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Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing¹

This standard is issued under the fixed designation D2898; 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 practice addresses the durability of a fire-retardant treatment of wood products by exposure to accelerated cycles of wetting, drying, or ultraviolet (UV) exposure, or combination thereof, prior to evaluation by a fire response test. Four conditioning methods are described.

1.2 This practice is applicable to wood products that have been treated with fire-retardant chemicals by pressure impregnation.

1.3 The test specimens are to be in the form of, or suitable for fabrication into, test specimens, such as those described in Test Methods E84, E108, and E1354 and other standard test methods for evaluating the fire performance of fire-retardant-treated wood products.

1.4 The text of these methods references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of these test methods.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *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.*

¹ This practice is under the jurisdiction of ASTM Committee D07 on Wood and are the direct responsibility of Subcommittee D07.07 on Fire Performance of Wood. Current edition approved July 15, 2024. Published July 2024. Originally approved in 1970. Last previous edition approved in 2017 as D2898 – 10 (2017). DOI: 10.1520/D2898-10R24.

2. Referenced Documents

2.1 ASTM Standards:²

D9 Terminology Relating to Wood and Wood-Based Products

E84 Test Method for Surface Burning Characteristics of Building Materials

E108 Test Methods for Fire Tests of Roof Coverings

E176 Terminology of Fire Standards

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

2.2 ICC Evaluation Service Acceptance Criteria:³

AC 107 Classified Wood Roof Systems

2.3 UL Standard:⁴

UL 790 Tests for Fire Resistance of Roof Covering Material

3. Terminology

3.1 *Definitions*—Definitions used in this practice are in accordance with Terminologies D9 and E176, unless otherwise indicated.

4. Significance and Use

4.1 This practice describes different methods of exposing fire-retardant-treated wood products or assemblies to controlled accelerated weathering or conditioning.

4.2 The conditioning simulates effects of leaching, drying, temperature, and, in two methods, UV light.

4.3 Method A is the method normally specified for regulatory purposes when testing fire-retardant-treated wood that is intended for exterior applications.

5. Apparatus

5.1 The test apparatus shall be capable of subjecting the specimen uniformly to the test conditions described in Section 7.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from ICC Evaluation Service, Inc., 5360 Workman Mill Road, Whittier, CA 90601, <http://icc-es.org>.

⁴ Available from Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062, <http://www.ul.com>.



5.2 No special means of protecting the specimen back and edges are required, but water shall not impinge directly on those surfaces which are not exposed either to the weather in the assembled form, or to fire in the subsequent test. Water spray nozzles shall be provided and arranged so as to distribute water evenly over the exposed specimen surface.

5.3 Accompany drying cycles with heating that is thermostatically controlled. The controlling temperature shall be the air temperature measured 1 in. (25 mm) above the specimen surface. When sunlamps are part of the method, the temperature-measuring device must be shielded from the UV radiation of the sunlamps. Accompany drying with uniform forced air movement across the surface of the decks at a rate of at least 25 ft/min (0.127 m/s). Forced air movement shall be uniform across the specimen surface, with provisions made for adequate air changes to assure thorough drying.

5.4 In Methods B and C, UV light shall be distributed as evenly as possible over the specimen surface. Use sunlamps⁵ providing UV characteristics of 5.0 W/m² irradiance at a wavelength of 315 nm to 400 nm at 1 m directed normal to and mounted 26 in. \pm 6 in. (660 mm \pm 152 mm) above the specimen measured from the bottom of the lamp. One lamp shall be used for each 8 ft² (0.74 m²) of specimen, or fraction thereof.

5.5 Water Spray Calibrations:

5.5.1 Measure the horizontal projected area over which each nozzle discharges water to the nearest square foot (0.09 m²). Measure the discharge of water for each nozzle for 1 min.

5.5.2 Monitor the total water use during the test. A commercial water meter is suitable for this purpose.

5.5.2.1 For Method A, the water usage shall be 42 gal/ft² \pm 1 gal/ft² (1711 L/m² \pm 41 L/m²) for a four-day cycle or 73 gal/ft² \pm 1.7 gal/ft² (2975 L/m² \pm 69 L/m²) for a seven-day cycle.

5.5.3 Each day during the water cycle, visually check the water flow from each nozzle for obvious water obstruction in the nozzle and uneven spray patterns. Make adjustments when necessary.

5.5.4 Review the total water flow at the end of each day and at the end of each water cycle. Correct the cause of any off-limit conditions.

5.5.5 The characteristics or quality of the water shall be noted (see Note 1).

NOTE 1—Note water quality, especially pH and hardness, as it can impact the accelerated weathering of the treated specimens.

6. Test Specimen

6.1 The test specimen shall include all parts of the corresponding fire test specimen that are subjected to weather exposure in normal use. Shingles or shakes shall be applied to their intended sheathing.

NOTE 2—It is acceptable to mount specimens in sections that can be reassembled subsequently without trimming into the appropriate fire test specimen.

6.2 The specimen surface shall have a slope of 4 in 12 in Methods A, C, and D of this standard. For Method B, the surface shall have a slope ranging from 4 in 12 minimum to 8 in 12 maximum.

7. Exposure Cycle

7.1 Method A:

7.1.1 The total duration of this method is twelve weeks (84 days).

7.1.2 Subject the specimens to an exposure cycle consisting of twelve one-week cycles. Each cycle is to consist of 96 h (4 days) of water exposure and 72 h (3 days) of drying.

7.1.3 Apply water in a moderately fine spray uniformly over the exposed specimen surfaces by spray nozzles that deliver an average of 0.7 in. of water per hour (0.005 mm/s) or 0.0073 gal/min·ft² (0.30 L/min·m²) of specimen surface at a temperature between 35 °F and 60 °F (2 °C and 16 °C).

7.1.3.1 Recirculation of the water is not permitted.

7.1.3.2 For decks intended for testing by Test Methods E108, nozzles shall be mounted approximately 7 ft (2.1 m) above the test decks.

7.1.4 Dry at a thermostatically controlled temperature of 135 °F to 140 °F (57 °C to 60 °C).

7.1.5 At the end of one or more cycles, change the position of the specimens within the apparatus so that each specimen occupies every location within the apparatus for an approximately equal number of cycles.

7.2 Method B:

7.2.1 The total duration of this method is 1000 h (41 days, 16 h).

7.2.2 Subject the specimen to a exposure cycle consisting of forty-two 24-h cycles. Each cycle is to consist of 4 h wetting, 4 h drying, 4 h wetting, 4 h drying, and 8 h rest. The last cycle is terminated without the 8-h rest period.

7.2.3 Apply water in a moderately fine spray uniformly over the exposed specimen surface at a rate of 0.3 gal/min·ft² \pm 0.02 gal/min·ft² (12.2 L/min·m² \pm 0.8 L/min·m²) of specimen surface. The temperature shall not exceed 90 °F (32 °C). During the first three cycles, drain all water rather than recirculate it. In each subsequent wetting period, circulate a volume of at least 5 gal (19 L) of fresh water through each spray head.

7.2.4 Dry at a temperature of 150 °F \pm 5 °F (66 °C \pm 3 °C), with this temperature attained within 15 min from the start of drying. Exposure to the UV sunlamps shall be continuous throughout the drying period.

7.2.5 At the end of one or more cycles, change the position of the specimens within the apparatus so that each specimen occupies every location within the apparatus for an approximately equal number of cycles.

7.3 Method C:

7.3.1 The total duration of this method is twelve weeks (84 days).

⁵ General Electric Type H275 RUV (275 W) or Osram Ultra-Vitalox (300 W), or equivalent, is suitable. General Electric no longer manufactures the Type H275 bulb. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.



7.3.2 Subject the specimens to an exposure consisting of 252 eight-hour cycles. Each cycle consists of four hours of water exposure, followed by four hours of drying.

7.3.3 For the water exposure, use spray nozzles that deliver an average of $0.3 \text{ gal/min/ft}^2 \pm 0.02 \text{ gal/min/ft}^2$ ($12.2 \text{ L/min/m}^2 \pm 0.8 \text{ L/min/m}^2$) at a temperature of 35 °F to 90 °F (1.6 °C to 32.2 °C) to apply the uniformly distributed water exposure.

7.3.3.1 For decks intended for testing by Test Methods **E108**, nozzles shall be mounted approximately two feet above the test decks.

7.3.3.2 Recirculation of the water is permitted with the following restrictions. At the end of each of the first three wetting cycles, and before each of last three wetting cycles, all water shall be drained from the system and replaced with fresh water. For all other wetting cycles, fresh water shall be introduced at a rate that provides a minimum of 5 gal (19 L) of fresh water per nozzle, per cycle.

7.3.4 Drying shall utilize sunlamps for both heat and UV exposure, with supplemental heaters as required to maintain a temperature of 145 °F to 155 °F (63 °C to 68 °C) with this temperature attained within 15 min from the start of drying.

7.3.5 At the end of one or more cycles, change the position of the specimens within the apparatus so that each specimen occupies every location within the apparatus for an approximately equal number of cycles.

7.4 Method D:

7.4.1 The total duration of this method is 97 days.

7.4.2 Subject the specimens to an exposure consisting of seven two-week cycles. Each cycle is to consist of 168 h (seven days) of water exposure, 48 h (two days) of rest for draining and 120 h (five days) of drying. The water exposure of the seventh cycle is six days.

7.4.3 Apply water in a moderating fine spray uniformly over the exposed specimen surfaces by spray nozzles that deliver an average of 0.7 in. of water per hour (0.005 mm/s) or $0.0073 \text{ gal/min-ft}^2$ (0.30 L/min-m^2) of specimen surface at a temperature between 35 °F and 60 °F (2 °C and 16 °C).

7.4.3.1 Recirculation of the water is not permitted.

7.4.3.2 For decks intended for testing by Test Methods **E108**, nozzles shall be mounted approximately 7 ft (2.1 m) above the test decks.

7.4.4 Dry at a thermostatically controlled temperature of 135 °F to 140 °F (57 °C to 60 °C).

7.4.5 At the end of one or more cycles, change the position of the specimens within the apparatus so that each specimen occupies every location within the apparatus for an approximately equal number of cycles.

8. Conditioning

8.1 Upon completion of the prescribed exposure, the specimens shall be conditioned in accordance with the applicable fire test standard.

8.2 For decks intended for testing by Test Methods **E108**, control the final drying cycle temperature so the moisture content of the deck lumber is from 8 % to 12 %. For plywood deck, the moisture content shall not exceed 8 %.

9. Report

9.1 Report the following information:

9.1.1 The accelerated weathering method (A, B, C, or D) used.

9.1.2 Description of the specimens.

9.1.2.1 Include information about the fire-retardant treatment including any surface coating and any identifying marks.

9.1.2.2 Visual observations of the specimens before and after the accelerated weathering.

9.1.3 Description of the weathering apparatus or chamber:

9.1.3.1 The horizontal projected area over which each nozzle discharges water to the nearest square foot (0.09 m^2).

9.1.3.2 The slope of the test specimen (see 6.2).

9.1.3.3 Information on the UV lamps used, if used.

9.1.3.4 Any deviations from the specifications in the standard.

9.1.4 Describe any means used to protect surfaces that are not exposed to weather in the assembled form or fire in the subsequent test (see 5.2).

9.1.5 Results of the water spray calibration (see 5.5).

9.1.6 The characteristics or quality of the water, including pH and hardness (see 5.5.5 and Note 1).

9.1.7 The quantity of water that was re-circulated (see 7.1.3.1, 7.2.3, 7.3.3.2, or 7.4.3.1).

9.1.8 Rate of flow of forced air movement across the surface of the specimens (see 5.3).

10. Keywords

10.1 fire retardant; fire retardant-treated wood; fire testing; weathering



APPENDIX

(Nonmandatory Information)

X1. COMMENTARY

X1.1 Method A was devised for larger specimens, and Method B for smaller ones.

X1.2 Method B was developed by the USDA, Forest Service, Forest Products Laboratory. The method and the exposure chamber commonly associated with Method B are described in various publications of that laboratory.

X1.3 A research study showed that the two exposure methods, A and B, were equivalent in leaching effect as demonstrated by the flame-spread results obtained on specimens exposed by either method when tested for flame spread.⁶

X1.4 Method C is part of the acceptance criteria for classified wood roof systems of the ICC Evaluation Service. The option of successful fire tests after the exposure of the

“amended rain test” was developed as an alternative to their requirement for successful fire tests of specimens exposed to the rain test of Method A of this standard and additional specimens subjected to three years of the natural weathering tests described in the fire test standard for roof coverings (UL 790 and Test Methods E108).

X1.5 Method D is an alternative test cycle for the Rain Test specified in Test Methods E108.

X1.6 This practice discusses methods for accelerated weathering of fire-retardant-treated wood for fire testing. In Test Methods E108 and in AC 107, such accelerated methods are referred to as “rain” tests. The term “weathering” refers to exposing the specimens to actual outdoor exposures for specified periods of time. For the outdoor exposures, the test decks are mounted facing south at an incline of 0.5 in. per horizontal foot (416 mm per horizontal metre). Decks are tested after each of one, three, five, and ten years of exposure.

⁶ “Correlation of ASTM Exposure Tests for Evaluating Durability of Fire-Retardant Treatment of Wood,” by C.A. Holmes, Forest Products Laboratory, Research Paper FPL 194, U.S.D.A. Forest Service, 1973.

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