



Designation: D 5945 – 96

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
Reprinted from the Annual Book of ASTM Standards. Copyright ASTM

Standard Test Method for Determining Temperature of Deflection of Plastics and Ebonite Under Load¹

This standard is issued under the fixed designation D 5945; 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 covers three procedures for determination of the temperature of deflection under load (bending stress) of plastics and ebonite:

1.1.1 Test Method A, using a nominal surface stress of 1.80 MPa;

1.1.2 Test Method B, using a nominal surface stress of 0.45 MPa; and

1.1.3 Test Method C, using a nominal surface stress of 8.00 MPa.

1.2 The test specimens are tested in one of two positions, flatwise or edgewise, with the requirements on test specimen dimensions being different in each case (see Guide D 5944, Section 6).

1.3 See Guide D 5944, 1.3.

NOTE 1—The test methods give better reproducibility with amorphous plastics than with semi-crystalline ones. With some materials, it may be necessary to anneal the test specimens to obtain reliable results. If applied, annealing procedures generally result in an increase in the temperature of deflection under load (see 7.2 and 7.3).

1.4 This test method is identical to ISO 75-2. This test method is comparable to Test Method D 648, but neither test method should be substituted for the other. The two test methods may differ with respect to test specimen dimensions, test specimen conditioning, test equipment, testing conditions, etc. The two test methods may not give the same results.

1.5 The values stated in SI units are to be regarded as the 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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 648 Test Method for Deflection Temperature of Plastics

Under Flexural Load²

D 5936 Specification for Multipurpose Test Specimens Used for Testing Plastics³

D 5939 Practice for Preparing Multipurpose Test Specimens and Bars of Thermoplastics by Injection Moulding³

D 5940 Practice for Preparing Small Plate Test Specimens of Thermoplastics by Injection Moulding³

D 5944 Guide for Describing the General Principles for Determining the Temperature of Deflection of Plastics Under Load³

2.2 *ISO Standards:*⁴

ISO 75-2 Determination of Temperature of Deflection Under Load—Part 2: Plastics and Ebonite

ISO 293:1986, Plastics—Compression Moulding Test Specimens of Thermoplastic Materials

ISO 294, Plastics—Injection Moulding of Test Specimens of Thermoplastic Materials

ISO 2818, Plastics—Preparation of Test Specimens by Machining

ISO 3167:1993, Plastics—Multipurpose Test Specimens

3. Terminology

3.1 *Definitions*—See Guide D 5944, Section 3.

4. Principle

4.1 A standard test specimen made of plastic or ebonite is subjected to a bending stress to produce one of the nominal surface stresses given in 1.1. The temperature is raised at a uniform rate, and the temperature at which a specified deflection occurs is measured.

5.

6. Apparatus

6.1 *Means of Applying a Bending Stress:*

6.1.1 See Guide D 5944, 6.1.

6.1.2 The span between the test specimen supports shall be 64 ± 1 mm if the specimen is tested in the flatwise position and 100 ± 2 mm if the specimen is tested in the edgewise position.

6.2 *Heating Equipment*—See Guide D 5944, 6.2.

¹ Bias This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.61 on USA Technical Advisory Group for ISO/TC 61 on Plastics.

Current edition approved June 10, 1996. Published August 1996.

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

³ *Annual Book of ASTM Standards*, Vol 08.03.

⁴ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

6.3 *Weights*—See Guide D 5944, 6.3.

6.4 *Temperature-Measuring Instrument*—See Guide D 5944, 6.4.

6.5 *Deflection-Measuring Instrument*—See Guide D 5944, 6.5.

7. Test Specimens

7.1 See Guide D 5944, Section 6.

7.2 One of two different types of test specimens shall be used, depending on the orientation of the specimen in the test apparatus.

7.2.1 If the specimen is tested in the flatwise position, its dimensions shall be as follows:

Length, l , 80 ± 2.0 mm
Width, b , 10 ± 0.2 mm
Thickness, h , 4 ± 0.2 mm

7.2.2 If the specimen is tested in the edgewise position, its dimensions shall be as follows:

Length, l , 120.0 ± 10.0 mm
Width, b , 9.8 to 15.0 mm
Thickness, h , 3.0 to 4.2 mm

7.3 The test specimen shall be produced in accordance with ISO 293 and 2818, or ISO 294 (Practices D 5939 and D 5940), or as agreed upon by the interested parties. In the case of compression-molded specimens, the thickness shall be in the direction of the molding force. For materials in sheet form, the thickness of the test specimen (this dimension is usually the thickness of the sheet) shall be in the range of 3 to 13 mm, preferably between 4 and 6 mm.

NOTE 2—The test results obtained on specimens approaching 13-mm thick may be 2 to 4°C above those obtained from thin test specimens because of poorer heat transfer.

NOTE 3—The possibility of conducting the test with a smaller (80 by 10 by 4 mm) specimen in the flatwise position has been introduced because it gives the following advantages:

- (1) The specimen can be taken from the narrow central part of the multipurpose test specimen specified in ISO 3167 (Specification D 5936),
- (2) It is more stable on the supports, and
- (3) It does not tend to stand on one edge like the edgewise test specimen.

7.4 The test results obtained on molded test specimens depend on the molding conditions used in their preparation. Molding conditions shall be in accordance with the standard for the material, or shall be agreed upon by the interested parties.

7.5 Discrepancies in test results due to variations in molding conditions may be minimized by annealing the test specimens before testing them. Since different materials require different annealing conditions, annealing procedures shall be used only if required by the materials standard or if agreed upon by the interested parties.

8. Conditioning

8.1 See Guide D 5944, Section 7.

9. Procedure

9.1 *Calculation of Force to be Applied:*

9.1.1 See Guide D 5944, 9.1.

9.1.2 The maximum nominal surface stress applied shall be one of the following:

(1) 1.80 MPa, in which case the procedure is designated Test Method A;

(2) 0.45 MPa, in which case the procedure is designated Test Method B; or

(3) 8.00 MPa, in which case the procedure is designated Test Method C.

(1)

9.1.3 The dimensions of the test specimen are given in 7.2. The span between the test specimen supports is given in 6.1.2.

9.2 *Initial Temperature of the Heating Equipment*—See Guide D 5944, 9.2.

9.3 *Measurement:*

9.3.1 See Guide D 5944, 9.3.

9.3.2 Apply one of the nominal surface stresses specified in 9.1.

9.3.3 Note the temperature at which the bar reaches the standard deflection given in Table 1 or Table 2 for the test specimen height concerned (thickness, h , for specimens tested in the flatwise position and width, b , for specimens tested in the edgewise position). This temperature is the temperature of deflection under load.

NOTE 4—The initial flexural strain due to the loading of the specimen at room temperature is neither specified nor measured in these test methods. The specified quantity, the standard deflection, s , is essentially a deflection difference, corresponding to a flexural-strain difference. The ratio of this flexural-strain difference to the initial flexural strain depends on the modulus of elasticity, at room temperature, of the material under test. This test method is not suitable, therefore, for comparing the temperatures of deflection under load of materials with widely differing elastic properties.

NOTE 5—The standard deflections given in Table 1 and Table 2 correspond to a flexural strain of 0.2 % at the surface of the test specimen.

10. Expression of Results

10.1 See Guide D 5944, Section 9.

10.2 If the individual results for amorphous plastics or ebonite differ by more than 2°C, or those for semi-crystalline materials by more than 5°C, repeat tests shall be conducted.

11. Test Report

11.1 See Guide D 5944, Section 10.

11.2 Information on (1) the orientation of the test specimen (flatwise or edgewise) and (2) the nominal surface stress may be given as follows:

11.2.1 Use Test Method A, B, or C to designate the nominal surface stress and the letters “e” and “f” to designate the test specimen orientation.

11.2.2 Thus, a test using a nominal surface stress of 1.80 MPa and flatwise test specimen orientation would be referred

TABLE 1 Standard Deflection for Different Test Specimen Heights—80 by 10 by 4-mm Specimen Tested in the Flatwise Position

Test Specimen Height (Thickness, h , of Specimen), mm	Standard Deflection, mm
3.8	0.36
3.9	0.35
4.0	0.34
4.1	0.33
4.2	0.32

