



Standard Test Method for Evaluating the Fire-Test-Response of Deck Structures to Burning Brands¹

This standard is issued under the fixed designation E2726/E2726M; 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 determines the fire-test-response characteristics of deck structures attached to or in close proximity to primary structures. The burning brand exposures test is intended to determine the degradation modes of decking materials when exposed to a burning brand on the upper surface of a deck structure.

1.2 The use of paints, coatings, stains, or other surface treatments for fire protection purposes are beyond the scope of this test method. This test method excludes the use of paints, stains, or coatings for this fire-test-response determination.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of the materials, products, or assemblies under actual fire conditions.*

1.5 *Fire testing of products and materials is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

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

D2898 Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

D6662 Specification for Polyolefin-Based Plastic Lumber Decking Boards

D7032 Specification for Establishing Performance Ratings for Wood-Plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails)

E84 Test Method for Surface Burning Characteristics of Building Materials

E108 Test Methods for Fire Tests of Roof Coverings

E176 Terminology of Fire Standards

2.2 ICC Evaluation Services, Inc.:³

AC 109 Acceptance Criteria for Thermoplastic Composite Lumber Products

AC 174 Acceptance Criteria for Deck Board Span Ratings and Guardrail Systems (Guards and Handrails)

3. Terminology

3.1 **Definitions**—For definitions of terms used in this test method, refer to Terminology **E176**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 **deck structure, n**—exterior structures comprised of deck boards or panels, stair treads, risers, and landings of decks, porches, and balconies.

3.2.2 **test material, n**—members that constitute the exposed surface of the deck structures.

4. Significance and Use

4.1 This test method is intended to establish the test protocol for decking materials and systems. This test method is intended to address a fire caused by exterior sources that involves the upper surface of the deck or structure.

¹ This test method is under the jurisdiction of ASTM Committee **E05** on Fire Standards and is the direct responsibility of Subcommittee **E05.14** on External Fire Exposures.

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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.

³ Available from International Code Council Evaluation Service, 5600 Workman Mill Road, Whittier, CA.

4.2 This test is a practical assessment of fire-test-response characteristics under a prescribed fire loading. This test method is a variation of Test Method E108.

5. Test Apparatus

5.1 The essential elements of the fire test apparatus are illustrated in Fig. 1. They include a test deck, an adjustable frame on which the test deck is mounted, a wind tunnel, an air velocity meter with or without the use of a timing device and an adjustable air supply. During the test:

5.1.1 Provide free outlet to outside air beyond and above the test apparatus to exhaust air introduced into the test room by the blower, and

5.1.2 Close all openings into the test room other than those mentioned in 5.1.1, such as doors and windows.

5.2 The temperature of the air supplied by the blower shall be maintained between 10 and 32°C [50 and 90°F].

5.3 *Wind Tunnel* (see Fig. 1)—The wind tunnel shall deliver 5.3 ± 0.2 m/s [12 ± 0.5 mph] airflow at zero incline over the width of the test specimen. Test Method E108 Burning Brand Roof Test apparatus shall be used, with the following modifications:

5.3.1 *Test Specimen Support*—The test specimen shall be supported horizontally with its leading edge 838.2 mm [33 in.] from the front opening of the wind tunnel with the joists parallel to the airflow and resting on two transverse metal supports. The top surfaces of these supports, which shall be no more than 76 mm [3 in.] wide, are at the same height as the floor of the wind tunnel.

5.3.2 *Fragments*—Burning fragments shall be free to fall to the floor of the room.

5.4 *Anemometer*—A device for measuring airflow across the deck shall be provided.

NOTE 1—Any direct reading instrument with scale graduated in increments of not more than 6 m/min [20 ft/min] or any timed instrument with scale graduated (for a 1 min timed reading) in increments of not more than 1.5 m/min (5 ft/min) will be suitable.

5.5 *Burner*—Gas-fueled burner for brand ignition. The flame temperature of the igniting flame shall be $888 \pm 28^\circ\text{C}$ [$1630 \pm 50^\circ\text{F}$] measured 59 mm [$2\frac{3}{16}$ in.] above the top of the burner, which is shielded from drafts.

6. Test Specimens (see Fig. 2)

6.1 The test specimen shall consist of joists as specified in 6.3 and test material as specified in 6.4.

6.2 *Test Specimen Size*—The overall size of the test specimen shall be nominally 610 by 710 mm [24 by 28 in.]. The overall test specimen length (that is, direction of joists) shall be 710 ± 51 mm [28 ± 2 in.] to accommodate variations in the test material's individual deck board width; the length of the test material shall be 610 ± 4 mm [$24 \pm \frac{3}{16}$ in.].

6.3 *Joists*—The test material shall be supported by two nominal 50 by 150 mm [2 by 6-in.] joists running perpendicular to the test material's deck boards with a 406 ± 4 mm [16 in.] center-to-center spacing, creating a 90 ± 4 mm [3.5 ± 0.16 in.] overhang on the outer side of each edge joist. Joist length shall meet the requirements specified in 6.2.

6.4 Test Material:

6.4.1 All test materials shall be representative of the as-manufactured product including the cross sectional dimensions.

6.4.2 Test material shall be sampled to meet the intended end-use of the test data.

6.4.3 Prior to testing, all test material and joists shall be conditioned to a constant weight or for a minimum of 30 days at $21 \pm 2^\circ\text{C}$ [$70 \pm 4^\circ\text{F}$] and 50 % RH ± 5 %, whichever comes first. Constant weight shall be defined as a change in test material weight less than or equal to 2 % in a 24-h period.

6.4.4 Edge-to-edge spacing and method of attachment shall conform to the manufacturer's installation recommendations. The test material shall be flush with the ends of the joists at the front of the test specimen (that is, the edge of the test specimen facing the front opening of the wind tunnel). Test material at the back of the test specimen (that is, the edge of the test specimen furthest away from the front opening of the wind tunnel) manufactured with tongue-and-groove edge connections shall be spaced and attached according to the manufacturer's recommendations.

7. Calibration

7.1 Calibrating Air Current:

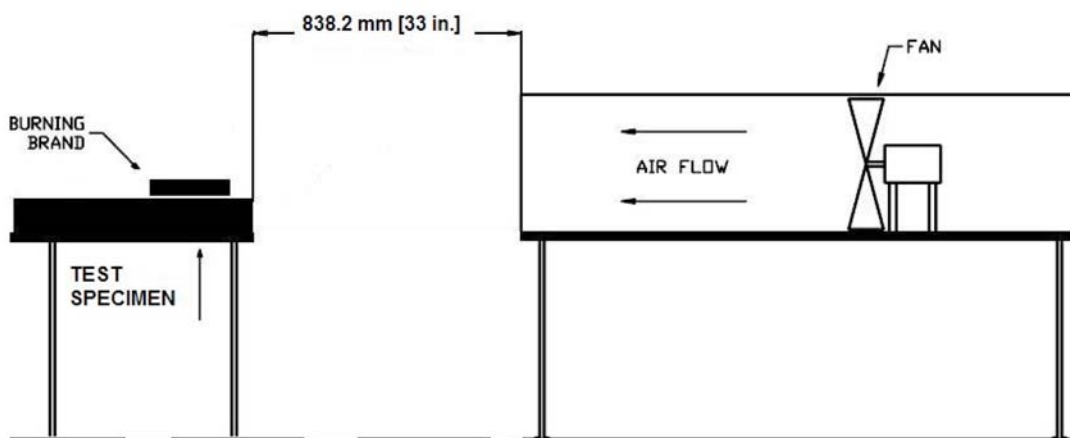


FIG. 1 Deck Structure Test Specimen and Test Apparatus (Burning-Brand)

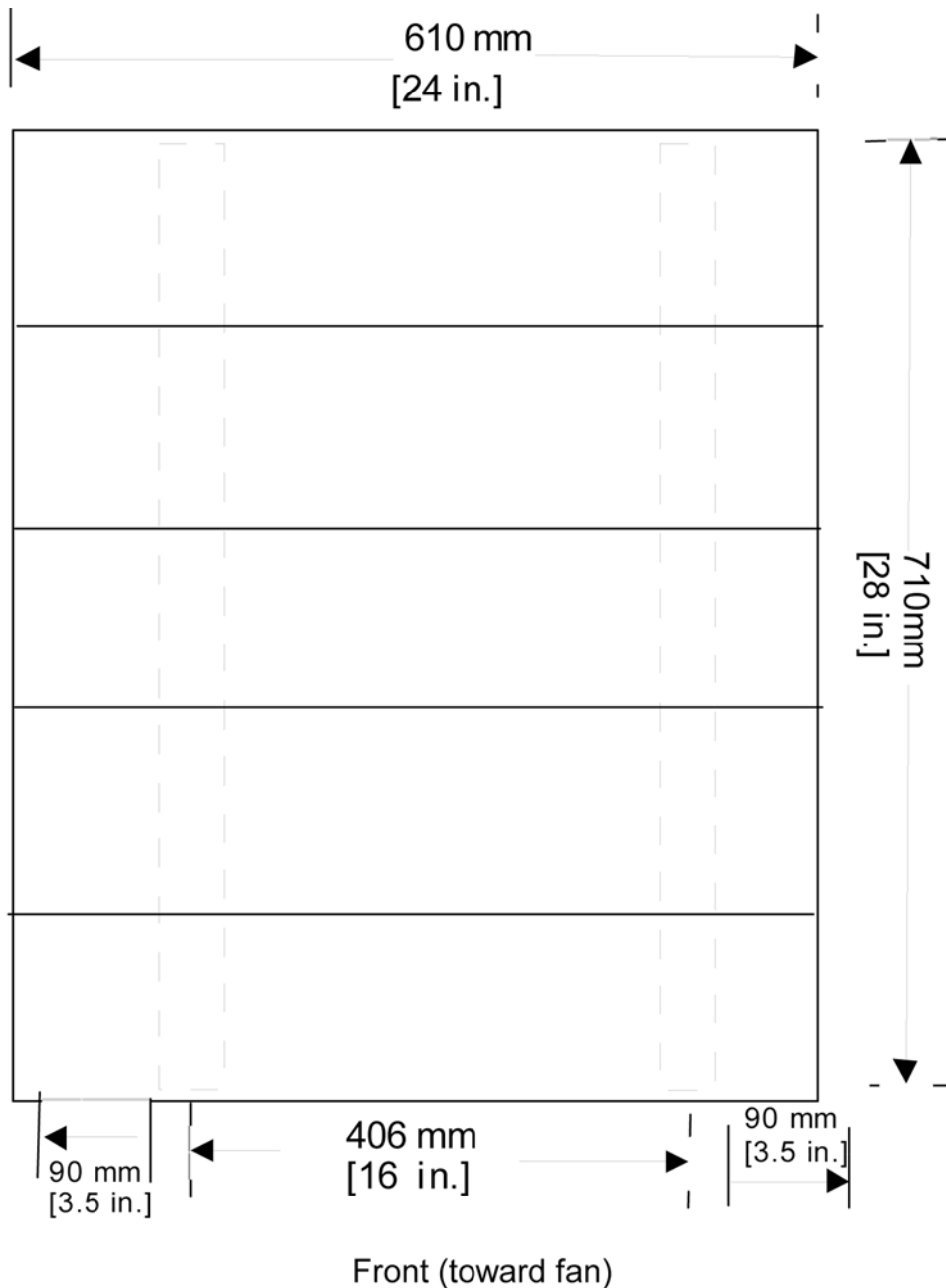


FIG. 2 Test Specimen

7.1.1 Set up the test apparatus and position a smooth deck, 1.3 m [4 ft-4 in.] long on the framework at a 127 mm per 304.8 mm [5 in. per 12 in.] horizontal incline.

7.1.2 Measure the air velocity at the center and 76 mm [3 in.] from the edges of the deck.

7.1.3 Position the center of the air measuring device 95 ± 3 mm [$3\frac{3}{4} \pm \frac{1}{8}$ in.] above the surface. The air flow through and around the instrument shall be as free and undisturbed as possible.

7.1.4 Adjust the air supply to produce a 1 min timed average velocity of 5.3 ± 0.2 m/s [12 ± 0.5 mph] at each of three locations detailed in 7.1.2.

8. Procedure

8.1 Conduct this test on three replicate test specimens.

8.2 Mount each test specimen in the manner described in 5.1.1 with the framework 838.2 mm [33 in.] from the air duct outlet.

8.3 *Size and Construction of Brands*—Construct each brand (Fig. 3), as follows, and condition in an oven at 41 to 49°C [105 to 120°F] for at least 24 h.

8.3.1 The Class A test Brand shall consist of a grid 305 mm [12 in.] square and approximately 57 mm [$2\frac{1}{4}$ in.] thick made of oven dry Douglas fir lumber free of knots and pitch pockets. Use 36 nominal 25 by 25 by 305 mm [1 by 1 by 12 in.] strips,

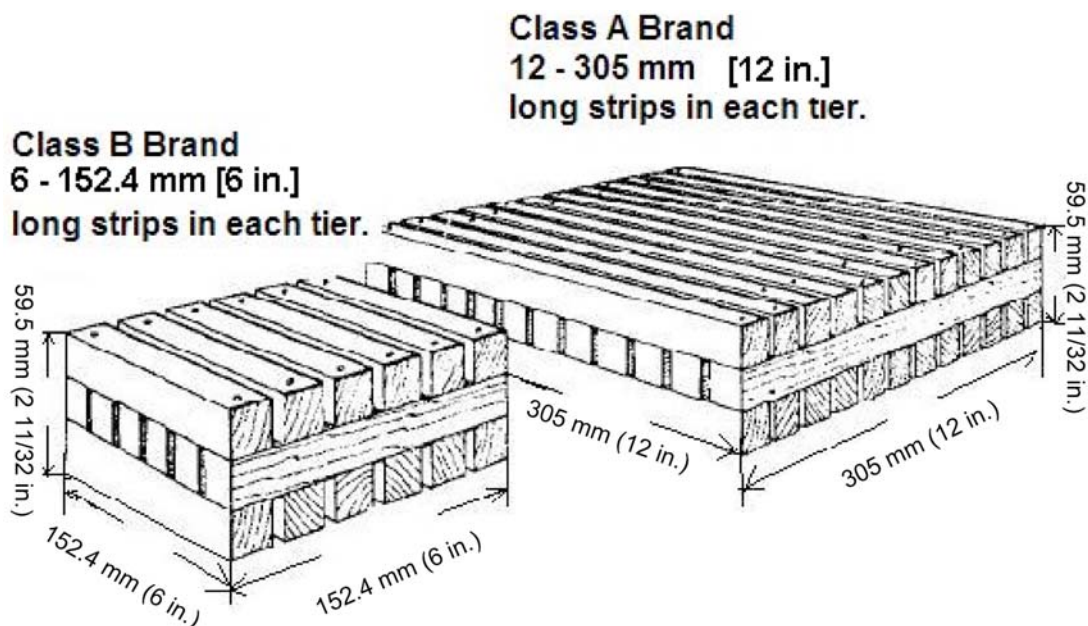


FIG. 3 Class A & B Brands

dressed on all four sides to 19 by 19 mm [$\frac{3}{4}$ by $\frac{3}{4}$ in.] and placed in three layers of twelve strips each with strips spaced 6.35 mm [$\frac{1}{4}$ in.] apart. Place these strips at right angles to those in adjoining layers and nail (Note 2) at each end of each strip on one face (Fig. 3). The dry weight of the finished brand shall be 2000 ± 150 g at the time of test.

8.3.2 The Class B test brand shall consist of a grid 152 mm [6 in.] square and approximately 57 mm [$2\frac{1}{4}$ in.] thick made of dry Douglas fir lumber free of knots and pitch pockets. Use 18 nominal 25 by 25 by 152 mm [1 by 1 by 6 in.] strips, dressed on all four sides to 19 by 19 mm [$\frac{3}{4}$ by $\frac{3}{4}$ in.], and placed in three layers of six strips each with strips spaced 6.35 mm [$\frac{1}{4}$ in.] apart. Place these strips at right angles to those in adjoining layers and nail (Note 2) at each end of each strip on one face (Fig. 3). The dry weight of the finished brand shall be 500 ± 150 g at the time of test.

NOTE 2—Nails used in the construction of Class A and B brands are No. 16, 38 mm [$1\frac{1}{2}$ in.] long bright, flat head, diamond point, wire nails. 68 nails weighing approximately 42 g are used for Class A brand. 32 nails weighing approximately 21 g are used for Class B brand.

8.4 *Ignition of Brand*—Before application to the test specimen, the brand shall be ignited by subjecting it, for the following required periods of time, to the flame of a gas burner of such size that, during the process of ignition, the brands are enveloped in the burner flame. The flame temperature of the igniting flame shall be $888 \pm 28^\circ\text{C}$ [$1630 \pm 50^\circ\text{F}$] measured 59 mm [$2\frac{3}{16}$ in.] above the top of the burner, which is shielded from drafts.

8.4.1 Expose Class A test brand to the flame for 5 min, during which time it shall be rotated to present each surface to the flame in the following manner and sequence: Each 305 by 305-mm [12 by 12-in.] face for 30 s, each 57 by 305-mm [$2\frac{1}{4}$ by 12-in.] face for 45 s, and each 305 by 305-mm [12 by 12-in.] face again for 30 s.

8.4.2 Expose Class B test brand to the flame for 4 min, during which time they shall be rotated to present each surface

to the flame in the following manner and sequence: Each 152 by 152-mm [6 by 6-in.] face for 30 s, each 57 by 152-mm [$2\frac{1}{4}$ by 6-in.] face for 30 s, and each 152 by 152-mm [6 by 6-in.] face again for 30 s.

8.5 Brand Placement:

8.5.1 *Class A Brand*—Place a brand on the surface of each test deck at the location considered most vulnerable (point of minimum coverage over deck joint) with respect to ignition of the deck but in no case closer than 101 mm [4 in.] from either side or 305 mm [12 in.] from the edge of the deck closest to the wind source. Place the brand so that the strips in both the upper and bottom layers are parallel to the direction of air flow and with the upper edge of the brand located 76 mm [3 in.] above the horizontal joint in the test deck. Secure to the deck by a No. 18 B & S gage soft iron wire.

8.5.2 *Class B Brand*—Place a brand on the surface of the test deck at the location considered most vulnerable (point of minimum coverage over deck joint) with respect to ignition of the deck. Position the brand with its upper edge 38 mm [$1\frac{1}{2}$ in.] above the selected joint in the deck boards, but in no case closer than 152 mm [6 in.] from each side or 305 mm [12 in.] from the edge of the deck closest to the wind source. Place the brand so that the bottom layers are parallel to the direction of air flow. Secure to the deck by a 1.02 mm [No. 18 B & S gage] soft iron wire.

8.6 *Duration of Test*—Continue the exposure until the brand is totally consumed and until all evidence of flame, glow and smoke has disappeared from both the exposed surface of the test material and the underside of the test material, but not for more than $1\frac{1}{2}$ h. Disregard the results of tests in which the brand does not show progressive and substantially complete consumption after application to the test specimen. If results are disregarded, the procedure shall be repeated using a new test specimen.

8.7 *Observations*—During and after the burning brand test, observe for deformation from the horizontal plane, location of

flaming or glowing combustion, displacement of the test material, flaming drops or particles falling from the deck that continue to burn on the floor and any generated flying brands, and flaming or smoke at the end of 1½ h test period. The entire test shall be recorded with a video or digital recorder to allow review of the details of performance.

9. Accelerated Aging/Weathering

9.1 The manufacturer shall have the option to conduct artificial or accelerated weathering prior to conducting the fire test. The process used shall evaluate the potential for the fire-test-response characteristics as measured in this test method to deteriorate due to accelerated aging/weathering of the deck material. Details of the weathering method used, or reference to a standard test method, shall be included in the report when used.

9.2 Guidance for the selection of an appropriate accelerated aging/weathering procedure can be found in **X1.4**.

10. Report

10.1 Report the following information:

10.1.1 Description of the test material, the test specimen including construction details of the application of the test material to the joists.

10.1.2 Storage conditions of test specimens,

10.1.3 Describe the pre-test accelerated aging / weathering procedure and exposure used (if applicable),

10.1.4 Moisture content of the test specimen at the time of testing,

10.1.5 Details of the calibration, including velocity measurements and flame temperature measurements,

10.1.6 Describe the size of brand used, and

10.1.7 Observations of the burning characteristics of the test specimen during and after test exposure, as detailed in Section **8**.

11. Precision and Bias

11.1 No information is presented about the precision and bias of this test method for measuring degradation modes of decking materials since the test results are nonquantitative and are reported as observations.

12. Keywords

12.1 burning brands; decking products; upper surface deck fire test

APPENDIX

(Nonmandatory Information)

X1. COMMENTARY

X1.1 Scope—This test method was developed in response to recommendations developed by the California Office of the State Fire Marshal (OSFM) regarding the performance of decking materials in a wildland fire (exterior wildfire exposure). The composite lumber industry and solid lumber industry participated in the development of these recommendations. The OSFM recommendations established performance criteria for a variety of materials to be used in exterior buildings, structures, and detached accessory structures. This test method is intended to address one component of an exterior wildfire exposure – the upper surface deck exposure. This is a performance test of an as-installed structure comprised of materials for which information about their performance is desired. No attempt has been made to correlate this test with existing flame spread test methods. The test is a practical attempt to simulate the case where a flaming combustible material contacts the upper surface of a structure and is capable of becoming involved in a wildland fire event. The judgment regarding the quantity of fire to be used was the result of wildland fire studies by University of California at Berkeley, the OSFM, along with input from industry and other fire researchers.

X1.2 Decking Test Method Development—The major concern about the ignition of decking is the hazard that it presents to the habitable structure. For example, most decks, porches, patios, and landings are adjacent and usually attached to the structure. As such, most decking is configured so that it is

capable of being threatened by two potential sources of ignition: brands on the surface and flaming material underneath the structure according to the following scenarios:

X1.2.1 Scenario 1—A brand lands on a deck causing combustion leading to flaming combustion. The flames impinge on the wall of the structure causing penetration at a vulnerable point such as a sliding door or combustible siding.

X1.2.2 Scenario 2—A brand is blown under a deck and onto combustible material causing flaming combustion leading to penetration through the siding or some other vulnerable point. Alternatively, the initial ignition is by flame contact of the combustibles by a surface fire, with the outcome (penetration through a sliding door, siding combustion, etc.) being the same.

X1.2.3 Scenario 1 will be discussed in this commentary. In an attempt to better understand the effects of an upper surface deck fire, a preliminary test method was developed by the Forest Products Laboratory at University of California at Berkeley. Initially it was important to select a test specimen size. After fire testing various sizes from “pallet size” about 1.2 by 1.2 m [4 by 4 ft], it was found that the minimum size for reproducibility was 610 by 610 mm [2 by 2 ft], with 50 by 150 mm [2 by 6] joists spaced 410-mm [16-in.] on center (a common joist spacing for decks). Deck board spacing was 5 mm [$\frac{3}{16}$ in.].

X1.2.4 The top-deck flaming brand test was modeled after a similar brand test for roofs as described in Test Methods **E108**,

also using 5.4 m/s [12 mph] airflow. For this initial investigation a Class A brand was used.

X1.2.5 Test Materials

The UC Berkeley deck tests included 15 commercial deck board materials (wood, wood/plastic, and all plastic) that were chosen to be representative of the range of more than 20 products available on the market in early 2001. Selection of products was based on material composition and cross-sectional form.

X1.2.6 Test Results

There were three major events that were observed for a wide range of deck boards: accelerated (runaway) combustion, dripping or dropping of flaming combustibles, and collapse of deck boards.

X1.2.7 This type of top deck exposure delayed the dripping and collapse that is expected in under deck exposure testing. One material had accelerated combustion and its performance was similar to its performance in the under-flame test. Three materials performed without negative events in both exposures (top deck and under-deck) and two had similar performances. The remaining 10 had differing events between the tests.

X1.2.8 The material with the highest wood fraction appeared to lack the ability to support its own weight in long-term exposure. All of the deck board materials with a “channeled” form on the underside had early degradation effects in the under-deck fire tests, presumably from the increased surface area, although in the burning brand tests, this early degradation was not seen. On the other hand, all of the “hollow” construction products, which generally performed well in the under-deck tests, exhibited board collapse within the 40-min test period in the burning brand tests.

X1.2.9 All tests were videotaped and most had still photos taken. The tapes were used to verify direct observations. The assemblies were tested by the end of June 2001 and therefore the composition of the synthetic materials reflected those manufactured by that date. Since the composition of most of the deck board products is proprietary, the results only apply to those formulations produced at that time. Thus, the user cannot assume that a newly-purchased product would necessarily have the same performance.

X1.3 In the standards development process within ASTM there were several modifications made to the original protocol. These changes included a slightly different end of test condition and the size of the fire brand. End of test conditions are based upon melting, dripping or falling debris, evidence of continuing combustion or smoking or a maximum time of 1½ h. These changes were based upon input from the individuals doing the test work at the University of California Berkeley and others. The fire brand size shifted from an “A” brand to “A” or “B” brand. This is to give the AHJ the ability to specify the size brand that they feel is most appropriate for their needs.

X1.4 Accelerated Aging/Weathering—There are several different accelerated aging/weathering procedures or specifica-

tions that contain information about weathering available. The effectiveness of any of these procedures varies with changes in the composition of the substrate being aged/weathered. The following procedures/specifications are currently available. Care should be taken in choosing the procedure/specification that is most appropriate for the material under evaluation. Always check with the regulatory agency to verify which procedure they require prior to testing. See Practice **D2898**, Specification **D6662**, and Specification **D7032**.

X1.5 Correlation to Test Method E84—A flame spread index generated with Test Method **E84** has been a traditional method used to understand the spread of flame characteristics for wood-based products such as paneling. This method has been referenced in the building codes for these purposes. For exterior decking used in combustible construction, there currently exist no formal requirement to access the spread of flame with the exceptions found in ICC-ES **AC 109** and **AC 174**. This test method is an attempt to ensure that all materials used in decking applications perform to a level expected of traditional solid wood products. As stated in **X1.1**, no attempt has been made to correlate this test with existing flame spread test methods.

X1.6 Conditions of Acceptance

X1.6.1 The California OSFM has established the following conditions of acceptance: Should one of the three replicates fail to meet the Conditions of Acceptance, three additional tests may be run. All of the additional tests shall meet the Conditions of Acceptance.

X1.6.1.1 Absence of sustained flaming or glowing combustion of any kind at the conclusion of the 40-min observation period.

X1.6.1.2 Absence of structural failure of any deck board.

X1.6.1.3 Absence of falling particles that are still burning when reaching the burner or floor.

X1.6.2 Another set of useful Conditions of Acceptance are as follows: a deck material shall meet the following minimum conditions when exposed to this fire test:

X1.6.2.1 At no time during the duration of the test shall flames extend laterally to any of the deck surface edges as evidenced by the degree of charring after the test.

X1.6.2.2 At no time during the duration of the test shall there be sustained flaming of the underside of the deck. If flaming does occur conduct another test, during which sustained flaming shall not occur.

X1.6.2.3 At no time shall there be any burn through of the deck board.

X1.6.2.4 At no time, throughout the duration of the test, shall combusting material fall below the deck surface in sufficient quantity to ignite and cause to flame a sheet of Kraft paper located 1.52 m [60 in.] or less below the deck surface.

X1.6.2.5 There shall be no flying, flaming brands, nor particles that continue to glow after reaching the floor.

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