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An American National Standard

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Standard Test Methods for Deformation of Plastics Under Load[1]

This standard is issued under the fixed designation D 621; 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.

These test methods have been approved for use by agencies of the Department of Defense to replace Method 1101 of Federal Test Method Standard 406, and for Listing in the DoD Index of Specifications and Standards.

$^{\epsilon 1}$ NOTE—The safety hazards caveat and the Precision and Bias section were added editorially in March 1988. The Referenced Documents section was also added, causing the renumbering of subsequent sections.

1. Scope

1.1 These test methods cover the determination of the deformation under compression of nonmetallic sheet and molded plastic materials, of all classes and all commercial thicknesses, intended for structural and insulating purposes. Two test methods are included, as follows:

Test Method A—For rigid plastics.

Test Method B—For nonrigid plastics.

1.2 The word deformation is used herein in the broad sense to cover (*1*) dimensional change due almost entirely to flow, and (*2*) dimensional change due to a combination of flow and shrinkage caused by loss of water or other volatile matter. The word flow as used in these test methods may describe either plastic or elastic deformation or combinations thereof.

NOTE 1—The values stated in SI units are to be regarded as the standard.

NOTE 2—Methyl methacrylate and polystyrene are examples of materials that deform almost entirely by flow. Cellulose acetate, cellulose acetate butyrate, phenolic laminated fiber, and vulcanized fiber are examples of materials that deform by a combination of flow and shrinkage.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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 374 Test Methods for Thickness of Solid Electrical Insulation[2]

D 575 Test Methods for Rubber Properties in Compression[3]

D 618 Methods of Conditioning Plastics and Electrical Insulating Materials for Testing[2]

3. Significance and Use

3.1 Data obtained by Test Method A give a measure of the ability of a rigid plastic in assemblies of conductors and insulators that are held together by bolts, rivets, or similar fastening devices, to withstand compression without yielding and loosening the assembly with time. Test Method A also gives a measure of the rigidity of plastics at service temperatures and consequently can be used as an identification test for procurement purposes.

3.2 Data obtained by Test Method B give a measure of the ability of a nonrigid plastic to return to its original dimensions with time after having been deformed. Test Method B determines the extent to which the plastic will follow associated parts in applications requiring elastic properties.

TEST METHOD A—RIGID PLASTICS

4. Nature of Test

4.1 The principle of Test Method A is essentially that of the parallel plate plastometer, namely, a constant-force system whereby a test specimen is conditioned, if necessary, and is then placed between the parallel plates of a constant-force device and the thickness observed over a required period at the stipulated temperature or temperatures.

5. Apparatus

5.1 *Testing Machine*—A machine capable of exerting a constant force of 113 kg (250 lb), 227 kg (500 lb), and 454 kg (1000 lb) ±1 % between the parallel anvils of the machine, which shall be arranged so that they can be brought into contact with the test specimen before the load is applied. A machine suitable for this test is shown in Fig. 1. A recommended method for calibrating such a device is given in the Appendix. One of the anvils of the machine shall preferably be self-aligning and shall, in order that the load may be applied evenly over the face of the specimen, be arranged so that the specimen is accurately centered and the resultant of the load is through its center. The machine shall also be equipped with a dial gage or the equivalent capable of measuring the relative movement of the faces to 0.025 mm (0.001 in.) or less. A thermometer of the total immersion type shall be suspended in such a manner that the bulb is

[1] These test methods are under the jurisdiction of ASTM Committee D-20 on Plastics and are the direct responsibility of Subcommittee D20.30 on Thermal Properties (Section D20.30.07).

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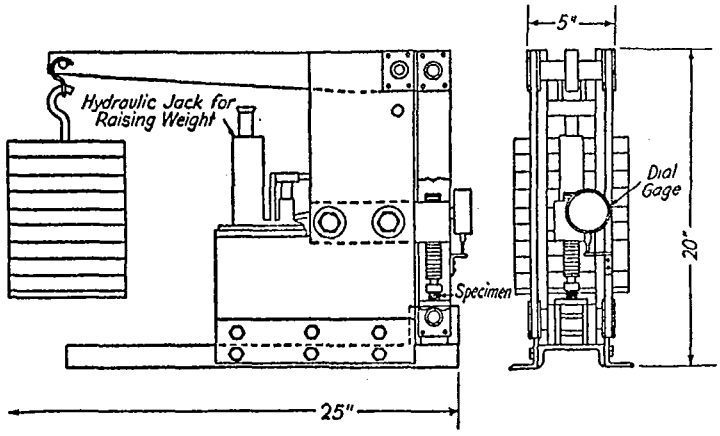
[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 09.01.



Metric Equivalents

in.	5	20	25
mm	127	508	635

FIG. 1 Deformation Testing Machine

approximately level with the specimen and not more than 76 mm (3 in.) therefrom.

5.2 *Test Chamber*—A test chamber of suitable size and construction to enclose the testing machine and maintain it during the test within ±1°C (2°F) of the specified test temperature, except for the short period at the beginning when opening the door may cause a drop in temperature.

6. Test Specimens

6.1 The test specimen shall be a 12.7-mm (½-in.) cube, either solid or composite. Materials over 12.7 mm (½ in.) in thickness shall be reduced to 12.7 mm (½ in.), and thinner materials shall be piled up with the total height as near to 12.7 mm (½ in.) as possible. The squares of the composite specimen shall be accurately aligned in all cases. Surfaces of the test specimens shall be plane and parallel.

6.2 The specimens for materials made in large sheets, such as phenolic laminated fiber, where moisture absorption characteristics may vary over the entire surface, shall be prepared, unless otherwise specified, in accordance with the sampling method described in 6.3, which averages the effect over the sheet by selecting squares comprising the specimen in such a manner that each square represents the same proportional part of the entire area of the sheet.

6.3 *Specimen from Sheet Materials*—The specimen shall be selected from the whole sheet by cutting a strip 12.7 mm (½ in.) in width from the sheet, parallel to the two long edges if the sheet is not square or parallel to any two if it is square, midway between them, and extending from the edge to the center of the sheet. If quarter sheets are used, the strip shall be taken from the edge corresponding to the center-to-edge section of the original whole sheet. The strip shall be divided into eight equal parts numbered from 1 to 8, beginning with the piece corresponding to the edge of the sheet. The squares used to form the composite test specimen shall be taken from these pieces. If the whole piece is not used, the squares cut from it shall be taken from the end which was originally nearest the edge of the sheet. If any piece is insufficient for the number of squares required to be cut from a piece bearing that number, a second strip shall be cut adjacent to the first one, cut into pieces, and the required number of squares taken from the appropriate pieces. The number of squares to be cut from each piece is prescribed in Table 1.

NOTE 3—Substantial variations in test values may occur, particularly with composite specimens, if the opposite faces of the specimens are not plane and parallel or if sink marks or other similar imperfections are present. To minimize such variations, the squares used to form the composite specimens, if necessary, shall be rendered plane and parallel and their adjoining surfaces shall be freed of sink marks and other imperfections by milling, grinding, or other appropriate means. If solid cubes are used, their opposite faces in contact with the anvils of the testing machine, if necessary, shall be milled plane and parallel and shall be smooth and free of imperfections.

7. Conditioning

7.1 Where deformation under average room conditions is required, condition and test specimens in accordance with 7.1.1 and 7.1.2.

7.1.1 *Conditioning*—Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Methods D 618 for those tests where conditioning is re-

TABLE 1 Number of Squares to be Cut from Each Piece

NOTE—In case of material of thicknesses not included in the table, the squares used in the composite test specimen shall be selected in accordance with the method for nearest thickness given in the table. In case the thickness is midway between two adjacent values in the table, the squares used in the composite test specimen shall be selected in accordance with the instructions for the thinner material.

Thickness of Material, mm (in.)	Total Number of Squares Required	Number of Piece							
		1	2	3	4	5	6	7	8
0.40 (1/64)	32	8	6	6	4	3	3	2	...
0.79 (1/32)	16	4	3	3	2	2	1	1	...
1.19 (3/64)	11	2	2	2	2	1	1	1	...
1.59 (1/16)	8	2	1	1	1	1	1	1	...
2.38 (3/32)	5	1	1	1	1	...	1	...	...
3.2 (1/8)	4	1	1	1	...	1	...	...	...
4.8 (3/16)	3	1	...	1	...	1	...	...	...
9.5 (3/8)	1	...	...	1	...	...	...	...	...
12.7 (1/2)	1	...	...	1	...	...	...	...	...