Designation: D6112 – 23

Standard Test Methods for Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes[1]

This standard is issued under the fixed designation D6112; 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 These test methods cover the determination of the creep and creep-rupture properties of plastic lumber and shapes, when loaded in compression or flexure under specified environmental conditions. Test specimens in the "as-manufactured" form are employed. As such, these are test methods for evaluating the properties of plastic lumber or shapes as a product and not material property test methods.

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 where the product is non-homogenous in the cross-section.

1.3 The values stated in inch-pound units are to be regarded as 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 1—There is no known ISO equivalent to this standard.

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]

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents
D883 Terminology Relating to Plastics
D2990 Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of 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D5033 Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics (Withdrawn 2007)[3]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
E4 Practices for Force Calibration and Verification of Testing Machines
E176 Terminology of Fire Standards
E456 Terminology Relating to Quality and Statistics

3. Terminology

3.1 *Definitions of Terms*—For definitions of terms used in these test methods and associated with plastics issues refer to the terminology contained in Terminology D883 or in Guide D5033. For definitions of terms used in this specification and associated with fire issues refer to the terminology contained in Terminology E176. For terms relating to precision and bias and associated issues, the terms used in this standard are defined in accordance with Terminology E456.

3.1.1 *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.

3.1.1.1 *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. **D883**

3.1.2 *resin, n*—a solid or pseudo-solid organic material often of high molecular weight, that exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally.

3.1.2.1 *Discussion*—In a broad sense, the term is used to

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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

designate any polymer that is a basic material for plastics. D883

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *compression—in a compressive creep test,* the decrease in length produced in the gauge length or the total length of a test specimen.

3.2.2 *creep modulus*—the ratio of initial applied stress to creep strain.

3.2.3 *creep strain*—the total strain, at any given time, produced by the applied stress during a creep test.

3.2.3.1 *Discussion*—The term creep, as used in this test method, reflects current plastics engineering usage. In scientific practice, creep is often defined to be the nonelastic portion of strain. However, this definition is not applicable to existing engineering formulas. Plastics have a wide spectrum of retardation times, and elastic portions of strain cannot be separated in practice from nonelastic. Therefore, wherever "strain" is mentioned in these test methods, it refers to the sum of elastic strain plus the additional strain with time.

3.2.4 *deflection—in a flexural creep test,* the change in mid-span position of a test specimen.

3.2.5 *deformation*—a change in shape, size or position of a test specimen as a result of compression, deflection, or extension.

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

3.2.7 *stress—for compressive creep,* the ratio of the applied load to the initial cross-sectional area.

3.2.7.1 *Discussion*—Maximum fiber stress for flexible creep is calculated based on the load at a given point on the load-deflection curve.

4. Summary of Test Method

4.1 These test methods consist of measuring the deflection or compression as a function of time and time-to-rupture, or failure of a specimen subject to constant flexural or compressive load under specified environmental conditions.

4.2 The four-point loading a outlined in this testing standard shall be used for the flexural creep tests.

4.3 Compressive loading as outlined in this testing standard shall be used for the compressive creep tests.

4.4 These test methods represent modifications of the compressive and flexural creep and creep rupture test methods specified in Test Methods D2990.

5. Significance and Use

5.1 Data from creep and creep-rupture tests are necessary to predict the creep modulus and strength of materials under long-term loads and to predict dimensional changes that have the potential to occur as a result of such loads.

5.2 Data from these test methods can be used to characterize plastic lumber: for comparison purposes, for the design of fabricated parts, to determine long-term performance under constant load, and under certain conditions, for specification purposes.

5.3 For many products, it is possible that 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 product specification before using this test method. Table 1 in Classification D4000 lists the ASTM materials standards that currently exist.

6. Apparatus

6.1 *General:*

6.1.1 *Loading System:*

6.1.1.1 The loading system must be so designed that the load applied and maintained on the specimen is within ±1 % of the desired load. The loading mechanism must allow reproductively rapid and smooth loading as specified in 11.1.3. In creep-rupture tests, provision must be made to ensure that shock loading, caused by a specimen failure, is not transferred to other specimens undergoing testing. The accuracy of the loading system shall be verified at least once each year in accordance with Practices E4.

6.1.1.2 Loading systems that provide a mechanical advantage require careful design to maintain constant load throughout the test. For example, lever systems must be designed so that the load does not change as the lever arm moves during the test.

6.1.2 *Compression and Deflection Measurements:*

6.1.2.1 The accuracy of the deformation measuring device shall be within ±1 % of the deformation to be measured.

6.1.2.2 Deformation measuring devices shall be calibrated against a precision micrometer screw or other suitable standard under conditions are nearly identical as possible with those encountered in the test. Caution is necessary when using deformation measuring devices whose calibration is subject to drifting with time and is dependent on temperature and humidity.

6.1.2.3 Deformation measuring devices shall be firmly attached to or seated on the specimen so that no slippage occurs. Electrical resistance gauges are suitable only if the material tested will permit perfect adhesion to the specimen and if they are consistent with 6.2.1

6.1.3 *Time Measurement*—The accuracy of the time measuring device shall be ±1 % of the time-to-rupture or failure or the elapsed time of each creep measurement, or both.

6.1.4 *Temperature Control and Measurement:*

6.1.4.1 The temperature of the test space, especially close to the gauge length of the specimen, shall be maintained within ±2°C by a suitable automatic device and shall be stated in reporting the results.

NOTE 2—The thermal contraction and expansion associated with small temperature changes during the test has the potential to produce changes in the apparent creep rate, especially near transition temperatures.

6.1.4.2 Care must be taken to ensure accurate temperature measurements over the gauge length of the specimen throughout the test. The temperature measuring devices shall be