INTERNATIONAL

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Standard Test Method for Compressive Properties of Plastic Lumber and Shapes[1]

This standard is issued under the fixed designation D6108; 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 the determination of the mechanical properties of plastic lumber and shapes, when the entire cross-section is loaded in compression at relatively low uniform rates of straining or loading. Test specimens in the "as-manufactured" form are employed. As such, this is a test method for evaluating the properties of plastic lumber or shapes as a product and not a material property test method.

NOTE 1—This test method was developed for application to plastic lumber materials, but it is generic enough that it would be equally applicable to other plastic composite materials, including wood-plastic composite materials.

1.2 Plastic lumber and plastic shapes are currently made predominantly with recycled plastics. However, this test method would also be applicable to similar manufactured plastic products made from virgin resins, or where the product is non-homogenous in the cross-section.

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

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—There is no known ISO equivalent to this test method.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing
D883 Terminology Relating to Plastics
D4000 Classification System for Specifying Plastic Materials
D5033 Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics (Withdrawn 2007)[3]
D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D6111 Test Method for Bulk Density And Specific Gravity of Plastic Lumber and Shapes by Displacement
E4 Practices for Force Calibration and Verification of Testing Machines
E83 Practice for Verification and Classification of Extensometer Systems
E456 Terminology Relating to Quality and Statistics
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
E2935 Practice for Evaluating Equivalence of Two Testing Processes

3. Terminology

3.1 *Definitions of Terms:*

3.1.1 Definitions of terms applying to this test method appear in Terminology D4000 and Guide D5033. For terms relating to precision and bias and associated issues, the terms used in this test method are in accordance with the definitions in Terminology E456.

3.1.2 *plastic lumber, n*—a manufactured product made primarily from plastic materials (filled or unfilled), typically used as a building material for purposes similar to those of traditional lumber, which is usually rectangular in cross-section. (Terminology D883)

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.20 on Plastic Lumber (Section D20.20.01).

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

3.1.2.1 *Discussion*—Plastic lumber is typically supplied in sizes similar to those of traditional lumber board, timber and dimension lumber; however the tolerances for plastic lumber and for traditional lumber are not necessarily the same. (Terminology D883)

3.1.3 *resin, n*—a solid or pseudosolid organic material often of high molecular weight, which exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally. (Terminology D883)

3.1.3.1 *Discussion*—In a broad sense, the term is used to designate any polymer that is a basic material for plastics.

3.2 *Definitions of Terms Specific to This Standard:*

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

3.2.2 *compressive strain*—the ratio of compressive deformation to the gage length of the test specimen, that is, the change in length per unit of original gage length along the longitudinal axis.

3.2.2.1 *Discussion*—Compressive strain is expressed as a dimensionless ratio.

3.2.3 *compressive strength*—the maximum compressive stress (nominal) carried by a test specimen during a compression test.

3.2.3.1 *Discussion*—Compressive strength may or may not be the compressive stress (nominal) carried by the specimen at the moment of rupture.

3.2.4 *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.

3.2.4.1 *Discussion*—Nominal (or effective) compressive strain is expressed in units of force per unit area. The expression of compressive stress in terms of the minimum original cross section is almost universally used. Under some circumstances the compressive stress has been expressed per unit of prevailing cross section. This stress is called the "true compressive stress".

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

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

3.2.7 *modulus of elasticity*—the ratio of compressive stress (nominal) to corresponding compressive strain below the proportional limit of a material.

3.2.7.1 *Discussion*—The modulus of elasticity is expressed in force per unit area, based on the effective/average initial cross-sectional area.

3.2.8 *percent compressive strain*—the compressive deformation of a test specimen expressed as a percent of the original gage length.

3.2.9 *plastic shape, n*—a manufactured product made primarily from plastic materials (filled or unfilled), which is not necessarily rectangular in cross section.

3.2.10 *proportional limit*—the greatest compressive stress that a material is capable of sustaining without any deviation from proportionality of stress to strain (Hooke's law).

3.2.10.1 *Discussion*—The proportional limit is expressed in force per unit area.

3.2.11 *secant modulus*—the ratio of the compressive stress (nominal) to the corresponding value of compressive strain on the stress-strain diagram at a specified value of strain, typically one percent strain (0.01 mm/mm) for plastic lumber.

3.2.11.1 *Discussion*—The secant modulus is expressed in force per unit area based on the effective initial cross-sectional area.

3.2.12 *stress at a given strain*—the stress on the stress-strain curve at a specified value of strain.

3.2.12.1 *Discussion*—The stress at a given strain should not be taken as the ultimate strength at failure. Typically a strain value of 3 % or 0.03 mm/mm is used for plastic lumber. The ultimate strength, or the maximum value of stress on the stress-strain diagram, can be higher for plastic lumber occurring at values of strain much greater than 3 %.

4. Significance and Use

4.1 Compression tests provide information about the compressive properties of plastic lumber and shapes when these products are used under conditions approximating those under which the tests are made. In the case of some materials, there will be a specification that requires the use of this test method, but with some procedural modifications that take precedence when adhering to the specification. Therefore, it is advisable to refer to that material specification before using this test method. Table 1 in Classification D4000 lists the ASTM materials standards that currently exist.

4.2 Compressive properties include modulus of elasticity, secant modulus, compressive strength, and stress at a given strain. In the case of a material that fails in compression by a shattering fracture, the compressive strength has a very definite value. In the case of a material that does not fail in compression by a shattering fracture nor exhibits a compressive yield point, the compressive strength is an arbitrary one depending upon the degree of distortion that is regarded as indicating complete failure. Many plastic lumber materials will not exhibit a true yield point. Compressive strength can have no real meaning in such cases. For plastic lumber, the stress at a given strain of 3 % (0.03 in./in. (mm/mm)) is typically used.

4.3 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.

5. Apparatus

5.1 *Testing Machine*—Any suitable testing machine capable of control of constant-rate-of-crosshead movement and comprising essentially the following: