Designation: ~~D1708 – 10~~ D1708 – 13

Standard Test Method for Tensile Properties of Plastics by Use of Microtensile Specimens[1]

This standard is issued under the fixed designation D1708; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method covers certain material specifications for which a history of data has been obtained using the standard microtensile specimen. ~~The specimen geometry has been changed to be equivalent to that of ISO 12086-2:1995.~~ In general, this test method is superseded for general use by either Test Methods D882 or Test Method D638. The very small Type V specimen in Test Method D638 is the recommended specimen when limited amounts of material are available.

1.2 This test method covers the determination of the comparative tensile strength and elongation properties of plastics in the form of standard microtensile test specimens when tested under defined conditions of pretreatment, temperature, humidity, and testing machine speed. ~~It can be used for~~ This method is applicable when using specimens of any thickness up to 3.2 mm (⅛ in.), including thin films.

1.3 This test method cannot be used for the determination of modulus of elasticity. For the determination of modulus, see Test Method D638 or Test Methods D882.

1.4 Test data obtained by this test method are relevant and appropriate for use in engineering design.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.6 *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.*

NOTE 1—There is no known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing
D638 Test Method for Tensile Properties of Plastics
D882 Test Method for Tensile Properties of Thin Plastic Sheeting
D883 Terminology Relating to Plastics
D4000 Classification System for Specifying Plastic Materials
D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D6988 Guide for Determination of Thickness of Plastic Film Test Specimens
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
~~2.2 *ISO Standard:*~~
~~ISO 12086-2:1995 Plastics—Fluoropolymer Dispersion, Moulding, and Extrusion Materials—Part 2 Preparation of Test Specimens and Determination of Properties~~[3]

3. Terminology

3.1 ~~*Definitions:*~~ *Definitions*—Definitions of terms applying to this test method appear in Terminology D883 and Test Method D638, Annex A2.

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[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.10 on Mechanical Properties.
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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.

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

4. Significance and Use

4.1 This test method provides data for quality control and acceptance or rejection under specifications.

4.2 Before proceeding with this test method, reference should be made to the ASTM specification of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters, or combination thereof, covered in the materials specification shall take precedence over those mentioned in this test method. If there are no material specifications, then the default conditions herein apply. Table 1 of Classification System D4000 lists the ASTM materials standards that currently exist.

5. Apparatus

5.1 The apparatus shall be as specified in Test Method D638, with the following exceptions:

5.1.1 *Grips*—~~Serrated~~ Use serrated grips faces ~~should be used~~ with care, since yielding or tearing at the grips may interfere with measurement of elongation even when the specimen breaks in the reduced section. Grips with rubber coated faces are recommended for thin specimens. ~~Care should be taken when selecting and using self tightening grips. Those which~~ Self-tightening grips that move as they tighten and result in a change in the grip separation between upper and lower grips are not satisfactory for this test method. If the specimen tab is not long enough to prevent the grip faces from cocking, ~~shims should be inserted~~ use shims to provide more uniform clamping.

5.1.2 *Drive Mechanism*—The velocity of the drive mechanism shall be regulated as specified in Section 8.

5.1.3 The fixed and movable members, drive mechanism, and grips ~~should~~shall be constructed of such materials and in such proportions that, after grip slack is taken up, the total elastic longitudinal deformation of the system constituted by these parts does not exceed 1 % of the total longitudinal deformation between the grips at any time during the test. If this is not possible, appropriate corrections shall be made in the calculation of strain values.

5.1.4 *Extension Indicator*—The extension indicator shall be capable of determining the distance between grips at any time during the test. The instrument shall be essentially free of inertia lag at the specified speed of testing, and shall be accurate to ±1 % of extension or better.

NOTE 2—It is desirable that the load indicator and the extension indicator be combined into one instrument, which automatically records the load as a function of the extension or as a function of time. In the latter case, the conversion to a load-extension record can readily be made because extension is proportional to time after the take-up of the initial grip slack.

5.1.5 *Micrometers*—~~Micrometers shall~~ Apparatus for measuring the width and thickness of the test specimen shall comply with the requirements of Test Method D5947 and shall read to 0.0025 mm (0.0001 in.) or less. Measure film thickness in accordance with Guide D6988.

6. Test Specimens

6.1 Microtensile test specimens shall conform to the dimensions shown in Fig. 1. This specimen shall be prepared by injection molding, die-cutting or machining from sheet, plate, slab, or finished article. Dimensions of a die suitable for preparing die-cut specimens are also shown in Fig. 1. Specimens may also be prepared by injection molding or compression molding.

6.2 All surfaces of the specimen shall be free of visible flaws, scratches, or imperfections. Marks left by coarse machining operations shall be carefully removed with a fine file or abrasive, and the filed surfaces shall then be smoothed with abrasive paper (No. 00 or finer). The finishing sanding strokes shall be made in the direction parallel to the long axis of the test specimen.

NOTE 3—Tabs shown in Fig. 1 are minimum size for adequate gripping. Shims may be required with thicker specimens to keep grips from cocking. Handling is facilitated and gripping improved by the use of larger tabs wherever possible.

7. Number of Test Specimens

7.1 At least five test specimens shall be tested for each sample in the case of isotropic materials.

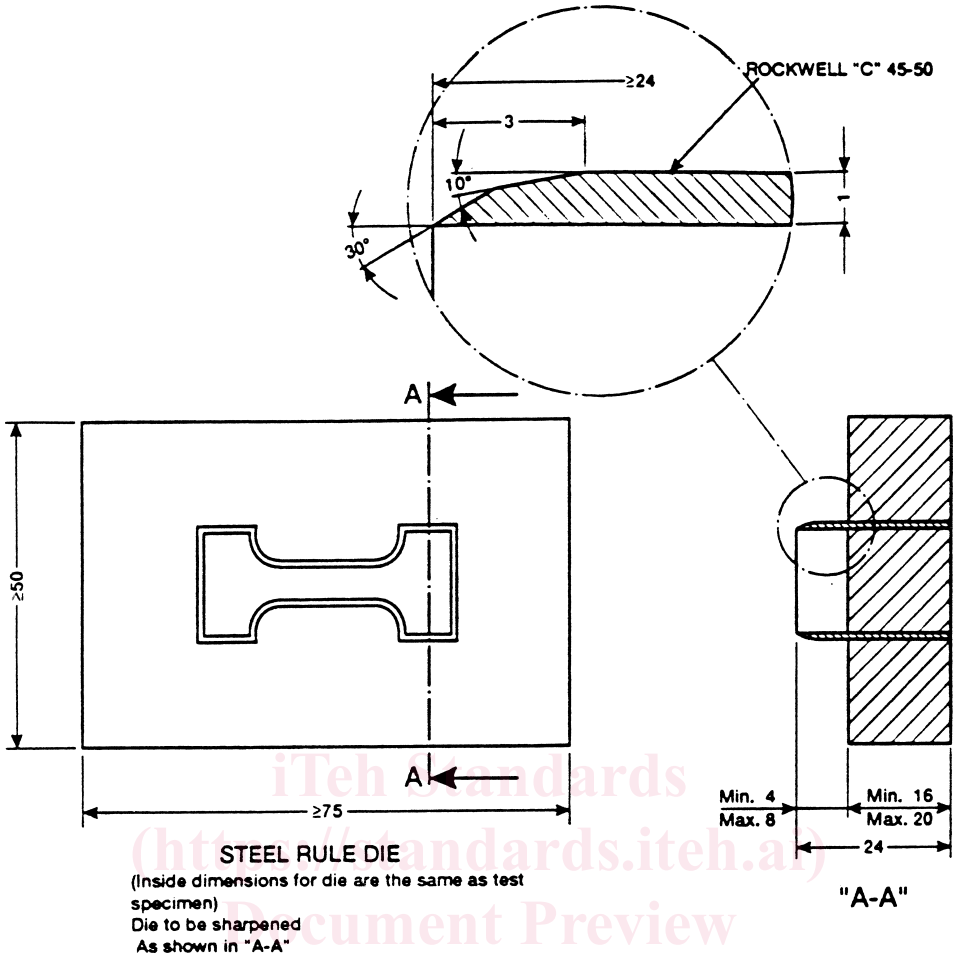
TABLE 1 Tensile Strength at Break for Seven Laboratories and Two Materials, MPa

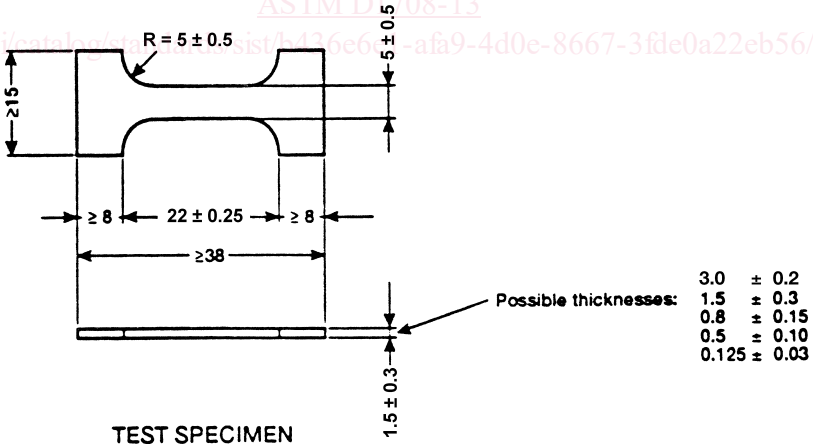
Material	Test Speed, mm/min	Average	S_r^A	S_R^B	r^C	R^D
Polyamide(imide)	1.3	193.6	1.60	5.48	4.48	15.3
Polybutylene	12.7	31.3	0.80	2.75	9.12	9.12

[A] S_r is the within-laboratory standard deviation for the indicated material. It is obtained by pooling the within-laboratory standard deviations of the test results from all of the participating laboratories:

$$S_r = [[(S_1)^2+(S_2)^2+\ldots+(S_n)^2]/n]^{1/2}. \quad (1)$$

[B] S_R is the between-laboratories reproducibility, expressed as a standard deviation, for the indicated material.
[C] r is the within-laboratory repeatability limit, $r = 2.8 \times S_r$.
[D] R is the between-laboratory reproducibility limit, $R = 2.8 \times S_R$.





NOTE 1—All dimensions are in millimetres.

FIG. 1 Microtensile Die and Test Specimen

7.2 Ten test specimens, five normal to and five parallel to the principal axis of anisotropy, shall be tested for each sample in the case of anisotropic materials.

7.3 Results obtained on test specimens that break at some obvious fortuitous flaw or at the edge of the grips shall be discarded and retests made, unless such flaws constitute a variable, the effect of which it is desired to study.

8. Speed of Testing

8.1 Speed of testing is the velocity of separation of the two members (or grips) of the testing machine when running idle (under no load).