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Designation: ~~F2164 – 13~~ F2164 – 18

Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure[1]

This standard is issued under the fixed designation F2164; 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 and crosslinked polyethylene pressure piping systems by filling with a liquid and applying pressure to determine if leaks exist in the system.

1.2 This practice does not address leak testing using a pressurized gas (pneumatic testing). For safety reasons, some manufacturers prohibit or restrict pneumatic pressure testing of their products. Failure during a pressure leak test can be explosive, violent, and dangerous, especially if a compressed gas is used. In a compressed gas test, both the pressure stress on the system and the energy used to compress the gas are released at a failure. ~~Contact component manufacturers for information about testing with gas under pressure.~~For field leak testing using pressurized gas, see Practice F2786.

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

1.4 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.

1.5 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.* Additional safety information is presented in Section 7 and throughout this standard.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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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

F2786 Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Testing Media Under Pressure (Pneumatic Leak Testing)

2.2 *Other Documents:*

PPI TR-4-PPI Listing of Hydrostatic Design Basis (HDB), Pressure Design Bases (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials[3]

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:*

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[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 ~~April 1, 2013~~Aug. 1, 2018. Published ~~April 2013~~August 2018. Originally approved in 2007. Last previous edition approved in ~~2010~~2013 as F2164~~–10~~–13.~~ε1~~. DOI: ~~10.1520/F2164-13.~~10.1520/F2164-18.

[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.

***A Summary of Changes section appears at the end of this standard**

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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 *approved, vt*—acceptable to the authority having jurisdiction.

3.2.3 *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.

NOTE 1—PPI TR-4 provides information about stress ratings for some plastic materials and products.

3.2.4 *restraint, n*—temporary or permanent structural measures or devices which restrict, guide, prevent, or safely limit disjoining or movement of piping system 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, and so forth. Restraint means that if violent separation or failure occurs during the test, any movement of components or parts is sufficiently constrained such that damage or injury is prevented.

3.2.5 *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.

3.2.6 *visible leakage, n*—the visible escape (drip, spray, stream, flow, and so forth.) of test liquid from the test section through components, joints, connections, appurtenances, and the like in the test section.

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4. Summary of Practice

4.1 The section of the piping system to be tested is isolated from other parts of the system and restrained against movement to prevent catastrophic failure. Components that are not to be subjected to test pressure or could be damaged by test pressure are isolated or removed as necessary. Isolated components are vented to atmosphere. The test section is filled with the testing liquid, 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, a retest is performed after a relaxation period. At the conclusion of an acceptable test, the test section may be placed in service. Purging and disposal of the test liquid from the test section may be necessary.

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

4.3 The authority having jurisdiction may specify procedures or requirements for test liquid disposal or erosion control.

5. Significance and Use

5.1 If required by the authority having jurisdiction, hydrostatic pressure leak testing may be conducted to discover and correct leaks or faults in a newly constructed or modified polyethylene or crosslinked 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. (**Warning**—Safety is of paramount importance when conducting hydrostatic pressure leak tests because testing under pressure may cause sudden violent rupture or failure.)

5.2 This practice uses a pressurized liquid to test for leaks. It does not verify if a piping material or a piping system design is suitable for pressure service. The suitability of a piping system for pressure service and its pressure rating or operating pressure is determined solely by its design and its installed components.

5.3 Systems that are not suitable for pressure testing should not be pressure tested. Such systems may contain lower pressure rated or non-pressure rated components that cannot be isolated from test pressure, or temporary caps or closures may not be practical. In these systems, leak inspections should be conducted during and after installation. Inspections typically include visual examination of joint appearance, mechanical checks of bolt or joint tightness, and other relevant examinations. See also Test Method F1417.

5.4 *Leakage Allowance*—There is no leakage allowance for a section of heat-fusion joined polyethylene piping, because properly made heat fusion joints do not leak. See 7.6.1.

5.4.1 Other types of joints or connections in the system may have a leakage allowance. Contact the joint or connection manufacturer for information.

5.5 *Expansion Allowance*—When test pressure is applied, polyethylene or crosslinked polyethylene pipe will expand slightly due to elasticity and Poisson effects. To compensate for expansion, make-up water is added during the initial expansion phase. The amount of make-up water (expansion allowance) will vary because expansion is not linear. This procedure compensates for expansion with an initial expansion phase, followed by a test phase. In the test phase, expansion is suspended by slightly reducing test pressure. See 9.6.

5.6 *Poisson Effect*—When test pressure is applied to plastic piping systems that have fully restrained joints (joints such as heat fusion, electrofusion, bolted flanges, and so forth.), diametrical expansion of the pipe may reduce the overall length of the fully restrained section. Poisson-effect length reduction may affect or cause disjoining in other contiguous sections that have partially restrained or non-restrained joints, such as bell-and-spigot joints, when such joints are in-line with the test section. To prevent Poisson-effect disjoining, take measures such as the installation of external joint restraints (diametrical clamps and tie-rods) on in-line non-restrained joints, installing in-line thrust anchors at the ends of the fully restrained section, or isolating the fully restrained test section from piping with non-restrained or partially restrained joints.

NOTE 2—When a tensile stress is applied to a material, it will elongate in the direction of the applied stress, and will 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 for Hydrostatic Procedures

6.1 *General*—Components such as caps, valves, blind flanges, manual or automatic air release devices, vents, and other devices that are used to isolate the test section from other parts of the system, to purge air from the system, and to isolate components that are not to be subjected to test pressure are generally needed.

6.1.1 Test section isolation and closure components are to be rated for pressures equal to or greater than the test pressure applied to the test section.

6.1.2 Although section isolation and closure components may only be connected to the test section for the duration of the test, the joint between the test section and a closure or isolation component should be at least as strong as joints in the test section. Additional restraint may be required.

6.1.3 Air release devices should be located at all high points along the test section.

6.1.4 Excessively worn or deteriorated equipment is unsuitable and is not to be used.

6.2 *Test Liquid*—An adequate supply of a safe test liquid, such as water, is necessary. The test liquid should be of appropriate safety and quality so that the environment, system, test equipment, and disposal (if necessary) are not adversely affected.

6.2.1 Where an existing water supply is used to supply test water, protect the existing water supply from backflow contamination in accordance with local codes or as required by the authority having jurisdiction. Remove backflow protection and isolate the test section from the existing water supply before testing.

6.2.2 Excluding retesting (if necessary), the quantity of liquid needed to fill the internal volume of the pipe test section and accommodate test section expansion and possible leakage at non-fusion joints and seals is estimated using:

$$V_{gal} = 1.015 \times 0.04 \times (ID_{in.})^2 \times L_{ft} \quad (1)$$

$$V_{m^3} = 1.015 \times 0.785 \times 10^{-6} \times (ID_{mm})^2 \times L_m$$

where:

V_{gal} = pipe section volume, U.S. gal,
$ID_{in.}$ = pipe inside diameter, in.,
L_{ft} = test section length, ft,
V_{m^3} = pipe section volume, m^3,
ID_{mm} = pipe inside diameter, mm, and
L_m = test section length, m.

6.3 *Filling and Pressurizing Equipment*—Liquid filling and pressurizing equipment such as pumps, and pressure regulating devices will usually be necessary. Filling equipment should be capable of filling the test section in a reasonable time against any elevation head pressure that may be present. Pressurizing equipment should be able to maintain the necessary test pressure in the test section and provide sufficient quantities of make-up test liquid for the duration of the test. Pressure regulating equipment should be capable of maintaining test pressure for the duration of the test.

6.3.1 Filling equipment and pressurizing equipment do not need to be the same equipment.

6.4 *Pressure Monitoring*—Use at least one calibrated pressure gage or sensor accurate to within two percent (2 %) of full scale. It is preferred that the gage or sensor full scale value not be more than twice the test pressure, and that scale graduations be no greater than two percent (2 %) of the full scale value. Using a valved tee, a gage cock for bleeding, a pressure snubber, and a duplicate, back-up pressure gage are recommended. A continuous pressure-recording device may be required.

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