



Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire- Retardant Treated Lumber¹

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 $66 \pm 2^\circ\text{C}$ ($150 \pm 4^\circ\text{F}$).

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 Wood²
- D 143 Methods of Testing Mechanical Properties of Small Clear Specimens of Wood²
- D 1165 Nomenclature of Domestic Hardwoods and Softwoods²
- D 3500 Test Methods for Structural Panels in Tension²
- D 4761 Test Method for Mechanical Properties of Lumber and Wood-Base Structural Material²
- E 176 Terminology of Fire Standards³

2.2 Other Standards:

- AWPA C20 Lumber—Fire Retardant Treatment by Pressure Processes⁴
- U.S. Product Standard PS 20 American Softwood Lumber Standard⁵

3. Terminology

3.1 *Definitions*—Definitions used in this test method are in

¹ This test method is under the jurisdiction of ASTM Committee D-7 on Wood and is the direct responsibility of Subcommittee D07.07 on Fire Performance of Wood.

Current edition approved April 10, 1999. Published July 1999. Originally published as D 5664-95. Last previous edition D 5664-95e1.

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.

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 $66 \pm 2^\circ\text{C}$ ($150 \pm 4^\circ\text{F}$) and $\geq 50\%$ 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 6.1).

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 6.2).

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 and humidity (see 6.3).

5.2 Data from the first two procedures in this test method of

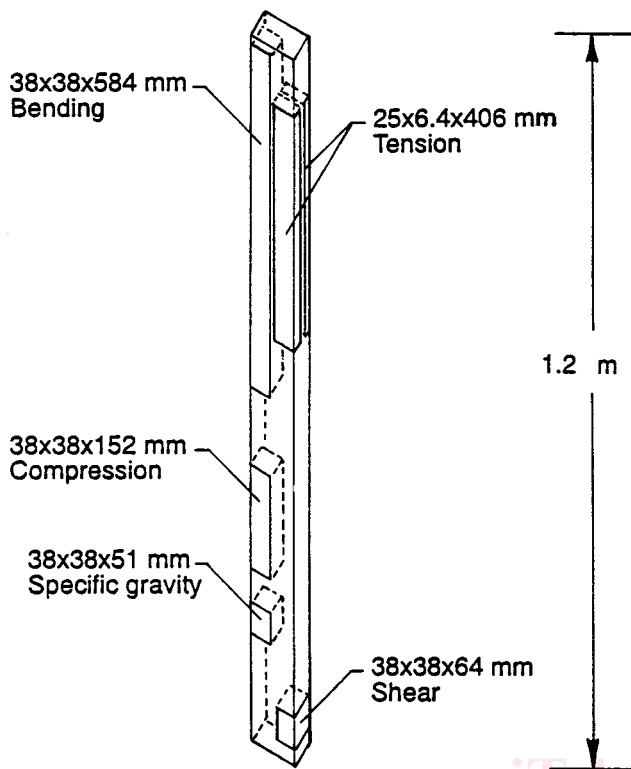


FIG. 1 Hypothetical Cutting Patterns to Obtain One Bending, Two Tension Parallel, One Compression Parallel, One Block Shear, and One Specific Gravity Block from Each 1.2-m (4-ft) Lumber Specimen

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.

6.1.2 Those specimens designated to be treated shall be treated with the candidate FR formulation and conform to all performance requirements of AWWA Standard C-20. All processing parameters shall be monitored and reported to ensure that treatment retention is representative and near the maximum used in later commercial processing. After treatment, the specimens shall be redried at a temperature within 5 % of the maximum allowed in AWWA Standard C-20.

6.1.3 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.

6.1.4 After cutting, all specimens (treated and untreated) shall be equilibrated to constant weight at $22 \pm 5^\circ\text{C}$ ($72 \pm 9^\circ\text{F}$) and $65 \pm 1\%$ relative humidity.

6.1.5 Appropriate treated and untreated specimens shall be alternately tested in bending, compression parallel, and horizontal shear using Methods D 143 and tension parallel using Test Methods D 3500, but with the exceptions listed in Table 1.

6.2 *Procedure 2*—For each species (Southern pine, Douglas fir and white spruce, four sets of 25 end-matched treated and untreated small clear bending and tension parallel specimens shall be cut from at least 25 nominal 2 by 4 (38 by 89 mm) 2.44-m (8-ft) long pieces. These specimens shall be used to assess the differential effects of exposure to elevated temperature between untreated and FR-treated clear wood specimens.

6.2.1 One set of 25 FR-treated and untreated specimens of each species shall be used as an unexposed control (that is, 0 days of exposure).

6.2.2 Three FR-treated and untreated groups of 25 specimens of each species shall be exposed in a controlled environment of $66 \pm 2^\circ\text{C}$ ($150 \pm 4^\circ\text{F}$) and $>50\%$ relative humidity.

6.2.3 One treated and one untreated group of 25 shall be withdrawn after 36 ± 3 , 72 ± 3 , and 108 ± 3 days.

6.2.4 Each group of specimens shall be equilibrated to constant weight at $22 \pm 5^\circ\text{C}$ ($72 \pm 9^\circ\text{F}$) and $65 \pm 1\%$ relative humidity then tested in bending in accordance with Methods D 143 and tension parallel in accordance with Test Methods D 3500, but with the exceptions listed in Table 1.

6.3 *Procedure 3*—The optional third procedure expands the results of the small clear results obtained in 6.1 and 6.2 to include additional information on size effects. It assesses both the initial effects of fire-retardant treatments on the allowable design stresses of lumber and the potential for additional

evaluation are indicative only for that species.

NOTE 1—The results of the three listed species (Southern pine, Douglas fir, white spruce) 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 *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.

6.1.1 For each species (Southern pine, Douglas fir, and white spruce), 25 specimens 2.44 m (8 ft) long, high-grade nominal 2 by 4's (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 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—High Grade is a relative term, but some latitude is required because it is a common industry practice to group grades for some