Designation: D7032 – 17

Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite and Plastic Lumber Deck Boards, Stair Treads, Guards, and Handrails[1]

This standard is issued under the fixed designation D7032; 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 specification covers procedures to establish a performance rating for wood-plastic composite and plastic lumber for use as exterior deck boards, stair treads, guards, and handrails. The purpose of this specification is to establish a basis for code recognition of these products or systems in exterior applications. The products addressed in this specification are considered combustible.

NOTE 1—While wood-plastic composites contain wood or other cellulosic materials, the presence of wood or other cellulosic materials in plastic lumber is not required by this specification. Due to non-wood materials in wood-plastic composites and plastic lumber the structural, physical, fire, and other attributes may not be similar to those of wood.

1.1.1 The plastic component of wood-plastic composites and plastic lumber covered by this specification shall consist primarily of thermoplastics.

1.2 Deck boards, stair treads, guards, and handrails covered by this specification are permitted to be of any code compliant shape and thickness (solid or non-solid).

1.3 Wood-plastic composites and plastic lumber are produced in a broad range of fiber and/or resin formulations. It is recognized that the performance requirements in this specification are valid for any material or combination of materials used as deck boards, stair treads, guards, or handrails.

1.4 Details of manufacturing processes are beyond the scope of this specification.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *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 requirements prior to use.*

1.7 *Table of Contents:*

[1] This specification is under the jurisdiction of ASTM Committee D07 on Wood and is the direct responsibility of Subcommittee D07.02 on Lumber and Engineered Wood Products.

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1.8 *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]

D9 Terminology Relating to Wood and Wood-Based Products

D198 Test Methods of Static Tests of Lumber in Structural Sizes

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D883 Terminology Relating to Plastics

D1037 Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

D1413 Test Method for Wood Preservatives by Laboratory Soil-Block Cultures (Withdrawn 2016)[3]

D1554 Terminology Relating to Wood-Base Fiber and Particle Panel Materials

D1761 Test Methods for Mechanical Fasteners in Wood

D1929 Test Method for Determining Ignition Temperature of Plastics

D1972 Practice for Generic Marking of Plastic Products (Withdrawn 2014)[3]

D2017 Test Method of Accelerated Laboratory Test of Natural Decay Resistance of Woods (Withdrawn 2014)[3]

D2047 Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

D2394 Test Methods for Simulated Service Testing of Wood and Wood-Base Finish Flooring

D2565 Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications

D2915 Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products

D3345 Test Method for Laboratory Evaluation of Solid Wood for Resistance to Termites

D4000 Classification System for Specifying Plastic Materials

D4092 Terminology for Plastics: Dynamic Mechanical Properties

D4761 Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Material

D5764 Test Method for Evaluating Dowel-Bearing Strength of Wood and Wood-Based Products

D6109 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products

D6662 Specification for Polyolefin-Based Plastic Lumber Decking Boards

E84 Test Method for Surface Burning Characteristics of Building Materials

E108 Test Methods for Fire Tests of Roof Coverings

E1354 Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

F1679 Test Method for Using a Variable Incidence Tribometer (VIT) (Withdrawn 2006)[3]

G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

2.2 *Other References:*

AWPA Standard E1 Standard Method for Laboratory Evaluation for Determination of Resistance to Subterranean Termites[4]

AWPA Standard E10 Standard Method of Testing Wood Preservatives by Laboratory Soil-Block Cultures[4]

2009 International Building Code International Code Council, Inc.[5]

2009 International Residential Code International Code Council, Inc.[5]

3. Terminology

3.1 *Definitions*—Terminology used to describe WPCs are defined in Terminologies D9, D883, D1554, and D4092, Practice D1972, and Classification D4000.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *center-point load*—a flexure test where the load comes in contact with the test specimen at a location that is ½ the test span.

3.2.2 *guard*—a building component or a system of building components located at or near the open sides of elevated walking surfaces that minimizes the possibility of a fall from the walking surface to a lower level.

3.2.3 *handrail*—a rail intended for grasping by the hand for guidance or support.

3.2.4 *plastic lumber*—a manufactured product made primarily from plastic materials (filled or unfilled), typically used as a building material, which is usually rectangular in cross-section.

3.2.5 *quarter-point loading*—a flexure test where the load comes in contact with the test specimen at two locations, each of which is located at ¼ the span from the specimen load support.

3.2.5.1 *Discussion*—For example, quarter-point loading for a test specimen on a 24-in. (610-mm) span would have two equal loads contact the test specimen each located 6 in. in from the test specimen load support. The distance between the two points of load would be 12 in. (305 mm).

3.2.6 *span rating*—an index number that identifies the test span used in all structural load testing, which is the maximum center-to-center support spacing for the specified end use, and

[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.

[4] Available from American Wood-Preservers' Association (AWPA), P.O. Box 361784, Birmingham, AL 35236-1784, http://www.awpa.com.

[5] Available from International Code Council (ICC), 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041-3401, http://www.intlcode.org.

allowable design capacity, in pounds per square foot (lbf/ft^2 (kN/m^2)), determined in accordance with this specification.

3.2.6.1 *Discussion*—For example, a deck span rating of 16/100 recognizes the deck board for installation perpendicular to the floor joists spaced a maximum of 16 in. (406 mm) on center, and for supporting the load combinations required by the applicable code, which in this case cannot exceed 100 lbf/ft^2 (4.79 kN/m^2).

3.2.7 *third-point loading*—a flexure test where the load comes in contact with the test specimen at two locations, each of which is located at ⅓ the span from the specimen load support.

3.2.7.1 *Discussion*—For example, third-point loading for a test specimen on a 24-in. (610-mm) span would have two equal loads contact the test specimen each located 8 in. in from the test specimen load support. The distance between the two points of load would also be 8 in. (205 mm).

3.2.8 *wood-plastic composite (WPC)*—a composite made primarily from wood- or cellulose-based materials and plastic(s).

4. General Requirements

4.1 *Sampling*—Samples for testing shall be representative of the population being evaluated. Sampling shall be representative of the possible variations due to changes in raw materials and process variables over time. It is essential to consider batch-to-batch and shift-to-shift variability when sampling actual production. Test specimens shall be selected from several production runs of a given item. Products shall be sampled at the manufacturing site by an accredited third party inspection agency or testing laboratory. Exceptions to sampling at the manufacturing site, such as at a warehouse or distribution center, shall be documented in the test report.

4.2 *Sample Size*—Selection of a sample size depends upon the property to be estimated, the actual variation in the property occurring in the population, and the precision with which the property is to be estimated. The principles of Practice D2915 shall be followed. The minimum sample size shall provide estimation of mean values within 5 % in accordance with 3.4.2 of Practice D2915.

4.3 *Conditioning*—Prior to testing, all specimens shall be conditioned to environmental conditions appropriate for the intended end use of the product. Alternatively, test specimens shall be conditioned for a minimum of 40 h at 68°F ± 4°F (20°C ± 2°C) and 50 ± 5 % RH. If data show that product properties are not affected by extreme moisture conditions, such as submersion, the material shall be permitted to be tested without special conditioning. When the product is to be subjected to a water soak environment, the test specimens shall be tested within 30 min upon removal from the treatment.

4.4 *Flexural Tests*—Flexural strength and stiffness shall be determined in accordance with principles of Test Methods D4761 or D6109. Alternatively, to assess compliance with performance requirements in its intended installed configuration, the deck boards shall be tested according to the two-span method defined in Annex A1. The test specimen cross section shall be the minimum anticipated structural size for the intended end use. The test span shall be that for which code recognition is desired. The specimens shall be loaded at a constant strain rate of 1 % per minute (±10 %). Average time to failure for each test configuration shall be recorded (see Commentary, X1.2). A constant strain rate of 1 % per minute is achieved by using a constant rate of test machine crosshead motion, R, (inches/minute) computed in terms of the test span, L, and the member depth, d, by the following equation:

$$R = 0.00185 \times L^2/d \quad (1)$$

For members where the depth (vertical dimension) is varying along the member length, the depth (d) shall be taken as the gross member depth at the point of maximum moment.

NOTE 2—Eq 1 is based on the maximum extreme fiber strain at midspan of a horizontally symmetric simple span member. For a product that is symmetric about its horizontal axis, Eq 1 yields the target strain rate at both the extreme tensile and extreme compressive faces. For a product that is not symmetric about its horizontal axis, the Eq 1 strain rate is the average of the strains at these faces. See Commentary for additional information.

NOTE 3—Some wood-plastic composites and plastic lumber exhibit exceptionally large deformations prior to failure in bending. Users are cautioned to take particular care in test machine set-up to accommodate large deflections, both in terms of deflection-measuring devices and support conditions.

4.4.1 *Flexural Strength*—Modulus of rupture (*MOR*) or moment capacity shall be reported for each specimen. Flexural strength shall be calculated from the maximum load achieved or the load at 3 % strain, whichever occurs first.

4.4.2 *Flexural Stiffness*—Apparent modulus of elasticity (*MOE*) or *EI* shall be reported for each specimen. Flexural stiffness shall be calculated from a linear least squares fit of the stress-strain curve over the range of 10 to 40 % of ultimate stress.

4.4.3 The flexural strength and stiffness for deck board, guard, and handrail materials shall be determined in accordance with 4.4 and shall be used to establish a standard baseline performance level for comparison with future production during the required quality control audits.

4.5 *Temperature and Moisture Effects:*

4.5.1 *Temperature Effect*—Testing shall be conducted to verify that allowable span and load ratings are applicable at a range of temperatures expected in service. For purposes of this specification, the lower and upper temperatures shall be -20 ± 4°F (-29 ± 2°C) and 125 ± 4°F (52 ± 2°C), respectively. Flexure tests shall be conducted to failure at the desired span. A minimum of 10 specimens shall be tested at each temperature. The flexural strength and stiffness shall be determined in accordance with 4.4 and the average change in properties between the flexural strength and stiffness of the control flexural specimens and the specimens tested at low and high temperatures shall be calculated as a percentage and reported. The average change in flexural strength and stiffness properties shall be calculated by determining the difference between the control and conditioned values and dividing that difference by the control value.

4.5.2 *Moisture Effect*—Testing shall be conducted to verify that allowable span and load ratings are applicable at moisture conditions expected in service. Flexure tests shall be conducted