



## Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins<sup>1</sup>

This standard is issued under the fixed designation F 1473; 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.

<sup>ε1</sup> NOTE—Section 8.4 was corrected editorially in November 1998.

### 1. Scope

1.1 This test method determines the resistance of polyethylene materials to slow crack growth under conditions specified within.

1.2 The test is generally performed at 80°C and at 2.4 MPa, but may also be done at temperatures below 80°C and with other stresses low enough to preclude ductile failure and thereby eventually induce brittle type of failure. Generally, polyethylenes will ultimately fail in a brittle manner by slow crack growth at 80°C if the stress is below 2.4 MPa.

1.3 The test is for compression molded plaques and for pipe sizes 16 mm and greater.<sup>2</sup>

1.4 *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.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing<sup>3</sup>
- D 1248 Specification for Polyethylene Plastics Molding and Extrusion Materials<sup>3</sup>
- D 1600 Terminology for Abbreviated Terms Relating to Plastics<sup>3</sup>
- D 1928 Practice for Preparation of Compression-Molded Polyethylene Test Sheets and Test Specimens<sup>3</sup>
- D 3350 Specification for Polyethylene Plastics Pipe and Fitting Materials<sup>3</sup>
- F 412 Terminology Relating to Plastic Piping Systems<sup>4</sup>

### 3. Terminology

#### 3.1 Definitions:

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.40 on Test Methods.

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<sup>2</sup> Lu, X., and Brown, N., "A Test for Slow Crack Growth Failure in Polyethylene Under a Constant Load," *Journal of Polymer Testing*, Vol 11, pp. 309–319, 1992.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 08.04.

3.1.1 Definitions are in accordance with Terminology F 412. Abbreviations are in accordance with Terminology D 1600, unless otherwise indicated.

3.1.2 *brittle failure*—a pipe failure mode which exhibits no visible (to the naked eye) permanent material deformation (stretching, elongation, or necking down) in the area of the break (F 412).

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *slow crack growth*—the slow extension of the crack with time.

### 4. Summary of Test Method

4.1 A specimen is taken from a pipe with a specified orientation relative to the extrusion direction or from compression molded plaques. It is precisely notched and then exposed to a constant tensile stress at elevated temperatures in air. The time for complete failure is recorded.

### 5. Significance and Use

5.1 This test method is useful to measure slow crack growth resistance of molded plaques of resins and extruded pipe at accelerated conditions such as 80°C, 2.4-MPa stress, and with a sharp notch.

5.2 The time to failure depends on the following test parameters: temperature; stress; notch depth; and specimen geometry. Increasing temperature, stress, and notch depth decrease the time to failure. Thus, in reporting the time to failure, all the conditions of the test must be specified.

### 6. Apparatus

6.1 *Lever Loading Machine*, with a lever arm ratio of about 5:1. The tensile load may also be applied directly using dead weights or any other method for producing a constant load. The pull rods on the grips shall have universal action to preventing bending. The grips shall be serrated to prevent slippage. The load on the specimen shall be accurate to at least  $\pm 0.5\%$ .

6.2 *Furnace*, heated by ordinary incandescent light bulbs covered with aluminum foil or any other suitable heating element.

6.3 *Temperature Controller*, shall be able to control the temperature within  $\pm 0.5^\circ\text{C}$  with respect to the set point.

6.4 *Temperature-Measuring Device*, a thermometer or a