

Introduction

For systems designed for watertight applications, water infiltration/exfiltration testing is typically used to demonstrate the integrity of an installed pipe line 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 non-perforated corrugated HDPE and HP pipe. This technical note provides additional clarification to the requirements and testing procedure outlined in ASTM F2487 as well as Joint Isolation Testing. These testing procedures are intended for pipe with watertight joints meeting the HDPE requirements of AASHTO M252, AASHTO M294, and ASTM F2306, and the HP requirements of AASHTO M330 and ASTM F2881.

General Procedure

It is necessary to first determine the groundwater conditions around the section of pipeline to be tested 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. If the groundwater level is less than 2 feet, an exfiltration test shall be used.

Infiltration Testing:

Below are some of the basic steps for testing a pipeline by an infiltration test.

- Step 1: Pipeline installation and backfilling is to be completed before testing takes place. Allow time for the groundwater to return to the normal level.
- Step 2: Testing shall be done from manhole to manhole. The maximum length of pipe tested should not exceed 700 ft.
- Step 3: Measure the groundwater elevation at both ends and determine the average head over the test section. The average head value will be used to compute the test section allowable leakage as outlined in the Allowable Leakage section on page 3.
- Step 4: Plug all pipe outlets discharging into the upstream manhole. This is done so that only the water infiltrating into the test section will be collected and measured.
- Step 5: Determine the appropriate testing time. Testing should be a minimum of 15 minutes and should not exceed 24 hours. Typical testing times are between 15 minutes and 1 hour.
- Step 6: Begin the test. Collect and measure the amount of water leakage at the outlet of the test section. Measurements are best made by either timing the filling of a small container of a known volume or by directing the flow into a container for a specified time and measuring the content.
- Step 7: If the measured rate of leakage is less than or equal to the allowable leakage for the project, the section of pipeline is acceptable. If the test section fails, the line should be inspected, repaired if needed, and retested in accordance with the previous steps. Contact your local Prinsco Representative for more information about common repair methods.

Exfiltration Testing:

Below are some of the basic steps for testing a pipeline by an exfiltration test.

- Step 1: Pipeline installation and backfilling is to be completed before testing takes place.
- Step 2: Testing shall be done from manhole to manhole. The maximum length of pipe tested should not exceed 700 ft.
- Step 3: Determine the groundwater elevation at both ends of the pipe. If the groundwater level is less than 2 feet above the crown of the pipe on the upstream end of the test section, the exfiltration test shall be used.
- Step 4: Plug all pipe outlets discharging into the upstream manhole as well as the outlet end of the test section. It is critical to ensure that the downstream end is properly plugged and secured. Ensure that all debris is



removed from the test section. Begin filling the test section with water at the upstream end. The amount of time it takes to fill the test section will depend on the length of the test section, the pipe diameter and the water source.

- Step 5: The water level at the upstream end of the pipe should be filled to a level 2 feet above the top of the pipe or 2 feet above the existing groundwater level, whichever is higher. It is recommended to use a plug with a vertical stand pipe to produce the appropriate water level.
- Step 6: Allow the pipe to remain full for a period long enough for stabilization of the pipe to occur and to ensure that all of the trapped air will be removed. The water level in the pipe should be held steady for a minimum of 3 hours and up to 72 hours, depending on the test section length and diameter of the pipe. Water may need to be added throughout the stabilization period to maintain the level in the system.
- Step 7: After the stabilization period is complete, refill the water to the appropriate level determined in Step 5. Begin the test. Measure and record the leakage for a test period of not less than 15 minutes and no more than 24 hours. The leakage can be measured by observing the water column drop in a stand pipe or by adding water at a known rate to maintain the water elevation throughout the test.
- Step 8: If the measured rate of leakage is less than or equal to the allowable leakage for the project, the section of pipeline is acceptable. If the test section fails, the line should be inspected, repaired if needed, and retested in accordance with the previous steps. Contact your local Prinsco Representative for more information about common repair methods.

Manholes should not be included in testing of the pipelines. If the water level is measured in the manhole for the exfiltration test, the leakage associated with the manhole should be subtracted from the overall leakage of the test section to establish a pass or fail grade for the pipe.

Joint Isolation Testing

An alternative to the infiltration and exfiltration testing detailed above is Joint Isolation Testing. This testing procedure allows the end-user to accurately gauge the integrity of each joint within the system and minimizes the amount of external influences affecting the test results. This practice is intended for testing 30 in and larger diameter pipe. This test allows the owner to use water under low pressure to demonstrate the integrity of the joint and construction procedures as the pipe is being installed.

- Step 1: Review proper operation, safety, and maintenance procedures as provided by the manufacturer of the joint test apparatus. Insure the apparatus has documentation indicating it has been properly calibrated.
- Step 2: Ensure that the joint being tested is free of debris. Move the joint test apparatus into the storm sewer line to the joint to be tested and position it to straddle the joint. The bleed-off petcock must be located at top dead center.
- Step 3: Inflate the end element sealing tubes with air in accordance with the equipment and manufacturer's instructions.
- Step 4: Introduce water into the void volume until water flows evenly out of the open petcock at the top of the joint. Close the petcock and pressurize with water to 3.5 psi above the pressure exerted by groundwater above the pipe. Shut off the water supply.
- Step 5: If the pressure holds or drops less than 1 psi in 5 seconds, the joint is acceptable. This is intended to be a go/no go test.
- Step 6: If the joint being tested fails, it should be retested, or repaired if necessary, and retested in accordance with the steps listed above.
- Step 7: After the joint test is completed, exhaust the air from the end element tubes which will release the water from the void volume. The test apparatus can then be moved to another joint to be tested or removed from the pipeline.

**Allowable Leakage**

The leakage criteria for the infiltration and exfiltration testing shall be determined by the owner based on the application and design requirements of the system. The maximum leakage allowance commonly used throughout the industry is 200 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 Table 1 for the equations used to calculate the adjusted leakage allowances.

Table 1 - Adjusted Leakage Allowance for Increased Pressure

Infiltration	Exfiltration
$Allowable\ Leakage = 200 \times \frac{\sqrt{Average\ Groundwater\ Head}}{\sqrt{6}}$	$Allowable\ Leakage = 200 \times \frac{\sqrt{Average\ Test\ Head}}{\sqrt{3}}$

Reference Specifications

- *ASTM F2487 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines*
- *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*