Designation: C 165 – 05

Standard Test Method for Measuring Compressive Properties of Thermal Insulations[1]

This standard is issued under the fixed designation C 165; 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 two procedures for determining the compressive resistance of thermal insulations.

1.1.1 Procedure A covers thermal insulations having an approximate straight-line portion of a load-deformation curve, but that shall or shall not have an identifiable yield point as shown in Figs. 1 and 2. Such behavior is typical of most rigid board or block-type insulations.

1.1.2 Procedure B covers thermal insulations that become increasingly more stiff as load is increased, as shown in Fig. 3. Such behavior is typical of fibrous batt and blanket insulations that have been compressed previously to at least the same deformation by compression packaging or mechanical softening.

1.2 It is recognized that the classification of materials under Procedures A and B shall not hold in all cases. For example, some batt or blanket materials that have not been compression packaged will exhibit behavior more typical of Procedure A for their first loadings. Also, some higher density fibrous insulation boards that have been precompressed will exhibit load-deformation curves more typical of Procedure B. There will also be thermal insulations with load-deformation curves that follow none of the three types shown here; that is, curves with no straight-line portion, curves with compaction areas, and curves that change from negative to positive slope.

1.3 This test method does not cover reflective or loose fill insulations.

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

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.*

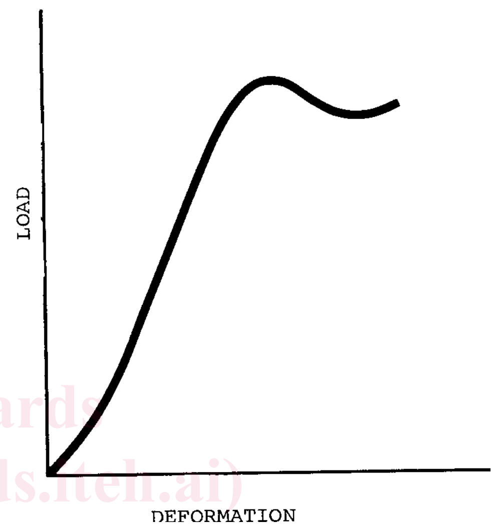

FIG. 1 Procedure A—Straight Line Portion with Definite Yield Point

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
C 168 Terminology Relating to Thermal Insulation
C 240 Test Methods of Testing Cellular Glass Insulation Block
E 4 Practices for Force Verification of Testing Machines
E 177 Practice for the Use of the Terms Precision and Bias in ASTM Test Methods
E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:*

[1] This test method is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.32 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.

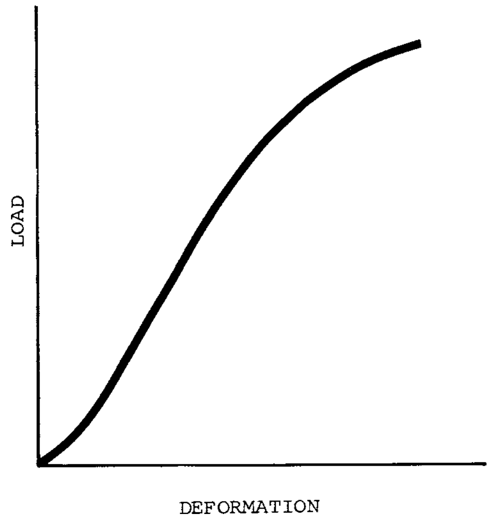

FIG. 2 Procedure A—Straight Line Portion but no Definite Yield Point

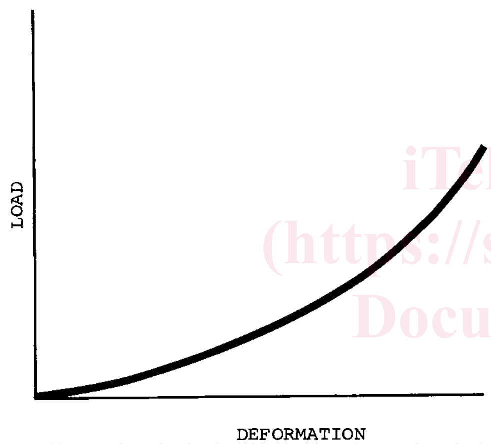

FIG. 3 Procedure B—Increasing Stiffness

3.1.1 Terminology C 168 applies to the terms used in this method.

3.2 Additional terms are defined as follows:

3.3 *compressive deformation*—the decrease in specimen thickness by a compressive load.

3.4 *compressive load*—the compressive force carried by the test specimen at any given moment.

3.5 *compressive modulus of elasticity*—the ratio of the compressive load per unit of original area to the corresponding deformation per unit of original thickness below the proportional limit of a material.

3.6 *compressive resistance*—the compressive load per unit of original area at a specified deformation. For those materials where the specified deformation is regarded as indicating the start of complete failure, the compressive resistance shall properly be called the compressive strength.

3.7 *proportional limit in compression*—the greatest compressive load that a material is capable of sustaining without any deviation from proportionality of load to deformation.

3.8 *yield point in compression*—the load at the first point on the load-deformation curve at which an increase in deformation occurs without an increase in load.

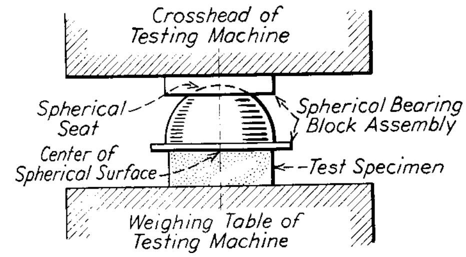

FIG. 4 Spherical Bearing Block for Compressive Strength Test

4. Significance and Use

4.1 In providing Procedures A and B, it is recognized that different types of thermal insulation will exhibit significantly different behavior under compressive load. Data must usually be obtained from a complete load-deformation curve, and the useful working range normally corresponds to only a portion of the curve. The user is cautioned against use of the product in the range beyond which the product is permanently damaged or properties are adversely affected.

4.2 Load-deformation curves provide useful data for research and development, quality control, specification acceptance or rejection, and for other special purposes. Standard loading rates shall not be used arbitrarily for all purposes; the effects of impact, creep, fatigue, and repeated cycling must be considered. All load-deformation data shall be reviewed carefully for applicability prior to acceptance for use in engineering designs differing widely in load, load application rate, and material dimensions involved.

5. Apparatus

5.1 *Testing Machine*— Standard hydraulic or mechanical compression testing machine of suitable capacity, and capable of operating at the specified constant rate of motion of the movable head. Verify the accuracy of the testing machine in accordance with Practices E 4.

5.2 *Loading Surfaces*— Surfaces shall be at least 1.0 in. (25.4 mm) greater in all directions than the test specimens, and shall be designed to remain plane within ±0.003 in./ft (±0.25 mm/m) under all conditions of load.

5.2.1 *Procedure A*— A preferred size is 8.0 in. (203 mm) square. One surface plate, either the upper or lower, shall be mounted rigidly with its surface perpendicular to the testing machine axis. The other surface plate shall be self-aligning, suspended by a spherical bearing block as shown in Fig. 4.

5.2.2 *Procedure B*— A preferred size is 1.0 ft^2 (0.093 m^2) in area, either 12 in. (305 mm) square or 13.54 in. (344 mm) in diameter. Both plates shall be mounted rigidly so that the surfaces are parallel to each other and perpendicular to the testing machine axis.

5.3 *Load Indicator*— Load-indicating mechanism that will permit measurements with an accuracy of± 1 % of total load.

5.4 *Deformation Indicator*—Deformation-indicating mechanism that measures crosshead movement, or a simple jig that will permit direct measurements, with an accuracy of ±0.1 % of specimen thickness. When crosshead movement is used to measure deformation, use a calibration curve unless it has been shown that under the conditions of test the crosshead indicator gives an accurate measure of specimen deformation.