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Methods of Fire Tests of ROOF COVERINGS

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**NATIONAL FIRE PROTECTION ASSOCIATION
International**

60 Batterymarch St., Boston 10, Mass.

National Fire Protection Association

International

Executive Office: 60 Batterymarch St., Boston 10, Mass.

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Definitions

The official NFPA definitions of shall, should and approved are:

SHALL is intended to indicate requirements.

SHOULD is intended to indicate recommendations, or that which is advised but not required.

APPROVED refers to approval by the authority having jurisdiction.

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters.

Approved Equipment

The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The standards are prepared, as far as practicable, in terms of required performance, avoiding specifications of materials, devices or methods so phrased as to preclude obtaining the desired results by other means. The suitability of devices and materials for installation under these standards is indicated by the listings of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada and the Factory Mutual Laboratories test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

Methods of Fire Tests of ROOF COVERINGS

NFPA No. 256 — May 1958

This standard was adopted by the National Fire Protection Association on May 22, 1958 on recommendation of the Committee on Fire Tests. It is the first edition.

The test procedure covered by this standard was developed by Underwriters' Laboratories, Inc. The standard was prepared by the E5 Committee of the American Society for Testing Materials and adopted by ASTM as a tentative standard in 1955. The text as published herein is the same as that published by the ASTM in E108-1956T.

NFPA COMMITTEE ON FIRE TESTS

R. C. CORSON, *Chairman*,
1207 Palm Trail, Delray Beach, Florida (rep. National Fire Protection Assn.).

PAUL BASELER, Building Officials Conference
of America.

E. W. FOWLER, National Board of Fire Un-
derwriters.

NOLAN D. MITCHELL, National Fire Pro-
tection Assn.

A. J. STEINER, Underwriters' Laboratories,
Inc.

GEORGE N. THOMPSON,* Washington, D. C.

LEWIS W. VAUGHAN, Underwriters' Lab-
oratories of Canada.

CALVIN H. YUILL, Southwest Research In-
stitute.

*Serving in a personal capacity.

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Methods of Fire Tests of ROOF COVERINGS

(NFPA No. 256 — May 1958)

Scope

1. (a) These methods are intended to measure the fire-retardant characteristics of roof coverings against fire originating outside the building on which they have been installed. They are applicable to roof coverings intended for installation on either combustible or noncombustible decks, and when applied in a manner to prevent leakage.

(b) Three methods of test are included as follows:

Method A. Intermittent Flame Exposure Test,

Method B. Spread of Flame Test, and

Method C. Burning Brand Test.

Apparatus

2. (a) The essential elements of the fire test apparatus are illustrated in Figures 1 and 2. It includes a test roof deck *A*; an adjustable frame *B*, (see also Figure 3), on which the test roof deck is mounted; a gas burner *C* as a source of flame; a wind tunnel *D*; an air velocity meter,* a gas pressure gage, a control valve, and a rheostat for regulating the blower speed. Control of the shape and size of the flame depends upon minimizing air turbulence in the immediate vicinity of the apparatus. To do this it is important that

(1) Free outlet to outside air be provided beyond and above the test apparatus to exhaust air introduced into the test room by the blower, and

(2) All openings into the test room other than those mentioned in Item (1), such as doors and windows, be kept closed during the test.

(b) Equipment shall be provided to maintain the temperature of the air supplied by the blower between 50° and 90° F.

*An Alnor Velometer has been found most satisfactory for this purpose as it reads velocity directly without the use of a timing device. Manufactured by the Illinois Testing Laboratories, 420 North LaSalle St., Chicago, Ill.

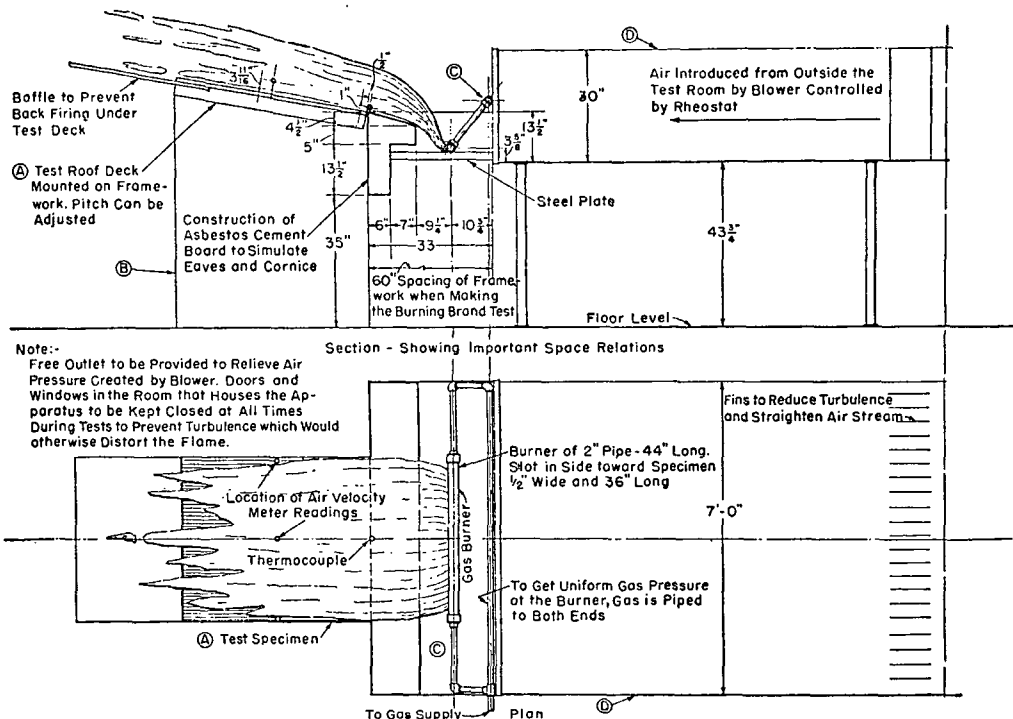


Figure 1. — Schematic Drawing of Fire Test Apparatus.

Preparation of Test Specimens

3. (a) *Construction of Test Decks.* — The test deck for the intermittent flame exposure test (Method A) and the burning brand test (Method C) shall be 3 feet 4 inches wide and 4 feet 4 inches long (Note 1). It shall be made of kiln-dried No. 1 common western white pine lumber, free from large or loose knots, sapwood, rot, and edge knots. The individual deck boards shall be nominally 1 inch thick and 8 inches wide (dressed on four sides to $25\frac{3}{32}$ by $7\frac{1}{2}$ inches). They shall be laid across the shorter dimensions of the test deck, spaced $\frac{1}{4}$ inch apart, and securely nailed to 2 by 4-inch yellow pine battens on the underside and at the outer edges of the deck (Figure 4).

The test deck for the spread of flame test (Method B) shall be constructed of the same materials and in the same manner as for the other tests except that it shall be 13 feet long instead of 4 feet 4 inches. It may be constructed, if desired, by assembling three standard decks end to end, fastening them together in an appropriate manner to make one long unit before application of the roofing.

NOTE 1. — For testing shingles, narrower boards not less than 4 inches nominal, shall be substituted in order to provide a maximum number of areas for placement of brands in accordance with Section 10(c), (Class C).

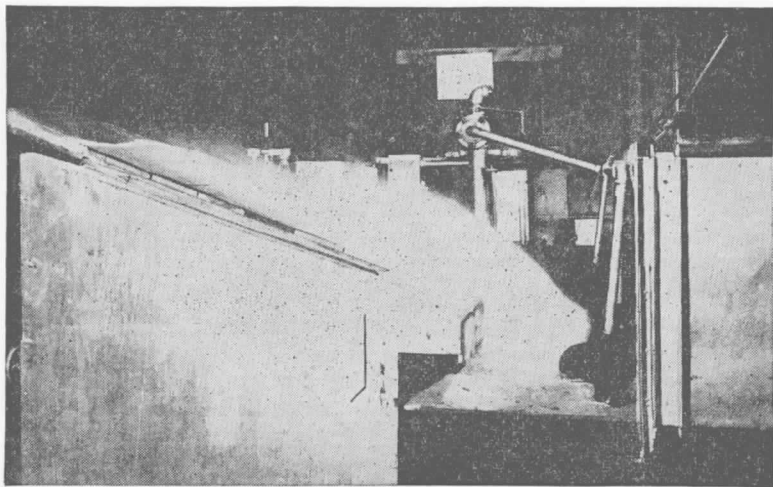


Figure 2. — Flame Test Apparatus in Operation. (Flame is directed by a 12 mph current of air from the end of the air tunnel.)

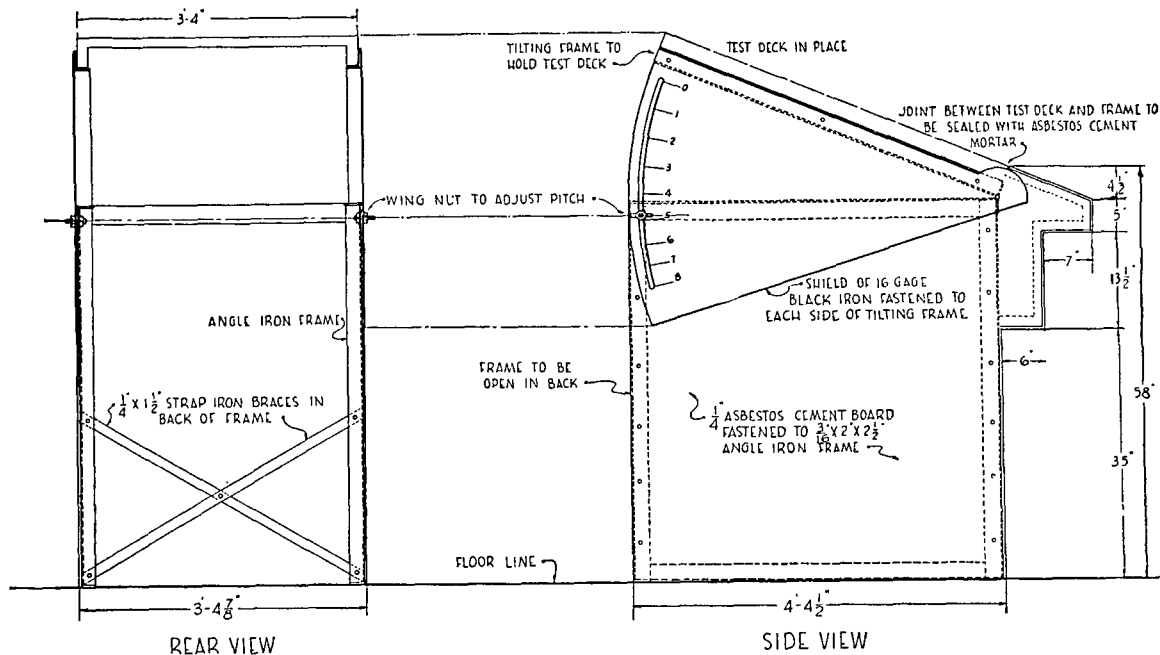


Figure 3. — Detail of Tilting Frame to Hold Test Roof Deck.

to the assembly in such a manner that it can easily be removed just before the deck is tested, and large enough to furnish a sample which can be oven tested for moisture content (Note 2). Test roof decks shall be stored so that each will be surrounded by freely circulating air.

NOTE 2. — Moisture determination shall be made on two pieces about 3 inch square, cut from the selected sample, after at least 2 inches has been removed from the end. These shall be dried at 212° to 220° F for not less than 16 nor more than 24 hours. The weight of the sample before and after drying shall be recorded and the moisture content calculated on the basis of the dried weight.

METHOD A. INTERMITTENT FLAME TEST

Procedure

4. (a) *Air Flow*. — Mount the test roof decks at slopes, as specified in Paragraph (b), in an air current which flows uniformly over the top surface of the roof covering. The velocity of the air current flowing parallel to the deck shall be 12 ± 0.5 mph as measured by an air velocity meter, located at points midway up the slope of the test panel at its center and edges, the point where the measurement is taken to be centered $3\frac{11}{16}$ inch above the surface of the roof panel (Figure 1).

(b) *Slope of Test Roof Deck*. — The slope of the test roof deck shall be as follows:

Built-up roofs.	Maximum slope for which roofing is recommended by the manufacturer
Shingles and Roll products.	5 inch rise per horizontal foot

(c) *Adjustment of Air and Gas*. — After adjusting the blower to produce the specified air current, subject the test roof deck to a sheet of gas flame approximately the width of the deck at its bottom edge. Adjust the flame to play uniformly over the top surface of the roof covering. The gas supply shall be predetermined by trial with an auxiliary test deck covered with asbestos cement board to develop a luminous flame with a temperature of $1400^\circ \pm 50^\circ$ F for classes A and B, and $1300^\circ \pm 50^\circ$ F for class C tests, as determined by a No. 14 gage chromel-alumel wire thermocouple. The thermocouple shall be mounted at the center of the test roof deck 1 inch above the surface and $\frac{1}{2}$ inch toward the source of flame from the lower edge of the deck. If these conditions are satisfied, the flame will extend approximately to the upper edge of the test roof deck 4 feet 4 inches, as illustrated in Figure 4, with licks of flames extending approximately 6 feet.

(d) *Application of Flame.* — Apply the exposing flame intermittently for specified periods with specified time intervals between applications, these sequences varying when proceeding under different test methods, as follows:

<i>Method of Test</i>	<i>Flame On, minutes</i>	<i>Flame Off, minutes</i>	<i>No. of Test Cycles, minutes</i>
Class A	2	2	15
Class B	2	2	8
Class C	1	2	3

(e) *Maintenance of Air Current.* — Maintain the air current at the 12 ± 0.5 mph rate after the last application of flame until all evidence of glow, flame, and smoke has disappeared, or until failure occurs. Do not permit blowing or other fanning of the undersurface of the test roof deck while under test to remove smoke.

Report

5. Record the presence or absence of the following phenomena in terms of the number of cycles required to produce them, or the number of cycles applied without producing them, as follows:

	Yes	No	No. of Cycles
First appearance of sustained flame on underside of roof deck	_____	_____	_____
First production of flying, flaming, or glowing brands which leave the deck	_____	_____	_____
First displacement of portions of the roofing on the deck resulting in deck exposure	_____	_____	_____

METHOD B. SPREAD OF FLAME TEST

Procedure

6. (a) *Air Flow.* — Mount the 13-foot test roof deck at the appropriate slope as specified for the intermittent flame test in Section 4(a). Adjust the velocity of air flowing over the surface of the deck to 12 ± 0.5 mph measured at the location and by the method described in Section 4(a).

(b) *Test Flame.* — The flame shall be applied in all respects the same as used for the intermittent flame test as prescribed in Section 4(c) and (d).

(c) *Duration of Flame Application.* — For classes A and B apply the gas flame continuously for 10 minutes, or until the flame (actual ignition of the test deck surface) has spread to the top of the deck, or until the flame has begun to recede from the point of maximum spread, whichever is the shorter. For class C apply the gas flame for a period of 4 minutes and then remove.

Report

7. During and after the spread of flame test make the following observations and measurements for each classification as follows:

(1) Record the greatest distance of flame travel, measured from the lower edge of the test roof deck to the location where the surface is burning.

(2) Observe the occurrence and behavior of flying, flaming, or glowing brands which leave the test deck. Record the length of time required to produce them.

METHOD C. BURNING BRAND TEST

Apparatus

8. (a) *Gas Burner ($\frac{3}{8}$ inch Pipe Connection).** — A burner, equivalent to that shown in Figure 5, operated to consume 100 cubic feet per hour of gas under a pressure of 3 inches of water when adjusted to a hard blue flame of maximum intensity.

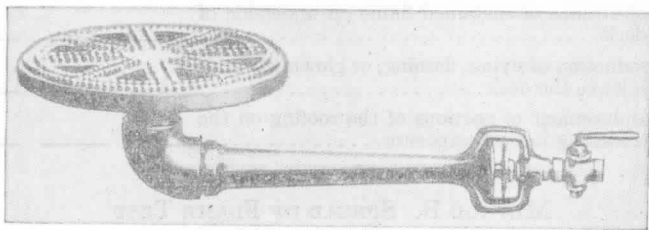


Figure 5. — Burner for $\frac{3}{8}$ -inch Pipe Connection.

(b) *Gas Burner ($\frac{1}{8}$ inch Pipe Connection).** — A smaller burner, as shown in Figure 6, operated to consume 32 cubic feet per hour of gas under the same conditions as described in Paragraph (a).

*Manufactured by Charles A. Hones, Inc., Baldwin, N. Y. When ordering burners the type of gas to be used, whether manufactured, liquefied, or natural, is customarily specified.

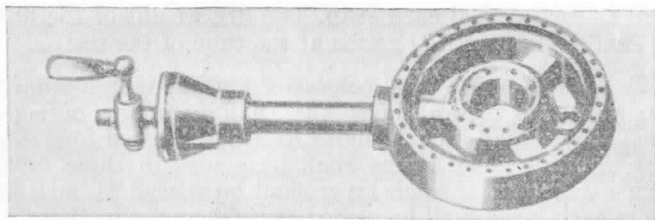


Figure 6. — Burner for $\frac{1}{8}$ -inch Pipe Connection.

Preparation of Brands

9. (a) *Description of Brands.* — Prepare the brands in three different sizes of wood, as shown in Figure 7, and condition them as specified in Paragraph (b). Designate the different sizes of brands as classes A, B and C, beginning with the largest, as follows:

(1) *Class A brand* shall consist of a grid 12 inches square and approximately 3 inches thick, made of kiln-dried, clear-grained Douglas fir, free from knots and pitch pockets. It shall be made of thirty-six nominal 1 by 1 by 12-inch strips dressed on four sides to $\frac{25}{32}$ by $\frac{25}{32}$ inch. The strips shall be placed in three layers of 12 strips each, and in each layer shall be spaced $\frac{1}{4}$ inch apart. Strips shall be placed at right angles to those in adjoining layers, and shall be nailed at their intersections using a three penny finish-

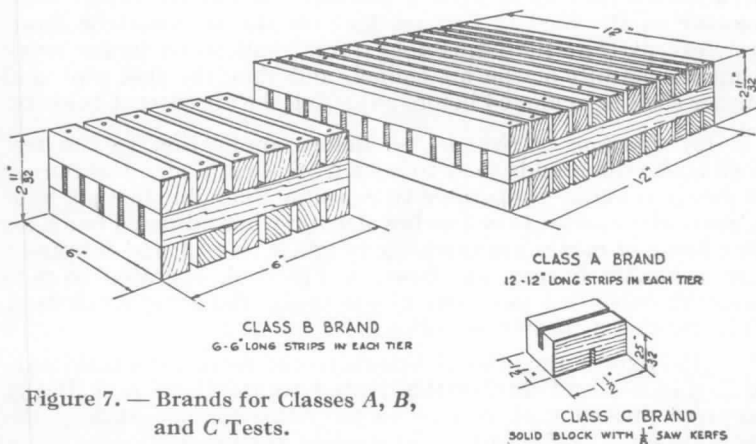


Figure 7. — Brands for Classes A, B, and C Tests.

ing nail at each end of each strip. The dry weight of the finished brand shall be 2000 ± 150 grams at the time of the test.

(2) *Class B brand* shall consist of a grid 6 inches square and approximately 3 inches thick. It shall be made of eighteen nominal 1 by 1 by 6-inch Douglas fir strips dressed four sides to $2\frac{5}{32}$ by $2\frac{5}{32}$ inch. The strips shall be placed in three layers of six strips each, and in each layer shall be spaced $\frac{1}{4}$ inch apart. Strips in each layer shall be placed at right angles to those in adjoining layers and shall be nailed at their intersections with a threepenny finishing nail at each end of each strip. The dry weight of the finished brand shall be 500 ± 50 grams at the time of the test.

(3) *Class C brand* shall consist of a block of kiln-dried, clear-grained white pine, free from knots and pitch pockets, $1\frac{1}{2}$ by $1\frac{1}{2}$ by $2\frac{5}{32}$ inch thick, with saw kerfs, each about $\frac{1}{8}$ inch wide and one-half the thickness of the brand deep, across the center of the top and bottom faces, at right angles to each other. The conditioned weight of the finished brand shall be $9\frac{1}{4} \pm 1\frac{1}{4}$ grams at the time of the test.

(b) *Storage and Handling.* — Oven dry the brands at 105° to 120° F to constant weight, so that when used they will weigh within the specified limits.

Procedure

10. (a) *Test Deck.* — A 3 foot 4 inch by 4 foot 4 inch test deck shall be set up in a 12 ± 0.5 mph air current in the same manner as specified in Section 4(a) for the intermittent flame test, except that the adjustable frame shall be 60 inches away from the mouth of the air tunnel, and that the fuel pipe and burner shall be removed before adjusting the air current velocity.

(b) *Ignition of Brands.* — Before application to the test deck ignite the brands so as to burn freely in still air. Use burner as shown in Figure 5, operated to consume 100 cubic feet per hour of gas under a pressure of 3 inches of water when adjusted to a hard blue flame of maximum intensity to ignite class A and B brands. Use a smaller burner, as shown in Figure 6, operated to consume 32 cubic feet per hour of gas under the same conditions, to ignite class C brands as follows:

(1) Expose the class A brands to the flame for a maximum of 5 minutes and during this period rotate them periodically so as to present each surface to the flame for one-sixth of the total time ($60 \times 5 \div 6$) = 50 seconds, each face.

(2) Expose the class *B* brands to the flame for a maximum of 3 minutes, and during this period rotate them periodically so as to present each surface to the flame for one-sixth of the total time ($60 \times 3 \div 6$) = 30 seconds, each face.

(3) Envelop the class *C* brands in the flame for a period not to exceed 2 minutes.

NOTE 1. — The above time limits are based upon the use of gas having a thermal value of 900 Btu per cu. ft. at a temperature of $1630^{\circ} \pm 50^{\circ}$ F, as determined by a No. 14 gage chromel-alumel wire thermocouple held in various places in the area of burning at a height of $2\frac{1}{16}$ inches above the top of the burner for igniting the brands. When a hotter flame is used to ignite the brands it may be found desirable to reduce the time of exposure (5, 3 and 2 minutes) in order to avoid significant reduction of their heating capacity when burning on the test deck.

(c) *Location of Brands on Test Roof Deck.* — The brands shall be fastened (Note 2) to the test roof deck as follows:

(1) Place the class *A* brands on the top surface of the test roof deck at its approximate center, and in a location considered most vulnerable with respect to ignition of the roof deck (Note 3), but in no case closer than 12 inches to any edge.

(2) Place the class *B* brands on the top surface of the test roof deck in positions considered most vulnerable with respect to ignition of the roof deck (Note 3). Not more than three brands shall be used on any one test deck, and they shall be not closer than 9 inches to any edge of the deck nor to any previously charred area.

(3) Place the class *C* brands on the top surface of the test deck, in positions considered most vulnerable with respect to ignition of the roof deck, but not closer than 6 inches to any edge, nor so that their effects will lap any previously damaged area. When joints occur in the same course of the roof covering, no brand shall be located closer than 2 inches to such joints. As many brands may be used on the same test deck as is consistent with the above conditions. They shall be placed so that the saw kerf on the deck side is parallel to the direction of air flow. When tests are conducted on coverings with unfastened or loose portions, remove such loose portions before the brands are applied.

NOTE 2. — Fasten the Classes *A* and *B* brands to the test decks throughout the test by soft iron wire of not less than No. 18 USS gage. Fasten the Class *C* brands to the test decks throughout the test by soft iron wire of No. 24 USS gage.

NOTE 3. — Place both Class *A* and Class *B* brands so that the lower tier of wood pieces is parallel to the direction of air flow.