



Designation: D 1621 – 00

Standard Test Method for Compressive Properties Of Rigid Cellular Plastics¹

This standard is issued under the fixed designation D 1621; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope *

1.1 This test method describes a procedure for determining the compressive properties of rigid cellular materials, particularly expanded plastics, based on test machine crosshead motion.

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

1.3 *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—This test method and ISO 844 are technically equivalent.

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

E 4 Practices for Force Verification of Testing Machines³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

2.2 ISO Standard:

ISO 844 Cellular Plastics—Compression Test of Rigid Materials⁵

3. Terminology

3.1 Definitions:

3.1.1 *compressive deformation*—the decrease in length produced in the gage length of the test specimen by a compressive load expressed in units of length.

3.1.2 *compressive strain*—the dimensionless ratio of compressive deformation to the gage length of the test specimen or the change in length per unit of original length along the longitudinal axis.

3.1.3 *compressive strength*—the stress at the yield point if a yield point occurs before 10 % deformation (as in Fig. 1a) or, in the absence of such a yield point, the stress at 10 % deformation (as in Fig. 1b).

3.1.4 *compressive stress (nominal)*—the compressive load per unit area of minimum original cross section within the gage boundaries, carried by the test specimen at any given moment, expressed in force per unit area.

3.1.5 *compressive stress-strain diagram*—a diagram in which values of compressive stress are plotted as ordinates against corresponding values of compressive strain as abscissas.

3.1.6 *compressive yield point*—the first point on the stress-strain diagram at which an increase in strain occurs without an increase in stress.

3.1.7 *deflection*—crosshead movement after the loading plates contact the specimen, expressed in millimetres or inches.

3.1.8 *gage length*—the measured thickness of the test specimen expressed in units of length.

3.1.9 *modulus of elasticity*—the ratio of stress (nominal) to corresponding strain below the proportional limit of a material expressed in force per unit area based on the minimum initial cross-sectional area.

3.1.10 *proportional limit*—the greatest stress that a material is capable of sustaining without any deviation from proportionality of stress-to-strain (Hooke's law) expressed in force per unit area.

4. Significance and Use

4.1 This test method provides information regarding the behavior of cellular materials under compressive loads. Deformation data can be obtained, and from a complete load-deformation curve it is possible to compute the compressive stress at any load (such as compressive stress at proportional-limit load or compressive strength at maximum load) and to compute the effective modulus of elasticity.

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

³ *Annual Book of ASTM Standards*, Vol 03.01.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

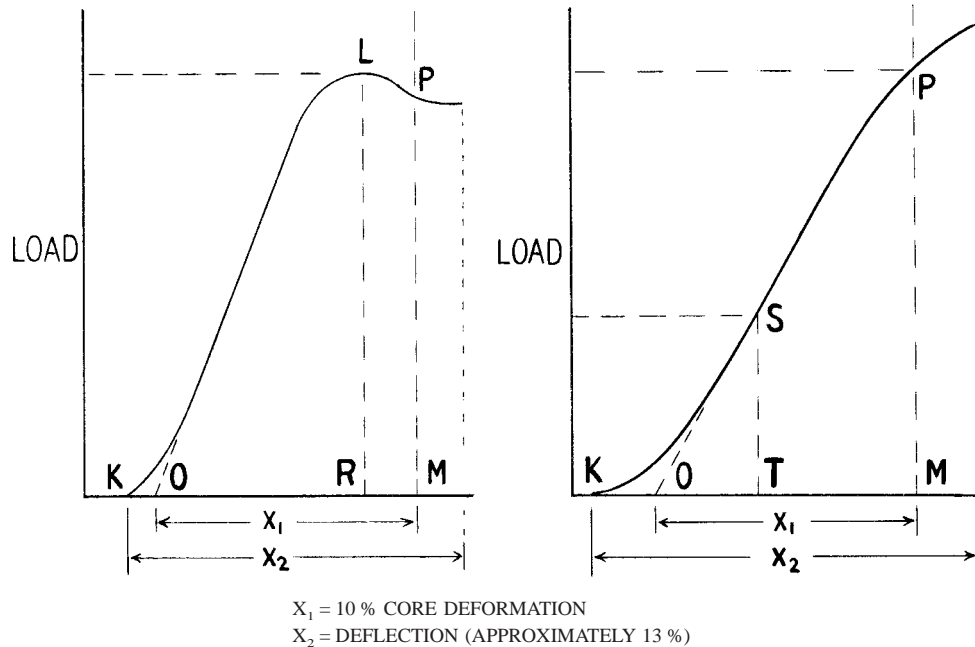


FIG. 1 a Compressive Strength (See 3.1.3 and Section 9)

FIG. 1 b Compressive Strength (See 3.1.3 and Section 9)

4.2 Compression tests provide a standard method of obtaining data for research and development, quality control, acceptance or rejection under specifications, and special purposes. The tests cannot be considered significant for engineering design in applications differing widely from the load - time scale of the standard test. Such applications require additional tests such as impact, creep, and fatigue.

4.3 Before proceeding with this test method, reference should be made to the specification of the material being tested. Any test specimen preparation, conditioning, dimensions, and/or testing parameters 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 apply.

5. Apparatus

5.1 *Testing Machine*—Any suitable compression testing machine capable of operating at a constant rate of motion of the movable crosshead may be used. A spherical loading block of the suspended, self-aligning type is recommended for the upper loading platen.

5.2 *Load Indicator*—Use a load-indicating mechanism that will permit measurements to a precision of $\pm 1\%$. Verify the calibration of the test machine and load indicator in accordance with Practices E 4.

5.3 *Deformation Indicator*—Use a deformation-indicating mechanism that will permit measurements to a precision of $\pm 0.1\%$.

5.4 *Micrometer Dial Gage*, caliper, or steel rule, suitable for measuring dimensions of the specimens to $\pm 1\%$.

NOTE 2—Although the use of dial gages or automatic recorders to measure crosshead movement and thus obtain deformation complies with this test method, it should be pointed out that this is not exactly comparable to the use of strain-measuring devices mounted on the specimen. The use of crosshead movement to obtain strain leads to values

of moduli of elasticity having considerable variation, and to values perhaps only one tenth of those obtained by measuring strain directly on the specimen.

6. Test Specimen

6.1 The test specimen shall be square or circular in cross section with a minimum of 25.8 cm^2 (4 in.^2) and maximum of 232 cm^2 (36 in.^2) in area. The minimum height shall be 25.4 mm (1 in.) and the maximum height shall be no greater than the width or diameter of the specimen. Care should be taken so that the loaded ends of the specimen are parallel to each other and perpendicular to the sides.

NOTE 3—Cellular plastics are not ideal materials, and the compressive modulus may appear significantly different, depending on the test conditions, particularly the test thickness. All data that are to be compared should be obtained using common test conditions.

6.2 All surfaces of the specimen shall be free from large visible flaws or imperfections. If it is necessary to place gage marks on the specimen, this shall be done so as not to affect the surfaces of the specimen.

6.3 If the material is suspected to be anisotropic, the direction of the compressive loading must be specified relative to the suspected direction of anisotropy.

6.4 A minimum of five specimens shall be tested for each sample. Specimens that fail at some obvious flaw should be discarded and retests made, unless such flaws constitute a variable the effect of which it is desired to study.

7. Conditioning

7.1 *Conditioning*—Condition the test specimens at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618, unless otherwise specified in the contract or