

Introduction

Stormwater drainage systems incorporating Prinsco GOLDFRO® Storm pipe are commonly evaluated during or after installation to verify that the pipe has been properly installed and is performing as intended. Typical field quality checks may include deflection measurements and joint integrity testing. The applicable testing requirements for a given project will be defined in the contract documents and project specifications. This technical note is intended to support—not replace—those project-specific requirements, and should be referenced alongside applicable national standards as they pertain to Prinsco GOLDFRO Storm pipe installations.

Deflection Testing

Flexible pipes, including GOLDFRO Storm, are designed to deflect and develop lateral soil support to carry external loads. As the pipe deflects, the vertical loads arch around the pipe and transfer to the supporting soil. This allows flexible pipes to withstand large loads while still providing a more efficient and easy method of installation compared to other pipe materials. Therefore, it is important for the pipe to be able to deflect or oval under load to avoid structural damage.

Deflection testing is generally not required when using proper construction practices associated with initial backfill material selection, placement, and compaction. However, some projects may require post installation deflection testing as a means of installation quality control.

This is typically accomplished using a mandrel, laser measurement tools, or video inspection. Pulling a mandrel through 10% of the pipe installed provides a reasonable indication of installation quality. A typical mandrel is shown in Figure 1.

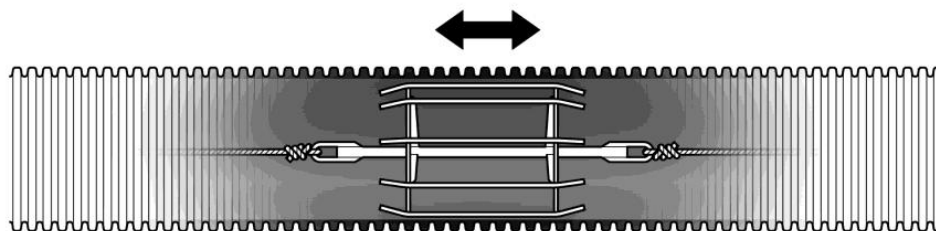


Figure 1: Typical Mandrel

Prinsco recommends a conservative maximum deflection of 7.5% of the base inside diameter (ID). The Base ID is a calculated value of the inside diameter that considers manufacturing variance as well as out of roundness from storage/handling. Some project requirements limit deflection to 5%. Table 1 should be used as a reference when using and sizing measurement devices such as mandrels or lasers.

**Table 1: Deflection Dimensions for Base Diameter**

Nominal Diameter	Base I.D.*	Inside Diameter w/ 5% Deflection	Inside Diameter w/ 7.5% Deflection
in. (mm)	in. (mm)	in. (mm)	in. (mm)
12 (300)	11.82 (296)	11.23 (281)	10.93 (273)
15 (375)	14.78 (370)	14.04 (351)	13.67 (342)
18 (450)	17.73 (443)	16.84 (421)	16.40 (410)
24 (600)	23.64 (591)	22.46 (562)	21.87 (547)
30 (750)	29.55 (739)	28.07 (702)	27.33 (683)
36 (900)	35.46 (887)	33.69 (842)	32.80 (820)
42 (1050)	41.37 (1034)	39.30 (983)	38.27 (957)
48 (1200)	47.28 (1182)	44.92 (1123)	43.73 (1093)
60 (1500)	59.10 (1478)	56.15 (1404)	54.67 (1367)

*Value is the larger of ASTM F2881 and AASHTO M330. If designing to a specific standard, please review allowable minimum diameter.

Results obtained from deflection testing can be easily misinterpreted, so findings should be thoroughly analyzed. Readings from either a mandrel or a laser device may be skewed for a variety of reasons unrelated to pipe deflection. For instance, debris in the pipe, joint misalignment or stubs that protrude inward into the pipeline may result in false negatives. It is important to understand that mandrel testing is a go/no-go test. In cases where abnormalities exist in deflection results, video or visual inspection should be performed prior to any rehabilitation efforts.

Joint Testing

For gravity flow storm drainage systems, various tests may be performed to demonstrate the integrity of the joints of the installed non-perforated pipe. Some important joint testing methods use infiltration and exfiltration. Infiltration helps to estimate the amount of groundwater entering the pipe, and exfiltration helps to estimate the amount of stormwater that is lost to the surrounding soil. The two most common ways of testing stormwater pipe joints are by using air or water to create constant pressure within the system.

Exfiltration Testing with Air – ASTM F1417 & ASTM F3058

Air tests are becoming more common in pipe joint testing due to the ease of using air compared to water. Since air is a compressible gas, it is extremely important to follow all safety regulations as defined in OSHA and project specifications. Two national testing standards that may be applicable to the joint testing of GOLDPRO Storm are ASTM F1417 *Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air*, and ASTM F3058 *Preliminary Field Testing of Thermoplastic Pipe Joints for Gravity Flow (Non-Pressure) Sewer Lines*. When either standard is specified by the project plans, review the standards carefully and follow the testing procedure and safety precautions described.

ASTM F1417 describes the testing of a run of pipe from one manhole to the next adjacent manhole. Inflatable plugs are positioned in the manholes and properly secured. Air is pumped into the pipeline and slowly builds pressure. Once the line has been pressurized to a stable 4.0 psi, the pressure is



decreased to 3.5 psi. The pressure in the line must not drop more than 0.5psi or 1.0psi (whichever is specified by the design engineer) in a specified amount of time.

Pressure Drop Times for Exfiltration Testing with Air

The minimum times for pressure to decrease with respect to a pipe's given diameter and length are given in Tables 2. If a section of pipe loses pressure quicker than the minimum time specified in the tables, that section of pipe fails the test and should be retested or examined to determine the mode of failure.

For lengths of pipe longer than 450 feet, refer to the column "Time for Longer Length" where length of pipe (L) is multiplied by a constant to determine the required pressure-drop test time.

Table 2: Time to Pressure Drop for GOLDPRO Storm (per ASTM F1417)

Pipe Diameter in. (mm)	Pressure Drop (psi)	Minimum Test Time (min:sec)	Length for Minimum Time ft (m)	Time for Longer Lengths (sec)	Time for Length Shown, (min : sec)							
					100' (30.5 m)	150' (45.7 m)	200' (61.0 m)	250' (76.2 m)	300' (91.4 m)	350' (106.7 m)	400' (121.9 m)	450' (137.2 m)
12 (300)	0.5	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
	1	11:20	(60.7)	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15 (375)	0.5	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
	1	14:10	(48.5)	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18 (450)	0.5	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
	1	17:00	(40.5)	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
24 (600)	0.5	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
	1	22:40	(30.2)	13.764 L	22:47	34:11	43:34	56:58	68:22	79:46	91:10	102:33
30 (750)	0.5	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
	1	28:20	(24.4)	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15

Data taken from ASTM 1417-11a Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.

A pressure drop of 0.5 psi is typically used for longer sections of pipeline, pipes of a larger diameter, or both. The pressure-drop time values are represented in Table 2.

For safety reasons Prinsco recommends testing individual joints for diameters 30" and larger. To test individual joints reference ASTM F3058, also known as the joint isolation test. This test is done with either air or water, and the use of inflatable bladders placed on each side of the joint which ultimately creates a void/open space between them. Once the bladders are inflated, the void is pressurized to 3.5 psi. If the pressure drop is less than 1.0 psi (3.6 kPa) in 5 seconds, the joint passes the test. This is a go/no go test with the design engineer having the final decision on acceptance. An advantage to using this test method is the ability to quickly test a joint and make any possible corrections. This is made even simpler by direct physical access to that section of pipe.



Infiltration/Exfiltration with Water – ASTM F2487

For systems designed for watertight applications, water infiltration/exfiltration testing is typically used to demonstrate the integrity of an installed pipeline via the amount of leakage measured. ASTM F2487 *Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High-Density Polyethylene and Polypropylene Pipelines* provides the general guidelines and requirements for testing installed GOLDPRO Storm pipe.

It is necessary to first determine the groundwater conditions around the pipeline section to determine whether an infiltration or an exfiltration test should be used. An infiltration test shall be used if the groundwater level is 2 feet or more above the crown of the pipe for the entire length of the test section. An exfiltration test shall be used if the groundwater level is less than 2 feet. If a field cut is being performed, exposed vent tubes need to be sealed for the field watertight testing procedure. Contact your local Prinsco Representative for information regarding sealing vent tubes.

Allowable Leakage

The leakage criteria for the infiltration and exfiltration testing shall be determined by the owner and is based on the application and design requirements of the system. The maximum leakage allowance commonly used is 100 gallons / (in. of internal diameter) (miles of pipeline) (24 hours).

When the average groundwater head over the pipe is greater than 6 feet for an infiltration test, the allowable leakage shall be increased by the ratio of the square root of the average groundwater head to the square root of the 6 feet head. Also, when the average test head exceeds 3 feet above the top of the pipe in the exfiltration test, the allowable leakage shall be increased by the ratio of the square root of the average test head to the square root of the 3 feet head. Refer to Equation 1 and 2 for the equations used to calculate the adjusted leakage allowances.

Equation 1 and 2: Adjusted Leakage Allowance for Increased Pressure

Infiltration	Exfiltration
$Allowable\ Leakage = 100 \times \frac{\sqrt{Average\ Groundwater\ Head}}{\sqrt{6}}$	$Allowable\ Leakage = 100 \times \frac{\sqrt{Average\ Test\ Head}}{\sqrt{3}}$

Conclusion

Prinsco GOLDPRO Storm is ideal for critical stormwater management applications and may be tested for deflection and joint integrity as discussed in this technical document. The testing procedures that were mentioned are no different than other stormwater products currently being used in the market. This document does not cover the safety concerns associated with testing installed GOLDPRO Storm. Any questions associated with testing GOLDPRO Storm can be directed to your local representative.

It should be noted that this product is intended for the conveyance of fluids. Access into this product for inspection or other reason(s) should be done in accordance with OSHA recommendations for confined space entry.



References

- *ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*
- *ASTM F2487 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High-Density Polyethylene and Polypropylene Pipelines*
- *ASTM F3058 – Standard Practice for Preliminary Field Testing of Thermoplastic Pipe Joints for Gravity Flow (Non-Pressure) Sewer Lines*
- *ASTM F1417 – Standard Practice for Installation Acceptance for Plastic Non-Pressure Sewer Lines Using Low-Pressure Air*
- *ASTM C969 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines*
- *ASTM C1103 – Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines*
- *ASTM F2881 – Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications*