



Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Media Under Pressure (Pneumatic Leak Testing)¹

This standard is issued under the fixed designation F2786; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides information on apparatus, safety, pre-test preparation and procedures for conducting field tests of polyethylene pressure piping systems after installation using gaseous media such as unodorized inert non-toxic gas or air, and applying pressure to determine if leaks exist in the system (pneumatic leak testing). This practice applies only to testing to discover leakage. Testing for other purposes such as testing to establish operating pressure is beyond the scope of this practice.

1.2 This practice does not address leak testing using pressurized liquids (hydrostatic testing). For field leak testing using pressurized liquids, see Practice F2164.

1.3 Leak testing with pressurized gaseous media shall be used only if one of the following conditions exists:

1.3.1 The piping system is so designed that it cannot be filled with a liquid, or

1.3.2 The piping system service cannot tolerate traces of liquid testing media.

1.4 Where hydrostatic testing is specified in contract documents or by the authority having jurisdiction, pressurized gaseous media (pneumatic) testing shall not be substituted without the express consent and authorization of the authority having jurisdiction.

1.5 Some manufacturers prohibit or restrict pressurized gaseous media testing of their products. Contact component manufacturers for information about testing with gaseous media under pressure. Where the manufacturer of a test section component prohibits or restricts pressurized gaseous media testing, pressurized gaseous media (pneumatic) testing shall not be used without the express consent and authorization of the authority having jurisdiction and the component manufacturer.

NOTE 1—Components that are not suitable for testing with gaseous

¹ This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.40 on Test Methods.

Current edition approved Feb. 1, 2010. Published February 2010. DOI:10.1520/F2786-10.

media may not be suitable for service with pressurized gaseous media.

1.6 This practice does not apply to leak testing of non-pressure, negative pressure (vacuum), or non-PE piping systems. For field acceptance testing of plastic gravity flow sewer lines, see Test Method F1417.

1.7 This practice does not apply to fuel gas piping systems that extend from the point of delivery to the appliance connections. For other than undiluted liquefied petroleum gas (LP-Gas) systems, the point of delivery shall be considered to be the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided. For undiluted LP-Gas, the point of delivery shall be considered to be the outlet of the final pressure regulator, exclusive of line gas regulators, in the system. Testing for these systems can be found in NFPA 54 / ANSI Z223.1. This practice does not apply to LP-Gas systems covered under NFPA 58.

1.8 This practice is intended for use with polyethylene pressure piping that conveys gaseous media under pressure (compressed gas) if the owner or operator or installer of the line does not have an established leak testing procedure that is acceptable to the authority having jurisdiction.

1.9 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard. Numbered notes and information in parentheses in the text of the practice are non-mandatory information. Table notes are mandatory information.

1.10 **Warning**—Failure during a pressure leak test can be extremely violent and dangerous especially where a compressed gaseous media is used. In a compressed gaseous media test, energy is applied to compress the gaseous media in addition to pressurizing the system. If failure occurs, both energies can be suddenly released and can be extremely violent compared to failure during leak testing with an incompressible liquid testing media.

NOTE 2—To illustrate the violent hazard of failure, assume a 5 Hp compressor is used to raise the test section to test pressure and that it takes 1 h to achieve test pressure. If sudden rupture occurs, energy release may occur in 2 s. Therefore, the horsepower of the energy release would be 5

$\text{HP} \times 1 \text{ h} \times 3600 \text{ sec/h} / 2 \text{ s} = 9,000 \text{ Hp}$. Further, if diameter is doubled, energy release is four times greater. For an example test section that is twice the diameter, energy release would be 36,000 Hp.

1.11 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Additional safety information is presented in Section 7 and throughout this practice.

2. Referenced Documents

2.1 ASTM Standards:²

D1600 Terminology for Abbreviated Terms Relating to Plastics

F412 Terminology Relating to Plastic Piping Systems

F1417 Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

F2164 Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

2.2 Other Standard:³

PPI TR-4 Liquefied Petroleum Gas Code PPI Listing of Hydrostatic Design Basis (HDB), Pressure Design Bases (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials

PPI Handbook of Polyethylene Pipe, Second Edition

2.3 NFPA Standards:⁴

NFPA 54 / ANSI Z223.1 National Fuel Gas Code

NFPA 58 Liquefied Petroleum Gas Code

3. Terminology

3.1 Abbreviations and terms are in accordance with Terminology **D1600** and Terminology **F412** unless otherwise indicated.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *authority having jurisdiction, n*—The organization, office or individual responsible for "approving" equipment and installation, or a procedure.

3.2.1.1 *Discussion*—The term "authority having jurisdiction" is used in this practice in a broad manner since jurisdictions and "approval" agencies vary, as do their responsibilities. Where public safety is concerned, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a Fire Chief, Fire Marshall, chief of a fire prevention bureau, labor department, building official, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau or other insurance company representative may be the "authority having jurisdiction. In many circumstances, the property owner

or his authorized engineer or agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

3.2.2 *approve, v*—Acceptable to or authorized by the authority having jurisdiction. (approved, approving, approval)

3.2.3 *authorized persons, n*—Persons that are fully informed of the testing procedure and hazards of field pressure testing, and that are qualified to operate the onsite testing equipment, and that are qualified to perform onsite leak detection.

3.2.3.1 *Discussion*—Authorized persons may be agents or representatives or inspectors for the authority having jurisdiction, or may be employees of the party conducting the test. Contract documents may identify responsibilities, but regardless of assigned responsibilities, only authorized persons shall be allowed in proximity of test sections when testing (per Section 9) is underway.

3.2.4 *pressure piping system, n*—A piping system where all components in the system are pressure rated and intended for conveying a fluid under continuous internal pressure. (See also Terminology **F412**, pressure pipe, and non-pressure pipe.) To verify suitability for pressure service, consult the component manufacturer.

3.2.4.1 *Discussion*—PPI TR-4 provides information about stress ratings for some plastic materials and products.

3.2.5 *restraint, n*—Temporary or permanent structural measures or devices that restrict, guide, prevent, or safely limit disjoining and movement of the piping system and piping components while the system is under pressure during testing or service conditions. Restraint may include backfill, anchors, thrust blocks, external clamps and tie rods (joint restraints), pipe guides, etc.

3.2.5.1 *Discussion*—Restraint means that if violent separation or failure occurs during pressurization or testing, any movement of components or parts is sufficiently constrained or prevented such that damage or injury is prevented.

3.2.6 *system design pressure, n*—The limiting continuous internal pressure specified by the piping system designer. System design pressure may be less than the pressure ratings of components in the system. System design pressure may be limited by component pressure ratings, by code or application requirements, or by other restrictions.

3.2.7 *visible leakage, n*—The visible escape (bubbles, drip, spray, stream, flow, etc.) of test fluid from the test section through components, joints, connections, appurtenances and the like in the test section. Visibility of gaseous media leakage is enhanced by the application of leak detection fluid at joints, seals or seams where leakage is likely.

4. Summary of Practice

4.1 The section of the piping system to be tested shall be isolated from other parts of the system, and shall be restrained per 3.2.5 against disjoining and movement to prevent injury or damage in the event of catastrophic failure. Components that are not to be subjected to test pressure or that could be damaged by test pressure shall be removed, or shall be isolated and vented to atmosphere. The test section is filled with the

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

⁴ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

gaseous testing media, raised to the test pressure and allowed to stabilize. The system is inspected or monitored for leakage, and then test pressure is relieved. If repairs or corrections are necessary, they are performed only when the test section is depressurized. If necessary, retesting is performed after leak repairs and a relaxation period. At the conclusion of an acceptable test (approval), the test section may be placed in service. Purging or disposal of the gaseous testing media from the test section may be necessary.

4.2 Test pressure and test duration are dependent on piping system volume and piping system temperature. The volume of compressed gaseous media available or compressor capacity will determine the test section length that can be raised to test pressure within specified test duration and test pressure limits. Elevated temperatures anywhere in the test section especially where test section areas are exposed to sunlight heating require reduced test pressure.

4.3 Acceptance is determined by the approval of the authority having jurisdiction.

4.4 If applicable, the authority having jurisdiction specifies procedures or requirements for gaseous testing media disposal or containment during depressurizing or purging.

5. Significance and Use

5.1 If required by the authority having jurisdiction, pressurized gaseous media leak testing may be conducted after installation to discover and correct leaks or faults in a newly constructed or modified polyethylene pressure piping system before placing the system in service. Leakage or faults usually occur at connections, joints, and mechanical seals where sealing under pressure is required.

5.2 Safety is of paramount importance when conducting pressurized gaseous media leak tests because testing results include no leaks, leaks, sudden violent rupture, or catastrophic failure.

5.3 Systems that contain lower pressure rated or non-pressure rated components that cannot be isolated or removed from exposure to test pressure, or where temporary caps or closures are not practical, are not suitable for testing in accordance with this practice.

5.4 *Leakage Allowance*—Leakage is not allowed for joints including butt, socket and saddle fusion, electrofusion, and restrained gas-tight mechanical joints. See 7.6.

5.5 Other types of joints, connections, or components having seals in the system may have a leakage allowance. Contact the joint, connection or component manufacturer for information.

5.6 *Poisson-Effect Expansion and Contraction*—When test pressure is applied to plastic piping systems that have fully restrained joints such as heat fusion, electrofusion, bolted flanges, etc., reduction of overall length or an increase in longitudinal stress results from diametrical expansion of the pipe. Disjoining (pull-out) of partially restrained or non-restrained connections or joints such as bell-and-spigot joints having insufficient resistance to pull-out stress or length reduction is possible when such joints are in-line with the test

section. To prevent Poisson-effect disjoining, take measures such as installing external joint restraints (diametrical clamps and tie-rods) across in-line partially restrained or non-restrained joints, installing in-line thrust anchors at the ends of fully restrained piping sections, or isolating a fully restrained test section from piping with nonrestrained or partially restrained joints.

NOTE 3—A tensile stress is applied to a material will cause elongation in the direction of the applied stress, and will cause a decrease in dimension at right angles to the direction of the applied stress. The ratio of decrease to elongation is the Poisson ratio. Under test pressure, piping materials will expand slightly in diameter and contract in length slightly according to the Poisson ratio of the material.

6. Apparatus and Equipment

6.1 Components such as caps, valves, blind flanges, and other devices that are used to isolate the test section from other parts of the system, and to isolate components that are not to be subjected to test pressure are required.

6.1.1 Test section isolation and closure components shall be rated for pressures equal to or greater than the test pressure applied to the test section, and shall be restrained against longitudinal separation (pull out or push off) such that the polyethylene pipe and the isolation or closure device shall not separate under the pressure forces and loads imposed during testing. Excessively worn, deteriorated or damaged equipment shall not be used. Equipment that is not capable of proper operation shall not be used.

6.1.2 Pipe squeeze-off shall not be used to isolate or sectionalize piping for test.

NOTE 4—Squeeze-off cannot always prevent gas flow.

6.2 *Gaseous Testing Media*—An adequate supply of non-toxic and non-flammable gaseous testing media is required. Gases such as natural gas, LP gas, propane, butane, hydrogen sulfide, and other flammable or toxic gases shall not be used as testing media.

6.3 *Leak Detection*—Leak detection fluids shall be non-toxic and chemically benign to polyethylene piping material and other materials used in connections, joints and seals. Ether or other leak detection fluids shall not be injected into or added to the gaseous testing media.

NOTE 5—Leakage usually occurs at a connection, joint, or seal in the system. Depending upon the type of connection, joint, or seal, leakage may be seepage, spray or a stream of gaseous testing media. Leak detection fluids applied to the connection, joint or seal typically produce bubbles from leakage.

6.4 *Filling and Pressurizing Equipment*—Filling and pressurizing equipment such as a compressor or pressurized cylinders of gaseous testing media are required. The equipment shall supply sufficient compressed gaseous testing media so that test duration limits are not exceeded. See 8.2.3. Filling equipment and pressurizing equipment shall be the same or separate equipment. All pressurizing gas shall pass into the test section through a single connection.

6.5 *Pressure Monitoring and Regulating*—Pressure monitoring and regulating equipment shall display, control and maintain test pressure for the duration of the procedure, and shall incorporate means to prevent overpressure.

NOTE 6—Excessive test pressure can cause damage or test section failure. One means to prevent overpressure is to install a calibrated pressure relief valve in the test section that is set to relieve test section pressure at not more than 5 psi (34.5 kPa) or 3 percent above test pressure.

6.5.1 Use at least two calibrated pressure gauges or sensors that are properly scaled for the test and accurate to within two percent (2%) of full scale. The gauge or sensor full scale value shall not be more than twice the test pressure, and scale graduations shall be no greater than two percent (2%) of the full scale value. A test tree combines valves, tees, a gauge cock for bleeding, a pressure snubber, and duplicate pressure gauges or sensors. See Fig. 1 for an example test tree. A continuous pressure-recording device is recommended.

6.5.2 Pressure monitoring equipment shall be calibrated against a recognized standard acceptable to the authority having jurisdiction. Records of calibration not more than 12 months prior to use shall be made available to the authority having jurisdiction. Pressure monitoring and regulating equipment that has not been calibrated within twelve (12) months prior to use or is damaged or otherwise incapable of proper operation shall not be used.

6.5.3 Locate the test pressure gauge or sensor to display and monitor test pressure in the test section.

NOTE 7—Duplicate pressure sensing and monitoring at several points in the test section provides redundancy in the event of pressure gauge or sensing device error or failure.

6.6 Temperature measuring equipment such as pyrometers or infrared temperature gauges accurate to within $\pm 5.4^{\circ}\text{F}$ ($\pm 3^{\circ}\text{C}$) to measure insitu temperature of exposed pipe in test sections is required for determination of maximum test pressure. Temperature monitoring equipment that has not been calibrated within twelve (12) months prior to use or is damaged or otherwise incapable of proper operation shall not be used.

6.7 Timing equipment such as clocks, wrist watches, stop-watches or other devices that display time in hours and minutes, the means to record beginning, intermediate and ending times and the means to determine the duration of applicable time periods. At least two timing devices shall be used. Timing devices shall be accurate to within 5 min in 24 h.

6.8 Other equipment to connect a compressor or pressurized cylinders of gaseous testing media to the test section, to control the flow of gaseous testing media, to power compressors and other equipment, to connect pressure regulating and monitoring equipment to the test section, to monitor pressure, and to purge the gaseous testing media from the test section are required as applicable.

7. Safety Precautions

7.1 This safety information is in addition to safety information in other sections of this practice.

7.2 Always take precautions to eliminate hazards to persons near lines being tested. For the entire duration of the procedure and any subsequent retesting, including filling, initial pressurization, time at test pressure, and de-pressurization, only authorized persons that are conducting the test or inspecting the piping section being tested are allowed in the proximity of the section under test.

7.3 For the entire duration of the procedure, the test section and the work area around the test section and equipment shall be supervised or secured with barricades and warnings so that unauthorized persons are kept a safe distance away.

7.4 Failure may result in sudden, violent, uncontrolled, and dangerous movement of system piping, or components, or parts of components.

7.5 *Restraint against Movement and Exposure of Connections, Joints and Seals*—Take measures to ensure that all parts of the section under test are structurally restrained per 3.2.5 against movement if failure occurs. Observe manufacturer's precautions for securing and restraining temporary mechanical end (test) caps. Defective or improperly secured temporary end closures or mechanical end caps shall not be used.

7.5.1 When connections, joints and seals are to be exposed for observation during the test, use restraint methods to control movement in the event of joint or connection separation, giving due consideration to restraining thrust forces. In particular,

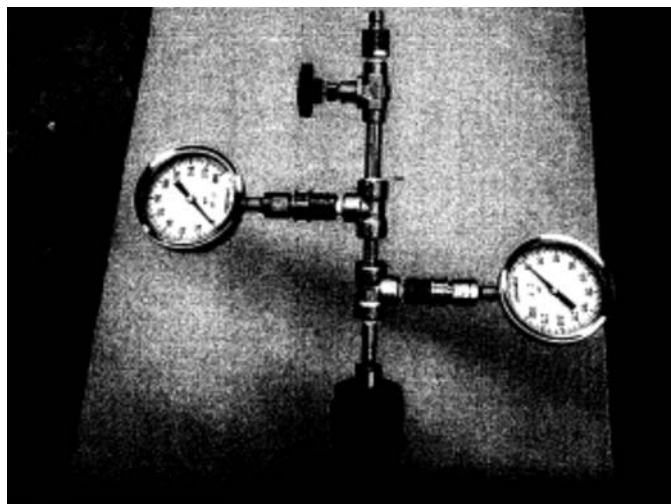


FIG. 1 Example Test Tree

pipes connected to restrained joints that derive their stability from the interaction of the pipe and soil shall be backfilled prior to testing.

7.5.2 Pipe connected to connections, joints and seals that are exposed for leakage observation shall be restrained. The unrestrained exposed pipe distance to the side of the exposed connection, joint or seal shall not exceed the greater of 5 pipe diameters or 3 ft (1 m).

7.6 When properly made, heat fusion joints in polyethylene pipe are structurally comparable to the parent PE pipe material and do not leak. Leakage at a fusion joint indicates a structurally deficient joint having the imminent potential for complete separation. If leakage is observed at a fusion joint, move away immediately, and depressurize the test section.

7.7 Do not perform a test against sections filled with natural gas.

8. Pre-Test Preparation and Set-Up

8.1 General:

8.1.1 Before testing, heat fusion joints shall be completely cooled. Mechanical joints shall be completely assembled with all necessary seals and all fasteners installed and securely tightened. Parts that seal service tees such as threaded caps shall be secured per manufacturer's instructions.

8.1.2 If required, flushing, pigging, or other means of cleaning the system to remove dirt and debris shall be performed before testing.

8.1.3 Before testing, concrete supports, blocking and anchors in the test section shall be cured until they have developed sufficient strength to withstand test pressure thrust forces.

8.1.4 Before pressure is applied, connections to test equipment, connections within the test section and if applicable connections between the test section and services shall be in proper operating condition and secure.

8.1.5 Before pressure is applied, isolated components or devices shall be vented to atmosphere.

8.1.6 Before pressure is applied, disconnect or isolate and vent all low pressure items.

8.1.7 Restrain all parts of the test section and components that will be subjected to test pressure against movement in the event of failure per 3.2.5. Temporarily remove, restrain, or isolate expansion joints and expansion compensators before starting the procedure. See 7.5.

8.2 *Test Section*—Testing may be conducted on the entire system, or on sections of the system. Test section size is determined by the capacity of the filling and pressurizing equipment. It is necessary to conduct the procedure within the allowable test duration. Equipment that has inadequate capacity will not be able to complete the test within the allowable test duration. If so, use higher capacity test equipment, or test a smaller (shorter) section of the system.

8.2.1 *Test Temperature*—Standard pressure ratings for polyethylene piping materials are for 73°F (23°C) and lower. Reduced test pressure is required where any part of the test section is above 73°F (23°C), especially areas of the test sections that are exposed for leakage inspection. Contact pipe,

fitting, or component manufacturers for assistance with elevated temperature test pressure reduction per 8.2.2.2 and 8.2.2.3.

NOTE 8—When testing with liquid testing media, a cooler liquid media filling the test section helps reduce overall test section temperature, especially sections that are exposed to sunlight heating during warmer climatological conditions. Testing with a gaseous testing media does not have a similar cooling effect. Therefore, heated compressed gas from a compressor or sunlight heating of exposed test section piping can raise exposed test section piping temperatures to 140°F (60°C) and higher. To reduce temperature increase in exposed parts of the test section, measures such as conducting tests during non-daylight or cooler early daytime hours, or shielding exposed parts of the test section against direct exposure to sunlight heating may be employed.

8.2.2 *Maximum Test Pressure*—Maximum test pressure is limited to assure safety and prevent damage and shall be in accordance with 8.2.2.1, 8.2.2.2 and 8.2.2.3 whichever is lower. Test pressure tolerance is controlled by test pressure monitoring and regulating equipment that is in accordance with 6.5.

NOTE 9—Lower pressure rated components or devices may include components or devices such as pipe or fittings made from other plastics or metals, or appurtenances such as valves, hydrants, regulators, pressure relief devices, or the like, or some types of mechanical connections such as lower pressure rated compression couplings or flanges with lower pressure rated back-up rings.

8.2.2.1 Where lower pressure-rated components or devices cannot be removed or isolated from the test section, the maximum test pressure shall not exceed the pressure rating of the lowest pressure-rated component in the test section. Consult the component manufacturer for pressure ratings.

8.2.2.2 Calculate leak test pressure for the intended test duration, $P_{(T)}$ as follows:

$$P_{(T)} = \frac{2 \times HDS \times F_T \times H_t}{(DR - 1)} \quad (1)$$

Where:

$P_{(T)}$ = Leak Test Pressure, psi (MPa), for Leak Test Time, T ,

T = Leak test Time, hours, per Table 1,

HDS = PE material hydrostatic design stress for water at 73°F (23°C), psi (MPa) per Table 2,

F_T = PE material temperature reduction factor per 8.2.2.3,

H_t = Leak Test Duration Factor for leak test time T per Table 1

DR = Pipe dimension ratio = pipe average outside diameter, in (mm) / pipe minimum wall thickness, in (mm)

8.2.2.3 Measure exposed test section pipe temperature with a pyrometer or infrared temperature measuring equipment. Where any part of the test section temperature is above 73°F (23°C), the applicable temperature reduction factor, F_T , shall be used.

NOTE 10—Different PE pipe materials have different elevated temperature performance. Consult the PE pipe manufacturer for the applicable temperature reduction factor, F_T . See Appendix X1 for example calculations. Additional information on temperature effects is available in the PPI Handbook of Polyethylene Pipe, Second Edition.

8.2.3 *Test Duration*—Test duration shall not exceed the leak test time, T , per Table 1 and is limited to assure safety and to

TABLE 1 Leak Test Duration Factor, H_t

Leak Test Pressure, $P_{(T)}$, psi (MPa)	Leak Test Time, T , hours	Leak Test Duration Factor, H_t
$P_{(8)}$	≤ 8	1.50
$P_{(48)}$	$>8 \leq 48$	1.25
$P_{(120)}$	$>48 \leq 120$	1.00

TABLE 2 PE Material Hydrostatic Design Stress

PE Material Designation	HDS for Water at 73°F (23°C), psi (MPa)
PE2606 (PE2406)	630 (4.3)
PE2708 PE3608 (PE3408)	800 (5.5)
PE3708 PE4608	
PE3710 and PE4710	1000 (6.9)

TABLE 3 Temperature Reduction Factor F_T , for 100°F (38°C) and Lower

Measured Pipe Surface Temperature	Temperature Reduction Factor, F_T
73°F (23°C) and lower	1.00
$>73^\circ\text{F}$ to 80°F ($>23^\circ\text{C}$ to 27°C)	0.94
$>80^\circ\text{F}$ to 90°F ($>27^\circ\text{C}$ to 32°C)	0.86
$>90^\circ\text{F}$ to 100°F ($>32^\circ\text{C}$ to 38°C)	0.78
$>100^\circ\text{F}$ ($>38^\circ\text{C}$)	(See Note 10)

prevent damage to the system. Test duration encompasses the total time required to pressurize, stabilize, hold test pressure, hold leak examination pressure, and depressurize the test section.

NOTE 11—Per 7.2 and 7.3, access by persons to systems and pipe sections under test is controlled for the duration of the test and any subsequent retesting.

9. Test Procedure

9.1 Observe all safety precautions throughout this practice, and specific safety precautions per Section 7.

9.2 Use appropriate apparatus and gaseous testing media per Section 6.

9.3 Prepare and set-up the test section for gaseous media pressure leak testing Section 8.

9.4 Pressurization, Examination and Duration:

9.4.1 Pressurization occurs in 3 sequential steps: pressurization to 10% of the leak test pressure, 9.4.2, increasing pressurization to 50% of the leak test pressure, 9.4.3, and then increasing pressurization to the leak test pressure 9.4.4. Record the time when pressurization starts. Monitor pressure display equipment during pressurizing.

9.4.1.1 Pressure monitoring equipment shall display comparable pressure readings. If different readings are obtained, discontinue the test. Depressurize the test section per 9.9 and correct pressure display equipment before restarting the test.

9.4.2 Gradually increase the pressure in the test section to 10 percent of the leak test pressure. Isolate (valve off) or disconnect the test section from filling and pressurizing equipment. Pressure monitoring equipment shall remain connected to the test section. Perform leakage examination per 9.6.

9.4.3 Upon successful examination, reestablish the connection to filling and pressurizing equipment and gradually increase the pressure in the test section to 50 percent of the leak

test pressure in steps of one tenth ($1/10$ th) of the leak test pressure. Isolate (valve off) or disconnect the test section from filling and pressurizing equipment. Pressure monitoring equipment shall remain connected to the test section. Perform leakage examination per 9.6.

9.4.4 Upon successful examination, reestablish the connection to filling and pressurizing equipment, and gradually increase the test pressure in steps of one tenth ($1/10$ th) of the leak test pressure until the maximum test pressure is reached. Isolate (valve off) or disconnect the test section from filling and pressurizing equipment. Pressure monitoring equipment shall remain connected to the test section. Perform leakage examination per 9.6.

9.4.5 The maximum time to conduct all levels of pressurization and examination per 9.4 shall not exceed test duration per 8.2.3. If the test pressure cannot be attained, or if it takes an unreasonably long time to reach test pressure, there may be faults such as excessive leakage, or open valving, or the pressurizing equipment may be inadequate for the size of the test section. If such faults exist, discontinue pressurizing, and correct them before continuing.

9.5 Monitor pressure display equipment and maintain test pressure for ten (10) to sixty (60) minutes or for a time period acceptable to the Authority Having Jurisdiction, but not exceeding leak test time, T , and leak test pressure, $P_{(T)}$, per 8.2.2, 8.2.2.1 and 8.2.2.2, and test duration per 8.2.3.

9.6 Leakage Examination:

9.6.1 Leakage examination is conducted for each 9.4 pressure level step. Where test section leakage or leakage of test section apparatus or equipment is discovered by visual inspection or by the inability to maintain test pressure within 5 % of the test phase pressure for 1 h, depressurize the test section and record the time when zero gauge pressure is reached. Effect

repairs as necessary. Leaks and faults shall not be corrected while the test section is under pressure.

9.6.2 Where no leakage is discovered, continue to the next 9.4 pressure level step and when all 9.4 levels have been completed, record the time of test completion, and depressurize the test section and conclude the test per 9.9.

9.7 *Retesting after leakage repairs*—If leakage is discovered after maximum test pressure has been reached per 9.4.4, depressurize the test section for leak repair and remain depressurized for a period of at least 8 hours total duration. Retest per 9.1 through 9.6.

9.8 *Pass/Fail Criteria*—A passing test is demonstrated by leakage examination that does not indicate leakage.

9.9 *After the Test*—If applicable, observe requirements for gaseous testing media disposal or containment. Remove temporary closure and isolation devices from the test section.

9.10 *Test Records*—Leak test records shall identify and record the following information if required by the Authority Having Jurisdiction

9.10.1 The gaseous testing media;

9.10.2 Backflow prevention devices or devices used to isolate the test section from system piping if used;

9.10.3 Insitu temperatures of exposed test section piping during the test, and if applicable, retesting;

9.10.4 Test pressures during the test procedure and if applicable retesting;

9.10.5 The type of test gauges or sensors in the test section;

9.10.6 The placement of test gauges or sensors in the test section, such as test gauge location distances and elevations from the beginning of the section;

9.10.7 Calibration records for pressure and temperature indicating devices dated within 12 months of the testing date;

9.10.8 Any adjustments made to test pressure for elevated temperature;

9.10.9 The test duration;

9.10.10 A description of the test section size, length, and site location;

9.10.11 A description of the test section components;

9.10.12 Description of any leaks or failures and the corrective actions taken;

9.10.13 The time between depressurization and retesting pressurization;

9.10.14 The date and time of day of the test;

9.10.15 The identification of the party conducting the test;

10. Keywords

10.1 air test; compressed air test, pressure; field leak test; leak test; polyethylene pipe; pneumatic leak test

APPENDIX

(Nonmandatory Information)

X1. LEAK TEST PRESSURE CALCULATIONS

Example leak test pressure calculations per 8.2.2.2.

X1.1 *Question*: What is the maximum leak test pressure for DR 11 PE4710 pipe for a 24 h leak test where the measured temperature of exposed pipe is 125°F (52°C)?

X1.1.1 *Answer*: From Table 1, $H_t = 1.25$, and from Table 2, $HDS = 1000$ psi. The PE pipe manufacturer provided a temperature reduction factor, F_T , of 0.70 for PE4710 pipe at 125°F (52°C).

X1.1.2

$$P_{(24)} = \frac{2 \times 1000 \times 0.70 \times 1.25}{(11 - 1)} = 175 \text{ psi} \quad (\text{X1.1})$$

X1.2 *Question*: What is the maximum leak test pressure for DR 13.5 PE2606 pipe for a 6 h leak test where the measured temperature of exposed pipe is 68°F (20°C)? For a 96 h leak test?

X1.2.1 *Answer*: From Table 1, $H_t = 1.50$ for a 6 h leak test, and $H_t = 1.00$ for a 96 h leak test; from Table 2, $HDS = 630$ psi. The PE pipe manufacturer provided a temperature reduction factor, F_T , of 1.00 for PE2606 at 68°F (20°C).

X1.2.2

$$P_{(6)} = \frac{2 \times 630 \times 1.00 \times 1.50}{(13.5 - 1)} = 151 \text{ psi} \quad (\text{X1.2})$$

X1.2.3

$$P_{(96)} = \frac{2 \times 630 \times 1.00 \times 1.00}{(13.5 - 1)} = 101 \text{ psi} \quad (\text{X1.3})$$

X1.3 *Question*: What is the maximum leak test pressure for DR 17 PE3608 pipe for an 8 h leak test where the measured temperature of exposed pipe is 155°F (68°C)?

X1.4 *Answer*: In this circumstance, the pipe manufacturer does not provide temperature reduction factors for PE3608 pipe for temperatures above 140°F (60°C); therefore, leak testing cannot be conducted while the pipe is at this temperature. Measures to reduce exposed pipe temperature to acceptable limits (at or below 140°F (60°C)) are necessary before testing.

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