Designation: F 2136 – 01

Standard Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe[1]

This standard is issued under the fixed designation F 2136; 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 test method is used to determine the susceptibility of high-density polyethylene (HDPE) resins or corrugated pipe to slow-crack-growth under a constant ligament-stress in an accelerating environment. This test method is intended to apply only to HDPE of a limited melt index and density range as defined in AASHTO Standard Specification M 294. This test method may be applicable for other materials, but data are not available for other materials at this time.

1.2 This test method measures the failure time associated with a given test specimen at a constant, specified, ligament-stress level.

1.3 The values stated in inch-pound units are to be regarded as the standard. Values given in parentheses are for information only.

1.4 Definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600, unless otherwise specified.

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

2. Referenced Documents

2.1 *ASTM Standards:*

D 1600 Terminology for Abbreviated Terms Relating to Plastics[2]

D 1928 Practice for Preparation of Compression-Molded Polyethylene Test Sheets and Test Specimens[2]

D 5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test[3]

E 4 Practices for Force Verification of Testing Materials[4]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[5]

F 412 Terminology Relating to Plastic Piping Systems[6]

F 1473 Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins[6]

2.2 *Other Document:*

AASHTO Standard Specification M 294[6]

3. Summary of Test Method

3.1 This test method subjects a dumbbell-shaped, notched test-specimen (Fig. 1) to a constant ligament-stress in the presence of a surface-active agent at an elevated temperature. It differs from Test Method D 5397 in that a constant ligament stress is used instead of a constant tensile load.

4. Significance and Use

4.1 This test method does not purport to interpret the data generated.

4.2 This test method is intended to compare slow-crack-growth (SCG) resistance for a limited set of HDPE resins.

4.3 This test method may be used on virgin HDPE resin compression-molded into a plaque or on extruded HDPE corrugated pipe that is chopped and compression-molded into a plaque (see 7.1.1 for details).

5. Apparatus

5.1 *Blanking Die*—A die suitable for cutting test specimens with holes to the dimensions and tolerances specified in Fig. 2.

5.2 *Stress-Crack Testing Apparatus*[7]—A lever loading machine, with a lever arm ratio of 2:1 to 5:1 similar to that described in Test Method D 5397. Alternatively, the tensile load may be applied directly using dead weights or any other method for producing a constant ligament stress. Determine the zero-load offset and lever-arm ratio for each test station, using

[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.

Current edition approved Aug. 10, 2001. Published October 2001.

[2] *Annual Book of ASTM Standards*, Vol 08.01.

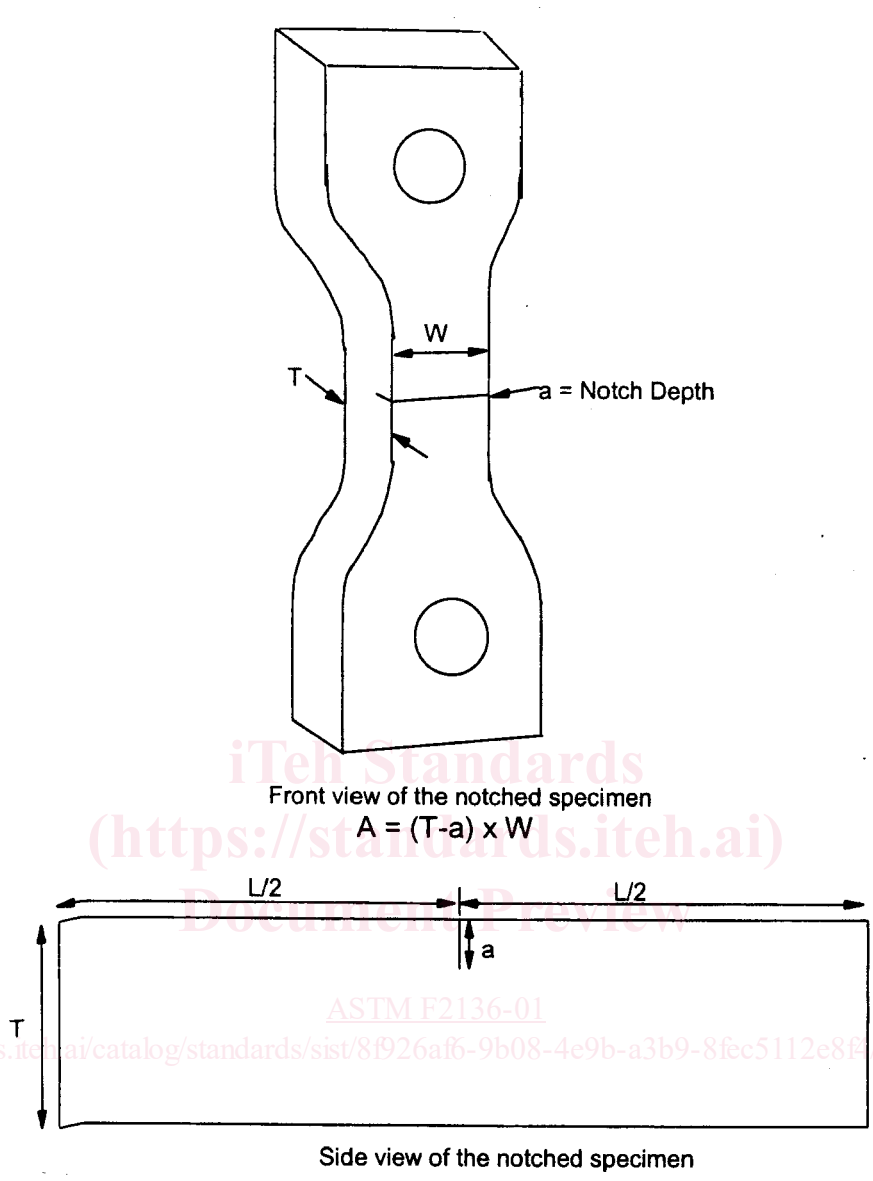
[3] *Annual Book of ASTM Standards*, Vol 04.09.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] *Annual Book of ASTM Standards*, Vol 08.04.

[7] Testing apparatus is available from BT Technology, Inc., 320 N. Railroad St., Rushville, IL 62681; Materials Performance, Inc., 2151 Harvey Mitchell Pkwy, S., Suite 208, College Station, TX 77840; Satec Systems, 900 Liberty St., Grove City, PA 16127; or equivalent.



T = thickness.
W = specimen width.

NOTE 1—The test specimen is intended to have the same geometry used for Test Method D 5397 specimens. The length of the specimen can be changed to suit the design of the test apparatus. However, there should be a constant neck section with length at least 0.5 in. (13 mm) long.

NOTE 2—It is preferable to modify the specimen die so that the attachment holes are punched out at the same time as the specimen rather than punching or machining them into the specimen at a later time. If the attachment holes are introduced at a later time, it is extremely important that they be carefully aligned so as to avoid adding a twisting component to the stress being placed on the specimen.

FIG. 1 Specimen Geometry—Test Specimen Dimensions

a force standard that complies with Practices E 4. The load on the specimen shall be accurate to 0.5 % of the calculated or applied load. The bath solution temperature shall be set at 122 ± 2°F (50 ± 1°C).

5.3 *Notching Device*[8]—Notch depth is an important variable that must be controlled. Paragraph 7.2.1 describes the notching procedure and type of apparatus used. The approximate thickness of the blade should be 0.2 to 0.3 mm.

NOTE 1—A round robin was conducted to determine the effect of types of blades on the notch depth. In this study, several types of steel blades (single-edge, double-edge, and so forth) from various manufacturers were used by the round-robin participants. The round robin consisted of seven laboratories using two types of resins molded into plaques. The standard deviation of the test results within laboratories is less than ±10 %.

5.4 *Micrometer*, capable of measuring to ±0.001 in. (±0.025 mm).

[8] Notching apparatus is available from BT Technology, Inc., 320 N. Railroad Street, Rushville, IL 62681; Satec Systems, 900 Liberty St., Grove City, PA 16127; or equivalent.