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Standard Test Method for Constant Tensile Load Joint Test (CTLJT)[1]

This standard is issued under the fixed designation F1588; 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 The constant tensile load joint test (CTLJT) is designed to demonstrate that a joint in a plastic piping system is resistant to the effects of long-term creep.

1.1.1 The joint is subjected to an internal pressure at least equal to its operating pressure and a sustained axial tensile load for a specified time period, usually 1000 h. The joint shall not leak, nor may the pipe *completely* pull out for the test duration. The total axial stress is set by the referencing document.

1.1.2 Some typical conditions for testing of joints on polyethylene pipe are described in Appendix X1.

1.2 This test is usually performed at 73 °F (22.8 °C).

1.3 The CTLJT was developed to demonstrate the long-term resistance to pullout of mechanical joints on polyethylene gas pipe. The CTLJT has also been successfully applied to the evaluation of other components of plastic piping systems. These applications are discussed in Appendix X1.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D638 Test Method for Tensile Properties of Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2513 Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

F412 Terminology Relating to Plastic Piping Systems

2.2 *ANSI Standard:*[3]

B31.8 Gas Transmission and Distribution Piping Systems

2.3 *Code of Federal Regulations:*[4]

OPS Part 192, Title 49

3. Terminology

3.1 *Definitions:*

3.1.1 *General*—Definitions are in accordance with Test Method D638 and Terminology F412, unless otherwise specified. Abbreviations are in accordance with Terminology D1600.

3.1.2 The gas industry terminology used in this test method is in accordance with the definitions given in ANSI B31.8 or OPS Part 192, Title 49, unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *mechanical joint, Category 1*—a mechanical joint design that provides a seal plus a resistance to force on the pipe end, equal to or greater than that which will cause a permanent deformation of the pipe or tubing. **(D2513)**

3.2.2 *mechanical joint, Category 3*—a mechanical joint design that provides a seal plus a pipe restraint rating equivalent to the anticipated thermal stresses occurring in a pipeline.

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

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[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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from U.S. Government Publishing Office, 732 N. Capitol St., NW, Washington, DC 20401-0001, http://www.gpo.gov.

This category has a manufacturers' pipe-end restraint that allows slippage at less than the value required to yield the pipe. (**D2513**)

3.2.3 *pipe*—refers to both pipe and tubing.

4. Summary of Test Method

4.1 A joint is subjected to a sustained axial load for a specified period of time (usually 1000 h). The test duration and the actual test conditions (axial stress, internal pressure, test duration, and test temperature) are either specified by a referencing document or, for new or unique applications, agreed upon between the user and the manufacturer. X1.2 contains a background discussion of axial stress values and axial load determination.

4.2 The joint is made to plastic pipe of the type, grade, size, and dimension ratio to be used in the final application. The axial tensile stress should be as high as possible, but shall be lower than the stress at which the plastic material continues to stretch and finally yields (the long-term yield strength) (see Note 1).

NOTE 1—During the first hours of a test, the pipe elongates measurably. Elongation continues for the duration of the test at a decaying rate.

4.3 A joint passes this test if it does not leak and does not pull out or allow slippage in excess of the manufacturers' specified design slippage during the test duration.

4.4 If a pipe in the test assembly yields before the specified minimum test time is attained, the total stress is above the long-term yield strength of that pipe and the test shall be performed again at a stress level calculated to be below the long-term yield strength of the pipe.

5. Significance and Use

5.1 This test method was designed to be used to validate the long-term resistance to pullout of joints designed for use in plastic natural gas piping systems.

5.2 This test method is used in addition to the short-term tests required by OPS Part 192.283b, Title 49. Informal versions of this test method are used by manufacturers and utilities to demonstrate that a joint is resistant to the effects of long-term creep and meets the requirements for classification as a Category 1 or a Category 3 joint in accordance with Specification D2513.

5.3 This test method may also be applicable for the determination of the effects of a sustained axial load on joints or other components of plastic piping systems designed for other applications. Test parameters and the internal pressurizing fluid, if any, should be listed in the referencing document.

5.4 Documents that reference this test method for products other than joints shall specify test conditions and performance requirements. In general, such products pass this test if they maintain their structural integrity, do not leak, and perform to specification during and after the test.

6. Apparatus

6.1 *Loading Methods:*

6.1.1 Any loading method that maintains the correct, in-line tensile load on the joint (within ±2 %) for the test duration is acceptable. Loading methods successfully employed for all size loads include lever arms, hydraulic cylinders, and air cylinders.

6.1.2 Dead weight (a pile of scrap steel or iron) has worked well for loads up to 1 ton (907 kg) (see Note 2).

NOTE 2—To provide an adequate stress level for ⅝ in. DR 7 PE tubing, about 200 lb (90 kg) are required. Pipe 2 in. SDR11 PE requires about 2000 lb (907 kg).

6.1.3 Hydraulic and air-powered loading frames have been constructed to provide up to 50 000 lb (22 680 kg) for tests on 3 in. IPS through 8-in. IPS joints. The stroke of the cylinder should be adequate for the material being tested.

6.2 *Applied Axial Load Determination Monitoring*—The applied axial load shall be maintained to within ±2 % of the calculated value.

6.2.1 Dead weight is weighed before the start of a test.

6.2.2 In systems with air or hydraulic cylinders, a load-cell and indicator may be used between the cylinder and the test assembly. An alternative is to accurately establish the relationship between inlet pressure and the force generated by a cylinder and then to monitor a pressure gauge placed in the pressurization line to the cylinder during the test.

6.3 *Pressure Gauge*—Each assembly shall have a pressure gauge to monitor internal pressure on the test assembly. The gauge shall be able to measure the test pressure to within an accuracy of 1 % or better.

6.4 *Test Assembly:*

6.4.1 The test assembly is capped and verified to be leak tight. Attachment devices that ensure straight line axial loading shall be used at each end to attach the test assembly to the loading device. The test assembly may contain more than one joint of the size under evaluation (see Note 3).

NOTE 3—There are many configurations possible with the wide variety of joints that are available. If the mechanical joint to be tested is suitable for the purpose, it can be used to cap the pipe ends.

6.4.2 The minimum length is three pipe diameters between fittings (stiffener ends). Elongation is proportional to specimen length. It is important to allow sufficient space in the apparatus to provide for anticipated elongation of the test specimen for the duration of the test.

7. Precautions and Safety Considerations

7.1 Each test fixture and joint assembly shall be designed to safely accommodate a sudden unexpected failure in any part of the test assembly. Both fixture and joint(s) shall be regularly inspected for safety. Joint pullouts usually occur unexpectedly and proceed from start to finish in seconds. Failure may be accompanied by the sudden release of the internal pressure or a falling test assembly, or both.

7.2 It is strongly recommended that water be used as the pressurizing fluid when testing systems that may fail in a brittle manner (specifically PVC systems). If that is not possible, the test specimens shall be placed in a strong chamber at all times when pressurized (see Note 4).