

DECKING

SFM STANDARD 12-7A-4

12-7A-4.1 Application. The minimum design, construction and performance standards set forth herein for unloaded decks are those deemed necessary to establish conformance to the provisions of these regulations. Materials and assemblies that meet the performance criteria of this standard are acceptable for use as defined in *California Building Standards Code*.

12-7A-4.2 Scope. This standard evaluates the performance of decks (or other horizontal ancillary structures in close proximity to primary structures) when exposed to direct flames and brands. The under-deck flame exposure test is intended to determine the heat release rate (HRR) and degradation modes of deck or other horizontal boards when exposed to a burner flame simulating combustibles beneath a deck. The burning brand exposure test is intended to determine the degradation modes of deck or other horizontal boards when exposed to a burning brand on the upper surface.

12-7A-4.3 Referenced document.

1. ASTM D 4444, Test Methods for Use and Calibration of Hand-Held Moisture Meters.
2. ASTM E 108, Test Methods for Fire Tests of Roof Coverings.
3. *California Building Code*, Chapter 7A.
4. UL 790, Standard Test Methods for Fire Tests of Roof Coverings.

12-7A-4.4 Definitions.

1. **Deck boards.** Horizontal members that constitute the exposed surface of the ancillary structure.
2. **Deck surface area.** The test specimen area defined by the overall specimen length and width after assembly.
3. **Heat release rate.** The net rate of energy release as measured by oxygen depletion calorimetry.

12-7A-4.5 Test assembly.

1. **Size.** The overall size of the test deck shall be nominally 24 x 24 inches (610 x 610 mm) unless width variation of deck boards requires an increase in overall deck width (i.e., the direction of joists) in order to meet the overall dimensions. The length of individual deck boards shall be 24 inches (610 mm).
2. **Joists.** The deck is supported by two nominal 2 x 6 Douglas-fir joists running perpendicular to the deck boards, and constructed with a 16-inch (406 mm) center-to-center spacing. A comparable species that may be more commonly used for structural framing of decks in a given region can be substituted for Douglas-fir.
3. **Deck board spacing and fastening.** Edge-to-edge spacing and method of attachment shall conform to the manufacturer's installation recommendations. The front deck board shall be flush with the ends of the joists, and the rear deck board shall overhang the end of the joists by 1 inch (25 mm).

3.1. In the absence of recommended installation guidance, the edge-to-edge spacing shall be $\frac{3}{16}$ inch (5 mm) with boards mechanically attached to the joists using deck screws.

3.2. If nominal 6-inch-wide deck boards are used, a total of 5 boards shall be used for each deck. Changing the board width could change the number of deck boards.

12-7A-4.6 Materials.

1. **Cross-sectional dimension.** All deck board materials are to have cross-sectional dimensions equivalent to use in service.
2. **Description.** The material under test should be described as completely as possible (unit weight, thickness, width, and general information regarding composition).
3. **Condition of test material.** Prior to testing, all materials (deck boards and joist material) shall be conditioned to a constant weight or for a minimum of 30 days at 73 ± 4 °F (23 ± 2 °C) and 50 ± 5 % relative humidity, whichever occurs first. Constant weight shall be defined as occurring when the change in test material weight is less than or equal to 2 percent in a 24-hour period.

12-7A-4.7 PART A. Under-deck flame test.

12-7A-4.7.1 Equipment.

1. **Burner.** A 12 x 12 inch (300 x 300 mm) sand diffusion burner shall be used. Natural gas, methane or propane shall be supplied to the burner through a metered control system. The gas supply to the burner shall produce a net heat output of 80 ± 4 kW throughout the flame exposure. Burner output can be determined from HRR or calculated from the gas flow rate, temperature, and pressure.
2. **Oxygen depletion calorimeter.** The equipment shall include a hood, associated ducting, and instrumentation to provide HRR data by oxygen depletion calorimetry.

12-7A-4.7.2 Test system preparation. See Figure No. 1.

1. **Deck support assembly.** The assembly that holds the test deck over the burner.
2. **Baffle panels and joist support.** Horizontal metal plates to support the deck joists along their full length, and also to confine burner flames to the underside of the deck boards located between the support joists.
3. **Back wall.** Ceramic fiber board or another noncombustible panel product for the back wall material. Total height of the back wall shall be 8 feet (2.4 m).
4. **Ledger board.** A 4-foot-long (1.2 m) simulated 2 x 6 ledger board shall be constructed of layers of ceramic fiber board (or other noncombustible panel product) and attached to the wall at a height slightly below the overhang of the rear deck board of the test deck.

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12-7A-4.7.3 Conduct of tests.

- 1. **Airflow.** The test shall be conducted under conditions of ambient airflow.
- 2. **Number of tests.** Conduct the test on three replicate assemblies.
- 3. **Burner output verification.** Without a deck in the apparatus, set the output of the burner to 80 ± 4 kW. Conduct a verification run of 3 minutes to ensure the heat release rate, and then turn off the burner.
- 4. **Measurement of heat release rate.** HRR is measured during the tests with a properly calibrated oxygen depletion calorimeter. Since HRR is typically a post-test analysis, this criterion for Acceptance may be determined at the end of the test.
- 5. **Burner positioning.** Center the burner directly under the middle deck board, midway between the joists. The distance from the top of the burner to the bottom of the deck boards shall be 27 inches (690 mm).
- 6. **Moisture content.** Measure the moisture content of the wooden members of the assembly using a moisture meter (ASTM D 4444).
- 7. **Procedure.**
 - 7.1 **Ignition.** Ignite the burner, controlling for a constant 80 ± 4 kW output.
 - 7.2 **Flame exposure.** Continue the exposure for a 3-minute period. Extinguish the burner.
 - 7.3 **Continued combustion.** Continue observation for an additional 40 minutes or until all combustion has ceased.
- 8. **Observations.** Note physical changes of the deck boards during the test, including structural failure of any deck board, location of flaming and glowing ignition, and loss of material (i.e., flaming drops of particles falling from the deck). It is desirable to capture the entire test with a video recorder to allow review of the details of performance.

12-7A-4.7.4 Report. The report shall include a description of the deck board material and the time of any degradation (effective net peak heat release rate, structural failure, flaming drops or particles falling from the deck) during the test.

- 1. **Calculated rate of heat release.** The effective net peak heat release rate (HRR) shall be calculated as follows:
 - 1.1. During the first 5 minutes of the test (the 3 minutes during which the ignition source burner is operating and the immediately following 2 minutes) the effective net peak HRR of the test assembly shall be reported as: $\text{effective net peak HRR} = (\text{peak heat release rate} - 80 \text{ kW}) / (\text{deck surface area})$.
 - 1.2. During the remaining test duration the effective net peak heat release rate of the test assembly shall be reported as: $\text{effective net peak HRR} = (\text{peak heat release rate}) / (\text{deck surface area})$

12-7A-4.7.5 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 must meet the Conditions of Acceptance.

- 1. Effective net peak heat release rate of less than or equal to 25 kW/ft^2 (269 kW/m^2).
- 2. Absence of sustained flaming or glowing combustion of any kind at the conclusion of the 40-minute observation period.
- 3. Absence of falling particles that are still burning when reaching the burner or floor.

12-7A-4.8 PART B. Burning brand exposure.

12-7A-4.8.1 Equipment.

- 1. **Wind tunnel.** The wind tunnel shall have the capability of providing 12 mph (5.4 m/s) airflow over the deck assembly.
- 2. **Anemometer.** Device for measuring airflow across the deck.
- 3. **Burner.** Gas-fueled burner for brand ignition.

12-7A-4.8.2 Test system preparation. See Figure 2. The ASTM E 108 "A" brand roof test apparatus is to be used, with the following modifications:

- 1. **Deck support.** The deck shall be supported horizontally with the center 60 inches (150 mm) from the front opening of the wind tunnel and the joists parallel to the airflow and resting on two transverse metal supports. The top surfaces of these supports, no more than 3 inches (75 mm) wide, are at the same height as the floor of the wind tunnel.
- 2. **Fragments.** Burning fragments shall be free to fall to the floor of the room.

12-7A-4.8.3 Conduct of tests.

- 1. **Number of tests.** Conduct the test on three replicate assemblies.
- 2. **Moisture content.** Measure the moisture content of the wooden members of the assembly using a moisture meter (ASTM D 4444).
- 3. **Procedure.** Adhere to ASTM E 108 "Standard Test Methods for Fire Tests of Roof Coverings" (burning brand test, "A" brand), with apparatus modified as described above in "Test system preparation" and the following procedure:
 - 3.1 The air velocity shall be calibrated using the 60-inch (1.5 m) framework spacing, with a smooth noncombustible calibration deck at a 5-inch per 12-inch horizontal incline positioned 60 inches (1.5 m) from the front opening of the wind tunnel. All other measurement details shall be followed as specified in Sections 4.4.2, 4.4.3, and 4.4.4 of ASTM E 108. Although ASTM E 108 specifies calibration to be conducted with the 33-inch (840-mm) framework spacing used for the intermittent flame test set up, tests have shown that at the nominal 12 mph setting, there was not difference in measured velocity between the 33- and 60-inch framework spacing.
 - 3.2 Mount the test specimen at a zero horizontal incline positioned 60 inches (1.5 m) from the front opening of the wind tunnel.

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3.3 Ignite the "A" brands as specified in Section 9.4 of ASTM E 108 as reprinted here:

1. Each 12- x 12-inch (300 x 300 mm) face for 30 seconds.
2. Each 2.25- x 12-inch (57 x 300 mm) edge for 45 seconds.
3. Each 12- x 12-inch (300 x 300 mm) face again for 30 seconds.

3.4 Center the burning brand laterally on the deck with the front edge 2.5 inches (64 mm) from the entering air edge of the deck.

3.5 Continue the exposure for a 40-minute period or until all combustion of the deck boards ceases. The test shall be terminated immediately if flaming combustion accelerates uncontrollably (runaway combustion) or structural failure of any deck board occurs.

Heat Release Rate is not monitored because of the impracticability with the specified airflow.

4. **Observations.** Note physical changes of the deck boards during the test, including deformation from the horizontal plane, location of flaming and glowing combustion, and loss of material (i.e., flaming drops of particles falling from the deck). It is desirable to capture the entire test with a video recorder to allow review of the details of performance.

12-7A-4.8.4 Report. The report shall include description of the deck board material, and the time of any degradation (accelerated combustion, board collapse, flaming drops or particles falling from the deck).

12-7A-4.8.5 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 must meet the Conditions of Acceptance:

1. Absence of sustained flaming or glowing combustion of any kind at the conclusion of the 40-minute observation period.
2. Absence of falling particles that are still burning when reaching the burner or floor.

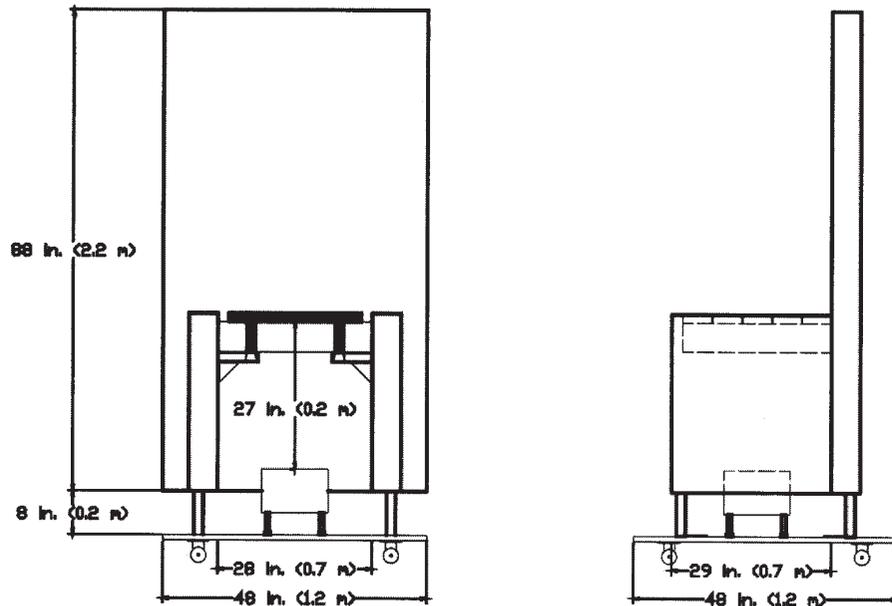


FIGURE 1. DECK TEST ASSEMBLY (UNDER DECK-FLAME)

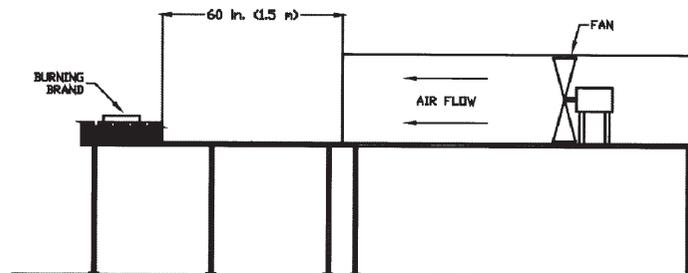


FIGURE 2. DECK TEST ASSEMBLY (BURNING-BRAND)