

Bulletin PP-901

LEAK TESTING

Part 1 – Pre-Test Considerations

Leak testing may be used to find leaks in a newly constructed or newly modified piping system, or in an established system where an apparent loss of integrity has been experienced. If they exist, leaks typically occur at joints or connections in the system.

Leak testing does not verify pressure rating or potential long-term performance. The system design and the pressure ratings of the installed components are the sole determinants of system pressure rating and long-term performance.

Liquids such as clean water are preferred as the test medium because less energy is released if the test section fails catastrophically. During a pressure test, energy (internal pressure) is applied to stress the test section. If the test medium is a compressible gas, then energy is used to compress the gas as well as apply stress to the pipeline. If a catastrophic failure occurs during a pneumatic test, both the pipeline stress energy and the gas compression energy are explosively released. With an incompressible liquid as the test medium, the energy release is only the energy required to stress the pipeline.

For M&I applications, leak testing of pressure piping systems is done by filling with a liquid and applying a pressure. Pneumatic (air) testing of pressure piping systems is not recommended.

Leak testing is described in ASTM F2164, "Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure."

SAFETY

Safety is of paramount importance. Leak tests can apply high stress to untried joints and parts in the system. Failure can occur by leaking or by catastrophic rupture that can cause sudden, violent movement. In some cases, leakage may immediately precede catastrophic rupture.

WARNING – Death or serious injury and property damage can result from failure at a joint or connection during pressure leak testing. Keep all persons a safe distance away during testing. The test section is to be supervised at all times during the test.

Ensure that all piping is restrained against possible movement from catastrophic failure at a joint or connection. When pressurized, faulty joints or connections may separate suddenly causing violent and dangerous movement of piping or parts. Correctly made joints do not leak. Leakage at a joint or connection may immediately precede catastrophic failure. Never approach or attempt to repair or stop leaks while the test section is pressurized. Always depressurize the test section before making repairs.

RESTRAIN AGAINST MOVEMENT

Before applying pressure, all piping and all components in the test section must be restrained. This means that if piping or parts move or separate during the test, it will not result in damage or injury. ***Never conduct leak tests on unrestrained piping.***

- D Heat fusion joints must be properly cooled before testing.
- D Mechanical connections must be completely installed and tightened per manufacturer's instructions.
- D If backfill provides restraint, it must be properly placed and compacted.
Joints and connections may be exposed for inspection.
- D End closures must be suitable for pressure service and pressure-rated for the test pressure.
- D Ensure that all connections to test equipment are secure. Disconnect or isolate all low pressure filling lines and all other parts that are not to be subjected to test pressure. Restrain, isolate or remove expansion joints before leak testing.

TEST SECTION

Testing may be conducted on the full system or in sections. Test section length is determined by the capacity of the testing equipment. Lower capacity pressurizing or filling equipment may not be capable of completing the test within permissible time limits. If so, use higher capacity test equipment or select a shorter test section. Before applying test pressure, allow time for the test fluid and the test section to equalize to a common temperature.

TEST PRESSURE

For pressure piping systems that include polyethylene pipe or fittings:

- ▷ The maximum permissible test pressure is measured at the lowest elevation in the test section.
- ▷ The maximum permissible test pressure is the lower of (a) 150% of the system design operating pressure provided that all components in the test section are rated for the test pressure, or (b) the pressure rating of the lowest pressure rated component in the test section.

For leak testing purposes, the maximum allowable test pressure in polyethylene pipe is 150% of the pipe's design pressure rating for the application and the application service temperature.

Do not subject lower pressure rated, non-polyethylene parts or devices to pressures above their pressure rating. Lower pressure rated parts may be removed or isolated from the test section to avoid damage or failure. Vent isolated parts or equipment to atmosphere.

All thermoplastic pipes have reduced strength at elevated temperature. Test pressure must be reduced when the test section is at elevated temperature either from service conditions or from environmental conditions such as being warmed by the sun. Multiply the test pressure by the Table 32 multiplier to determine the allowable elevated temperature test pressure.

Table 32 Elevated Temperature Multiplier

Test Section Temperature °F (°C)	≤ 80 (≤ 27)†	≤ 90 (≤ 32)	≤ 100 (≤ 38)	≤ 110 (≤ 43)	≤ 120 (≤ 49)	≤ 130 (≤ 54)	≤ 140 (≤ 60)‡
Multiplier	1.00	0.90	0.80	0.75	0.65	0.60	0.50
† Use the 80°F (27°C) multiplier for 80°F (27°C) and lower temperatures.							
‡ The maximum service temperature for Performance Pipe PE pressure piping is 140°F (60°C).							

TEST DURATION

When testing at pressures above system design pressure up to 150% of the system design pressure, the maximum test duration is eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow it to relax for at least eight (8) hours before pressurizing the test section again.

CAUTION – Testing at excessive pressure or for excessive time may damage the piping system.

When testing at system design pressure or less, test duration including time to pressurize, time for initial expansion, time at test pressure and time to depressurize should be limited to a practical time period given that the test section is not to be left unsupervised at any time during leak testing.

Test Fluid

HYDROSTATIC TESTING

The test liquid should meet appropriate industry standards for safety and quality so that the environment, system, test equipment and disposal (if necessary) are not adversely affected. The recommended test liquid is water.

PNEUMATIC TESTING

WARNING – Death or serious injury. Failure during a pneumatic (compressed gas) leak test can be explosive and result in death or serious bodily injury.

If failure occurs when using compressed gas as the test fluid, the failure releases the energy applied to stress the piping system, and the energy applied to compress the gas. Such failure can be explosive and dangerous. Compared to hydrostatic testing, pneumatic testing can be more dangerous because failure during pneumatic testing releases more energy. For safety reasons, pneumatic testing is not recommended.

Part 2 – Leak Testing Procedures

Read all of this publication and observe all safety precautions before conducting any leak test.

LOW PRESSURE AIR TESTING OF GRAVITY FLOW SYSTEMS

For gravity flow and low or intermittent pressure applications such as sewer and odor control, leak testing in accordance with ASTM F-1417 is recommended.

HYDROSTATIC LEAK TESTING

This hydrostatic leak test procedure consists of filling, an initial expansion phase, a test phase, and depressurizing. There are two alternatives for the test phase.

Filling

Fill the restrained test section completely with test liquid.

WARNING – Ensure that there is no air trapped in the test section. Failure with entrapped air can result in explosive release and result in death or serious bodily injury. Use equipment vents at high points to remove air.

Initial Expansion Phase

Gradually pressurize the test section to test pressure, and maintain test pressure for three (3) hours. During the initial expansion phase, polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.

Test Phase – Alternate 1

Immediately following the initial expansion phase, reduce test pressure by 10 psi, and stop adding test liquid. If test pressure remains steady (within 5% of the target value) for one (1) hour, no leakage is indicated.

Test Phase – Alternate 2

This alternative is applicable when the test pressure is 150% of the system design pressure.

Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain test pressure for one (1), or two (2), or three (3) hours. If the amount of make-up water needed to maintain test pressure does not exceed the amount in Table 33, no leakage is indicated.

Table 33 Test Phase – Alternate 2 – Make-Up Water Allowance

Nominal Pipe size (in.)	Make-Up Water Allowance for Test Phase – Alternate 2, (U.S. Gal/100 ft of pipe)		
	1-Hour Test	2-Hour Test	3-Hour Test
1-1/4	0.06	0.10	0.16
1-1/2	0.07	0.10	0.17
2	0.07	0.11	0.19
3	0.10	0.15	0.25
4	0.13	0.25	0.40
5-3/8	0.19	0.38	0.58
5	0.21	0.41	0.62
6	0.3	0.6	0.9
7-1/8	0.4	0.7	1.0
8	0.5	1.0	1.5
10	0.8	1.3	2.1
12	1.1	2.3	3.4
13-3/8	1.2	2.5	3.7
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.0	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3
26	5.0	10.0	15.0
28	5.5	11.1	16.8
30	6.3	12.7	19.2
32	7.0	14.3	21.5
34	8.0	16.2	24.3
36	9.0	18.0	27.0
42	12.0	23.1	35.3
48	15.0	27.0	43.0
54	22.0	31.4	51.7

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INITIAL SERVICE LEAK TESTING

An initial service leak test may be acceptable when other types of tests are not practical, or when leak tightness can be demonstrated by normal service, or when an opportunity is afforded by performing initial service tests of other equipment. An initial service leak test may apply to systems where isolation or temporary closures are impractical, or where checking out pumps and other equipment allows the system to be examined for leakage prior to full-scale operations.

The piping system should be gradually brought up to normal operating pressure, and held at normal operating pressure for at least ten (10) minutes. During this time, joints and connections may be examined for leakage.

At the conclusion of the test, depressurize the test section by the controlled release of fluid from the test section. Controlled release avoids the potential for pressure surge.