Designation: D 5664 – 01

An American National Standard

Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber[1]

This standard is issued under the fixed designation D 5664; 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 procedures for obtaining data to assess the initial adjustments to allowable design stresses for lumber treated with candidate commercial fire-retardant (FR) formulations and further procedures for obtaining data to assess the effect of extended exposure to elevated temperature of 66 ± 2°C (150 ± 4°F).

1.2 *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:*

D 9 Terminology Relating to Wood[2]

D 143 Methods of Testing Mechanical Properties of Small Clear Specimens of Wood[2]

D 1165 Nomenclature of Domestic Hardwoods and Softwoods[2]

D 3500 Test Methods for Structural Panels in Tension[2]

D 4761 Test Method for Mechanical Properties of Lumber and Wood-Base Structural Material[2]

E 84 Test Method for Surface Burning Characteristics of Building Materials[3]

E 176 Terminology of Fire Standards[3]

2.2 *Other Standards:*

AWPA C20 Lumber—Fire Retardant Treatment by Pressure Processes[4]

U.S. Product Standard PS 20 American Softwood Lumber Standard[5]

3. Terminology

3.1 *Definitions*—Definitions used in this test method are in accordance with Terminologies D 9 and E 176 and Nomenclature D 1165.

4. Summary of Test Method

4.1 The general objectives of this test method are to develop data to adjust allowable design stresses of FR-treated lumber for the initial effects for the tested FR-formulation(s) and to develop data on in-service thermal stability after extended exposure to environmental conditions up to 66 ± 2°C (150 ± 4°F) and ≥50 % relative humidity.

4.2 *Procedure 1*—This procedure uses small clear specimens cut from end-matched nominal 2 by 4 (38 by 89-mm) dimension lumber (see Fig. 1) to compare the initial effects of fire-retardant treatments to untreated controls for bending, tension parallel, compression parallel, and horizontal shear properties.

4.3 *Procedure 2*—This procedure uses small clear specimens cut from end matched nominal 2 by 4 (38 by 89-mm) dimension lumber. This second set of specimens is used to assess the differential trends between end-matched fire-retardant treated and untreated specimens on bending and tension parallel properties over the course of a prolonged exposure to elevated temperature.

4.4 *Procedure 3*—The optional third procedure uses full-sized nominal 2 by 4 (38 by 89-mm) dimension lumber to modify the small clear specimen results from 4.2 and 4.3 for size effects.

5. Significance and Use

5.1 The mechanical properties evaluated by this test method provide the following:

5.1.1 Data for use in developing modification factors for the allowable design properties of fire-retardant treated lumber when used at or near room temperatures (see 6.3).

5.1.2 Data for use in developing modification factors for allowable design properties of fire-retardant treated lumber when exposed to elevated temperatures and humidity (see 6.4).

5.1.3 Data (optional) for use in modifying these factors for size effects when fire-retardant treated lumber is used at or near room temperature and when exposed to elevated temperatures

[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] *Annual Book of ASTM Standards*, Vol 04.10.

[3] *Annual Book of ASTM Standards*, Vol 04.07.

[4] Available from American Wood-Preservers Assoc., P.O. Box 849, Woodstock, MD 21163.

[5] Available from The American Lumber Standard Committee, P.O. Box 210, Germantown, MD 20875-0210.

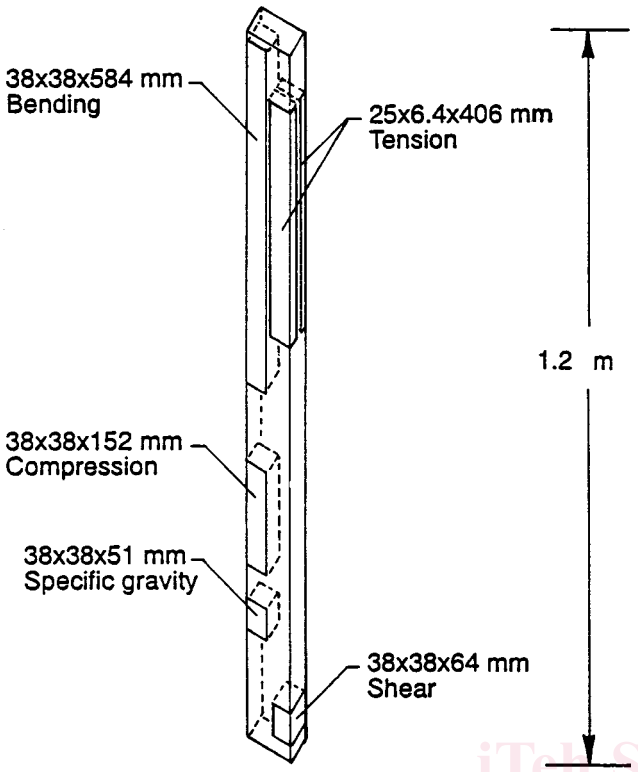

FIG. 1 Hypothetical Cutting Patterns to Obtain One Bending, Two Tension Parallel, One Compression Parallel, One Block Shear, and One Specific Gravity Block from Each 1.2-m (4-ft) Lumber Specimen

and humidity (see 6.5).

5.2 Data from the first two procedures in this test method of evaluation are indicative only for that species.

NOTE 1—The results of the three listed species (Southern pine, Douglas fir, and either white spruce or a Spruce/Fir mixture) may be used together to make inference on untested wood species because the three tested species represent the full spectrum of expected treatability.

5.3 Data from the optional third part of this three-part method of evaluation are indicative for all species because it is primarily used to assess size effects.

6. Procedures

6.1 *Treatment*:

6.1.1 Pressure treat those pieces designated for treatment with the fire-retardant formulation being evaluated. The gage retention level of each charge shall not be less than the midpoint of the retention range as specified for the species by the agency certifying the flame spread index of the treated lumber. The retention range specified by the certifying agency shall provide a flame-spread index of 25 or less when tested in accordance with Test Method E 84 extended to 30 min, when the flame spread progresses no more than 3.2 m (10.5 ft) beyond the center line of the burners during the extended test and shows no evidence of significant progressive combustion.

6.1.2 Weigh all treated pieces before and immediately after treatment to determine the chemical retention based on the solution retained and the concentration of chemicals in the solution. Complete a treating report for each charge of material to document the treating cycle, times, pressures, gage retention, and piece retentions.

6.2 *Post-treatment Drying*:

6.2.1 After pressure treatment, kiln dry the treated pieces to a maximum moisture content of 19 % following the standard redrying procedures established for the treatment and species by the manufacturer. For 21 of the first 24 h of drying, the dry bulb temperature shall not be more than 2°C (4°F) below the maximum redry temperatures specified during that step of the manufacturer's procedures. For the remainder of the required kiln drying period, the dry bulb temperature shall not be more than 3°C (5°F) below the manufacturer's maximum for that step. Sticker all test pieces to obtain proper air flow across both surfaces and to provide even drying.

6.2.2 Monitor the moisture content of the test pieces during the drying cycle by individually weighing representative pieces. Keep a well-documented kiln charge report and kiln recorder chart showing dry and wet bulb temperatures during the redrying period.

6.3 *Procedure 1*—The first procedure presents a methodology using small clear wood specimens to assess the initial effect of fire-retardant treatment on median mechanical properties. The results may be used to adjust the allowable design stresses of lumber based on estimates of median reductions in bending, tension parallel, compression parallel, and horizontal shear properties using small clear specimens cut from larger end-matched dimension lumber specimens.

6.3.1 For each species/species grouping (Southern pine, Douglas fir, and either white spruce or a Spruce/Fir mixture), twenty five (25) 2.44–m (8–ft) long, high-grade nominal 2 by 4s (38 by 89 mm) shall be obtained and cut into 1.22-m (4-ft) halves. Each specimen shall be marked to identify it with its matched-sister(s) specimen(s). For each specimen, one 1.22-m (4–ft) half shall be randomly allotted to remain untreated and the other half assigned to be treated with the candidate fire-retardant treatment and each half shall be appropriately marked.

NOTE 2—A Spruce/Fir mixture can be obtained by obtaining Canadian Spruce-Pine-Fir and removing the Lodgepole and Jack pine which can be visually segregated from the remaining spruces and firs.

NOTE 3—High Grade is a relative term, but some latitude is required because it is a common industry practice to group grades for some species/species groupings into "and better" categories. If available, Select Structural often is desirable because it provides an adequate yield of small clear specimens. It should also be noted that initial use of ≥30 specimens will usually ensure 25 acceptable specimens when using lower grades which have lower yields.

6.3.2 After treating and redrying are completed, each treated and untreated nominal 2 by 4 (38 by 89-mm) piece shall be cut into small clear specimens as shown in Fig. 1. Care shall be taken to avoid cutting specimens containing strength-reducing characteristics such as knots, cross-grain, or slope-of-grain in excess of 1 in 12. When cutting small test specimens, an original wide surface shall remain unmachined and each specimen shall later be tested so that this surface is exposed to the greater stress during that particular mechanical test. Each end-matched treated and untreated specimen shall be tested with the same relative surfaces in tension and compression. Tension parallel specimens shall be machined as shown in Fig. 2. Horizontal shear specimens shall be machined as shown in Fig. 3.