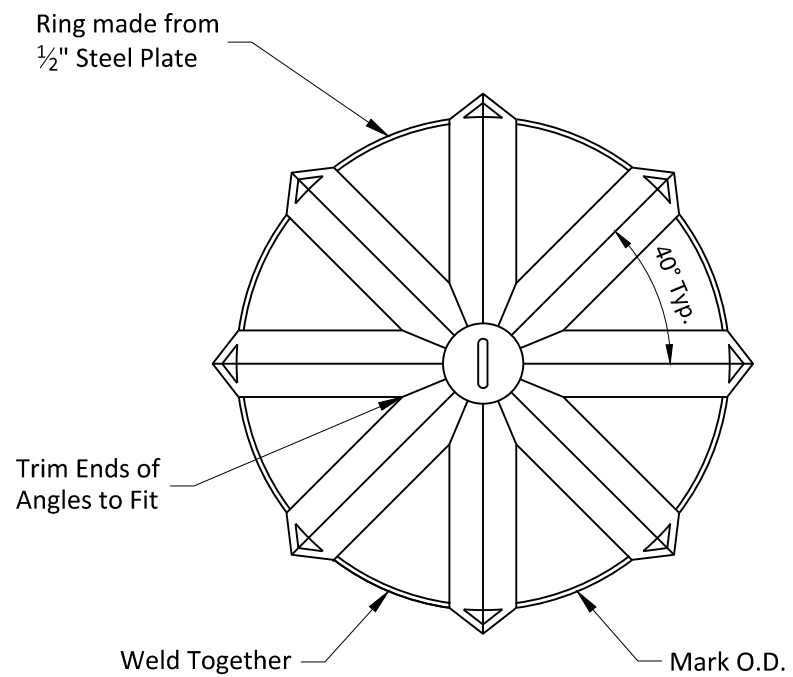
849.6 MEASUREMENT: Air/Infiltration/Exfiltration, and Deflection Testing will not be measured for payment.

849.7 PAYMENT: No direct payment shall be made for Air/Infiltration/Exfiltration and Deflection Testing and all costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains. Refer to Specification 866 for payment of settlement testing.

-End of Specification-



SIDE OR TOP VIEW



END VIEW

Note:
All Mandrels must be Approved by SAWS Construction Inspection Dept. and Stamped before Use.

PROPERTY OF SAN ANTONIO WATER SYSTEM SAN ANTONIO, TEXAS	GO, NO GO DEFLECTION TESTING MANDREL	APPROVED	REVISED
		March 2008	December 2019
		DD-849-01	
		SHEET <u>1</u> OF <u>2</u>	

SIZE	A	B*	MANDREL O.D.	RING O.D.
			PVC (SDR -26)	PVC (SDR -26)
6"	4.0"	4.5"	5.50	4.79
8"	5.5"	6"	7.37	6.66
10"	7.0"	7.5"	9.21	8.50
12"	8.0"	9"	10.96	10.25
15"	10.0"	11"	13.42	12.71
18"	12.0"	13.5"	————	————
21"	14.0"	16"	————	————
24"	16.0"	18"	————	————
27"	18.0"	20"	————	————

*Minimum Length

CHART

Notes:

PVC Pipes and Fittings 6" to 15" in Diameter shall Conform to ASTM D-2241

PVC Pipes and Fittings 18" to 27" in Diameter shall Conform to ASTM F-679

This information is provided as a reference. All deflection testing shall be done in accordance with TCEQ Chapter 217.

PROPERTY OF SAN ANTONIO WATER SYSTEM SAN ANTONIO, TEXAS	GO, NO GO DEFLECTION TESTING MANDREL CHART	APPROVED	REVISED
		March 2008	December 2019
		<i>DD-849-01</i>	