Designation: D7857 – 16

Standard Test Method for Evaluating the Flexural Properties and Internal Bond Strength of Fire-Retarded Mat-Formed Wood Structural Composite Panels Exposed to Elevated Temperatures[1]

This standard is issued under the fixed designation D7857; 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 is designed as a laboratory screening test. It is intended to establish an understanding of the respective contributions of the many wood material, fire-retardant, resin and processing variables, and their interactions, upon the mechanical properties of fire-retarded mat-formed wood structural composite (FRSC) panels as they affect flexural and internal bond (IB) performance and as they are often affected later during exposure to high temperature and humidity. Once the critical material and processing variables have been identified through these small-specimen laboratory screening tests, additional testing and evaluation shall be required to determine the effect of the treatment on the panel structural properties and the effect of exposure to high temperature on the properties of commercially produced FRSC panels. In this test method, treated structural composite panels are exposed to a temperature of 77°C (170°F) and at least 50% relative humidity.

1.2 The purpose of the preliminary laboratory-based test method is to compare the flexural properties and IB strength of FRSC panels relative to untreated structural composite panels with otherwise identical manufacturing parameters. The results of tests conducted in accordance with this test method provide a reference point for estimating strength temperature relationships for preliminary purposes. They establish a starting point for subsequent full-scale testing of commercially produced FRSC panels.

1.3 This test method does not cover testing and evaluation requirements necessary for product certification and qualification or the establishment of design value adjustment factors for FRSC panels.

NOTE 1—One potentially confounding limitation of this preliminary screening test method is that it may be conducted with laboratory panels that may not necessarily represent commercial quality panels. A final qualification program should likely be conducted using commercial quality panels and the scope of the review should include evaluation of the effects of the treatment and elevated temperature exposure on all relevant mechanical properties of the commercially produced panel.

1.4 This test method is not intended for use with structural plywood.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound 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 limitations prior to use.*

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

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

D1165 Nomenclature of Commercial Hardwoods and Softwoods

D2395 Test Methods for Density and Specific Gravity (Relative Density) of Wood and Wood-Based Materials

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

D3043 Test Methods for Structural Panels in Flexure

D5516 Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures

D6305 Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing

[1] This test method is under the jurisdiction of ASTM Committee D07 on Wood and is the direct responsibility of Subcommittee D07.07 on Fire Performance of Wood.

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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.

E84 Test Method for Surface Burning Characteristics of Building Materials
E176 Terminology of Fire Standards
E2768 Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test)

2.2 *Other Standards:*

AWPA U-1 Commodity Specification H: Fire Retardants[3]
NFPA 703 Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials[4]
PS 2 U.S. Performance Standard for Structural-Use Panels[5]

3. Terminology

3.1 *Definitions*—Definitions used in this test method are in accordance with Terminologies D9 and E176 and Nomenclature D1165.

3.1.1 Structural Composite Panels: wood composite panels of various sizes and thicknesses manufactured using flakes, strands, wafers or particles derived from wood or similar bio-based resources assembled together with thermoset resins and other complementary materials, such as waxes or chemical additives in a hot-press intended for load-bearing applications as building materials.

4. Summary of Test Method

4.1 The purpose of this test method is to determine the effect of fire-retarded chemical treatment on flexural properties and IB strength of FRSC panels and to evaluate the effect of exposure to elevated temperatures on these properties.

4.2 Specimens of both the FRSC panel and an untreated panel manufactured with otherwise identical parameters are preconditioned to constant moisture content under conditions sufficient to produce moisture content of 10 ± 2 % in the untreated specimens.

4.3 After preconditioning (see section 6.4), 203-mm (8-in) wide specimens of treated and untreated treated structural composite panels are exposed to 77°C (170°F) temperature and relative humidity equal to or greater than 50 % for various time periods.

4.4 After the elevated-temperature exposure, the specimens are subjected to post-exposure conditioning under the same temperature and relative humidity used for preconditioning.

4.5 After post-exposure conditioning (see section 7.2), flexure and internal bond tests are conducted on exposed specimens. Flexural properties considered include maximum moment, bending stiffness, and work to maximum load.

5. Significance and Use

5.1 The properties evaluated by this test method are intended to provide comparative information on the effects of fire-retardant chemical formulations and environmental conditions on the flexural properties and IB strength of FRSC panels.

5.2 This practice uses a controlled elevated-temperature environment to produce temperature-induced losses in the mechanical properties of FRSC panels and untreated panels.

5.3 Prediction of performance in natural environments has not been directly correlated with the results of this test method.

5.4 The reproducibility of results in elevated-temperature exposure is highly dependent on the type of specimens tested and the evaluation criteria selected, as well as the control of the operating variables. In any testing program, sufficient replicates shall be included to establish the variability of the results. Variability is often observed when similar specimens are tested in different chambers even though the testing conditions are nominally similar and within the ranges specified in this test method.

6. Test Specimens

6.1 *Material Selection:*

6.1.1 Source panels for this test shall be selected from laboratory panels manufactured on a hot press large enough to provide flexural specimens having a span-to-depth ratio not less than 48:1 after allowances for both sufficient edge trimming to remove panel edges and ensuring the D3043 required overhang beyond the flexural test supports. The nominal panel thickness shall be between 9 mm (11⁄32 in.) and 19 mm (3⁄4 in.).

NOTE 2—The initial experiments that provide the scientific basis for this method used specimens cut from larger mat-formed structural composites and evaluated at approximately a 70:1 span-to-depth ratio. (**1**, **2**, **3**).[6]

NOTE 3—If larger panels and hot presses are used, more test specimens can be expected. If smaller panels and presses are used fewer specimens can be obtained. In all cases experience suggests that at least 25-mm should be trimmed from all four panel edges prior to cutting any test specimens.

6.1.2 Both treated and matched untreated panels shall be manufactured from a single batch of matched wood materials. Other than the fire-retardant treatment, both sets of panels shall be manufactured using the same manufacturing parameters including, but not limited to, thickness, density, resin content, wax content, and press schedule.

NOTE 4—For the resulting data to have maximum utility, it is recommended that both materials and process conditions be selected to closely parallel those used in manufacturing commercial panels.

6.1.3 Each panel shall be free of manufacturing defects, such as abnormally large surface voids, internal blows, or visible damage. Orientation, size, and shape, of surface flakes, strands or fibers shall be uniform and representative of normal commercial production. Ensure that enough materials are produced or obtained because it is required that all materials in this study be obtained from a single batch of structural composite panels.

NOTE 5—Depending on the initial size of panels used, users should ensure that a number of additional untreated and FRSC source panels are available because potential culling of small 200-mm (8-in) wide specimens may require additional FRSC panels.

6.2 *Treatment:*

[3] Available from American Wood Protection Association (AWPA), P.O. Box 361784, Birmingham, AL 35236-1784, http://www.awpa.com.
[4] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.
[5] Available for National Institute for Standards and Technology (NIST), 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899 http://www.nist.gov.
[6] The boldface numbers in parentheses refer to the list of references at the end of this standard.

6.2.1 The fire-retardant treatment shall be impregnated into the panel and shall provide a flame-spread index of 25 or less when tested in accordance with Test Method E2768 or when tested in accordance with ASTM E84 for an extended period of 30 min, and also show no evidence of significant progression of combustion. Additionally the flame front shall not progress more than 3.2 m (10.5 ft) beyond the centerline of the burners at any time during the test.

6.2.1.1 Materials listed as fire-retardant-treated wood are deemed to comply with the provisions of 6.2.1. When alternative performance criteria for the treatment are being evaluated, the test report on specimens of that treatment shall state clearly the alternative criteria and that the fire-retardant treatment retention was limited to that required for those alternative criteria.

6.2.2 Treatment of FRSC panels is done during panel manufacture. The fire-retardant retention level of every treated panel and each specimen cut from those panels shall not be less than the value midway between the median of the retention range and the maximum retention desired for the treated structural composite panels.

6.2.3 Weigh all materials used to produce the structural composite panels before pressing and weigh the manufactured panels immediately after pressing. Complete a treating report for each batch of panels to document the materials used, press cycle, times, pressures, and fire-retardant retentions.

6.3 *Specimen Preparation:*

6.3.1 Source panels and all experimental test specimens shall be inspected and the culling of specimens done as necessary in accordance with the criteria in 6.1.3.

6.3.2 A minimum of 100 untreated and 100 FRSC test specimens shall be prepared.

6.3.3 Each test specimen shall be at least 200-mm (8-in) wide and long enough to meet the span-to-depth requirements (6.1.1). Each test specimen shall be labeled to identify the original panel and location of the specimen within that panel. Care should be taken to avoid assigning more than one specimen from each panel to any experimental group. Care shall also be taken to ensure assignment of equal numbers of specimens cut from center and cut from nearer an original edge for each group of 20 experimental specimens.

NOTE 6—The initial experiments that provide the scientific basis for this method used specimens cut from larger FRSC panels and evaluated specimens from 102-mm (4-in) to 305-mm (12-in) wide and found that specimens of at least 200-mm (8-in) wide provide stable coefficient of variation for both flexural stiffness and strength (Fig. 1). The above width limitation of 200-mm (8-in) specimen width reflects those findings **(2, 3, 4)**.

6.3.4 Randomly select 20 of the 100 untreated and treated specimens to serve as the sets of unexposed controls. The remaining 80 treated and 80 untreated specimens shall be randomly assigned to 4 sets of 20 specimens for both the treated and untreated material. Three of these four sets are then subjected to elevated temperature exposure followed by strength testing. This leaves 1 treated and 1 untreated set of specimens not assigned to any set for testing (see Note 7).

NOTE 7—The resulting extra set of 20 treated and 20 untreated specimens can be saved as replacement sets if the number of specimens in a set drops below the minimum of 18 (7.3.5). Alternatively, the extra 20 treated and untreated specimens can be used to increase the number of specimens in each set.

6.4 *Preconditioning*—Condition all sets of treated and untreated specimens at an ambient temperature and relative humidity to achieve an equilibrium moisture content in the

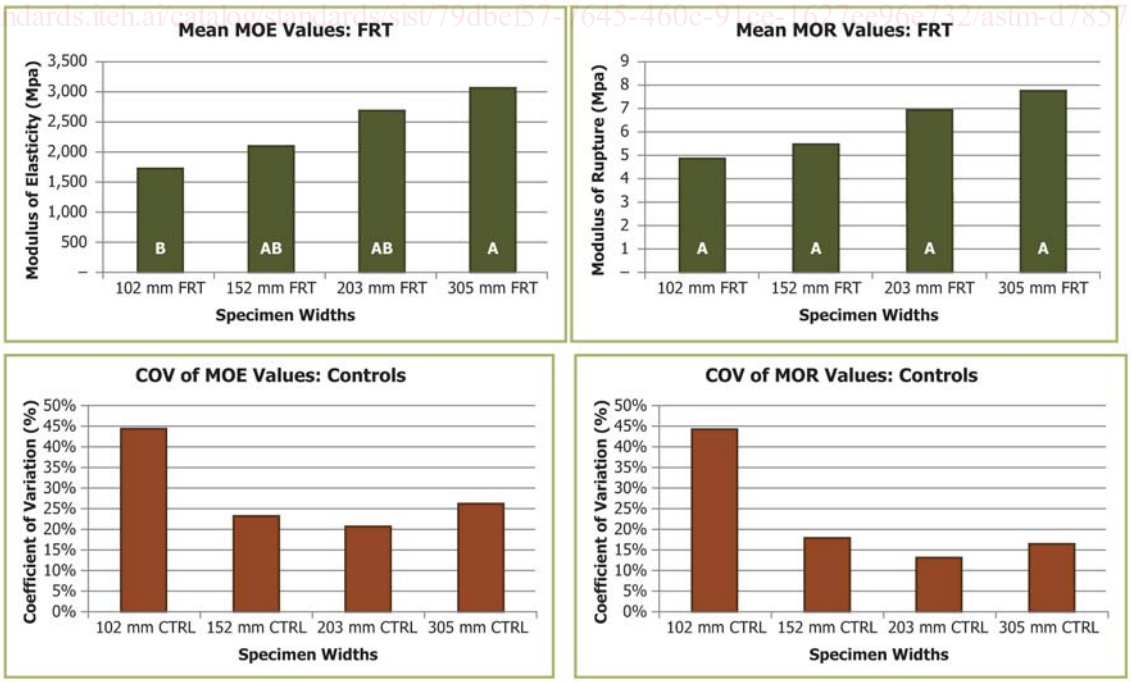

FIG. 1 An Example of Relationship Between Strandboard Specimen Width and the Corresponding Mean Test Values and Coefficient of Variations for Both Flexural Stiffness and Strength for FRSC Over Time of Exposure at 77°C (170°F) (from 2, 3)