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SURFACE BURNING OF BUILDING MATERIALS 1961



Fifty Cents

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NATIONAL FIRE PROTECTION ASSOCIATION
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National Fire Protection Association

International

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Method of Test of Surface Burning Characteristics of Building Materials

NFPA No. 255 — May 1961

ASA A2.5 — 1963

This standard was adopted by the National Fire Protection Association on May 18, 1961 on recommendation of the Committee on Fire Tests to supersede the standard adopted in 1958. This 1961 edition is a complete revision of the 1958 standard. It was approved as an American Standard by the Am. Stds. Assn. on Oct. 29, 1963.

Previous editions of this standard have been published by Underwriters' Laboratories, Inc., as UL 723.

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History

The test procedure covered by this standard was originally developed by Underwriters' Laboratories, Inc., and a descriptive article thereon was published in the NFPA Quarterly for July, 1943. Subsequently the test method was considered by Committee E-5 of the American Society for Testing Materials and adopted by the ASTM as a tentative standard in 1950. Subsequent to NFPA action on this standard on recommendation of the Committee on Building Construction in 1953, a new NFPA Committee on Fire Tests was created to provide the machinery for NFPA action on fire test standards in cooperation with the American Society for Testing Materials. At the 1955 Annual Meeting the Committee on Fire Tests by a divided vote recommended continuing tentative status but in view of the recommendation of the NFPA Committee on Building Construction and also of the NFPA Committee on Safety to Life which needed this standard for use in connection with interior finish requirements (see NFPA No. 101), the Standard was officially adopted in 1955 and revised editions in 1958 and 1961.

1961 Revision

This 1961 revision primarily involves an expansion of the details of the construction and calibration of the test equipment. The method of test and the classification of materials so tested have not been changed.

METHOD OF TEST OF SURFACE BURNING CHARACTERISTICS OF BUILDING MATERIALS

NFPA No. 255 — 1961

1. Scope

(a) This method of test of surface burning characteristics of building materials is applicable to any type of building material that, by its own structural qualities or by the manner in which it is applied, is capable of supporting itself in position or may be supported in the test furnace to a thickness comparable to its recommended use. The purpose is to determine the comparative burning characteristics of the material under test by evaluating the flame spread over its surface, fuel contributed by its combustion, and the density of smoke developed when exposed to a test fire.

(b) It is the intent of this method of test to register performance during the period of exposure, and not to determine suitability for use after the test exposure.

(c) This method does not establish ratings of standards of performance for specific uses, as these depend upon service requirements.

NOTE: Reference may be made to the Standard Methods of Fire Tests of Building Construction and Materials (NFPA No. 251) for procedures for determining the performance, under fire exposure conditions, of building constructions and materials when incorporated in a test structure and subjected to a standard exposing fire of controlled extent and severity.

2. Fire Test Chamber

(a) A fire test chamber supplied with gas fuel of uniform quality shall be employed for this test method.

(b) The fire test chamber, Figures 1 and 2, shall consist of a horizontal duct having an inside width of $17\frac{1}{2}$ inches $\pm \frac{1}{2}$ inch, a depth of 12 inches $\pm \frac{1}{2}$ inch measured from the bottom of the test chamber to the ledge of the inner walls on which the specimen is supported, and a length of 25 feet. The sides and base of the duct shall be lined with insulating masonry as illustrated by Figure 2. One side shall be provided with draft-tight observation

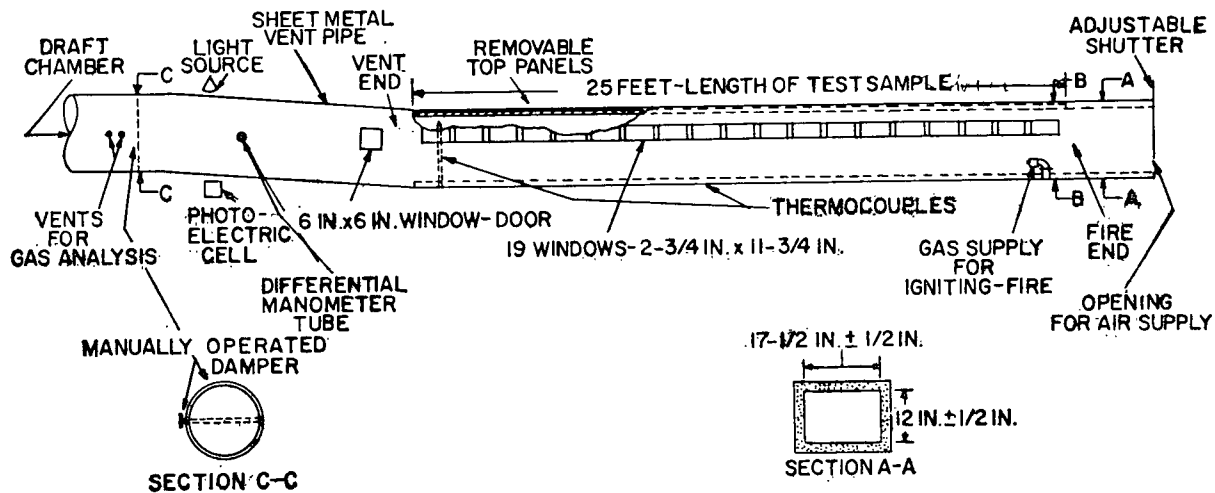


Figure 1. Details of test furnace.

windows so that the entire length of the test sample may be observed from outside the fire test chamber.

(c) The top shall consist of a removable noncombustible structure insulated as shown in Figure 2, of a size necessary to cover completely the fire test chamber and to accommodate the test samples. The top shall be designed so that it can be sealed against the leakage of air into the fire test chamber during the test, and it shall be designed to permit the attachment of test samples when necessary.

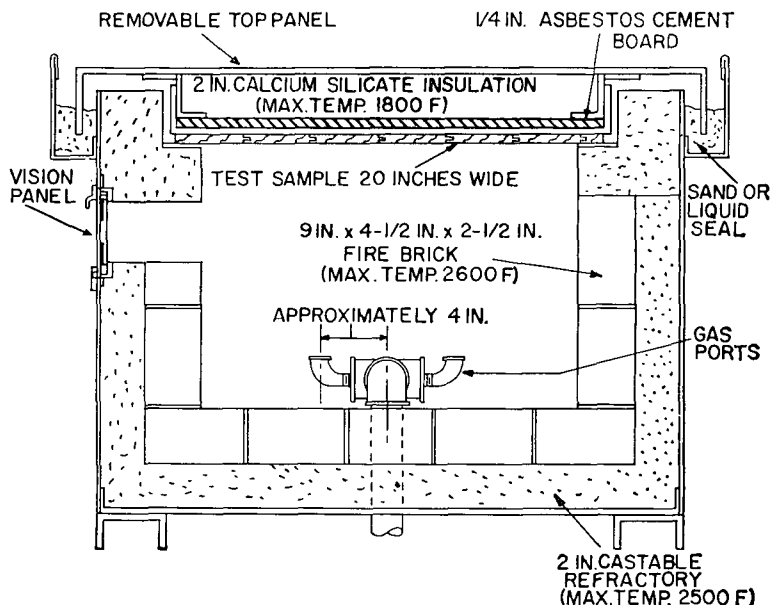


Figure 2. Cross section of furnace at BB of Figure 1.

(d) One end of the test chamber, designated as the "fire end," shall be provided with two gas burners delivering flames upward against the surface of the test sample. The burners shall be spaced 12 inches from the fire end of the sample, and $7\frac{1}{2}$ inches $\pm \frac{1}{2}$ inch below the under surface of the test sample. The burners shall be positioned transversely, approximately 4 inches on each side of the center line of the furnace so that the flame is evenly distributed over the cross section of the furnace. See Figure 2.

The controls used to assure constant flow of gas to the burners during period of use shall consist of a pressure regulator, a gas meter calibrated to read in increments of not more than 0.1 cubic feet, a manometer to indicate gas pressure in inches of water, a quick-acting gas shutoff valve, a gas metering valve, an orifice plate in combination with a water manometer to assist in maintaining uniform gas-flow conditions. An air intake fitted with a vertically sliding shutter extending the entire width of the test chamber shall be provided at the fire end. The shutter shall be positioned so as to provide an air inlet port 3 inches high measured from the floor level of the test chamber.

(e) The other end of the test chamber, designated as the "vent end," shall be fitted with a square-to-round transition piece, which is in turn fitted to a flue pipe 16 inches in diameter. The movement of air shall be by induced draft, and the draft-inducing system shall have a total draft capacity of at least 0.15-inch water column with the sample in place and the shutter at the fire end open the normal 3 inches, and the damper in the wide-open position. A draft gage to indicate static pressure shall be connected to the flue pipe upstream of the damper and photoelectric-cell opening, and at a point of minimum air turbulence.

(f) A light source shall be mounted on a horizontal section of the vent pipe at a point where it will be preceded by a straight run of pipe, and where it will not be affected by flame in the test chamber, and with the light beam directed downward along the vertical axis of the vent pipe. A photoelectric cell of which the output is directly proportional to the amount of light received shall be mounted under the light source and connected to an ammeter suitable for indicating changes in smoke density.

(g) A manually operated damper shall be installed in the vent pipe downstream of the smoke-indicating attachment.

(h) An automatic draft regulator may be mounted in the vent pipe downstream of the manual damper.

(i) A 16 or 18 AWG unprotected thermocouple shall be inserted through the floor of the test chamber so that the tip will be 1 inch from the exposed surface of the test

sample and within 1 foot of the vent end of the test sample at approximately the center of its width.

(j) A 16 or 18 AWG thermocouple embedded $\frac{1}{8}$ inch below the floor surface of the test chamber shall be mounted 14 feet distant from the fire end of the test sample.

(k) The room in which the test chamber is located shall have provision for a free inflow of air during test, to insure that the room is maintained at atmospheric pressure during the entire test run.

3. Calibration of Test Equipment

(a) A $\frac{1}{4}$ -inch asbestos-cement board shall be placed on the ledge of the furnace chamber, the removable top of the test chamber shall be placed in position, and all joints sealed against the infiltration of air.

(b) With the $\frac{1}{4}$ -inch asbestos-cement board in position on top of the ledge of the furnace chamber, and with the removable top in place, the draft shall be established so as to produce an 0.15-inch water column reading on the draft manometer, with the fire end shutter open 3 inches and the manual damper in the wide-open position. Then the fire-end shutter shall be closed and sealed. The manometer reading should increase to at least 0.25 inch, indicating that no excessive air leakage exists.

(c) The automatic draft regulator and the manual damper shall be adjusted to establish a draft reading of approximately 0.075-inch water. The required draft gage reading shall be maintained throughout the test by regulating the manual damper. The air velocity at seven points, 1 foot from the vent end, shall be recorded. These points shall be determined by dividing the width of the tunnel into seven equal sections and recording the velocity at the geometrical center of each section. The average velocity shall be 240 ± 5 feet per minute.

(d) The air supply shall be maintained at $70 \pm 5^{\circ}\text{F}$, and the relative humidity at between 35 and 40 per cent.

(e) The gas supply shall be initially adjusted at approximately 5,000 Btu per minute. The gas pressure, the pressure differential across the orifice plate, and the volume of gas used shall be recorded in each test.

(f) The test chamber shall be preheated for 10 minutes with the $\frac{1}{4}$ -inch asbestos-cement board and the removable

top in place and with the fuel supply adjusted to the required flow. During the preheat test, the temperatures indicated by the thermocouple at the vent end of the test chamber shall be recorded at 30-second intervals and compared to the preheat temperature shown in the time-temperature curve, Figure 3. The preheating is for the purpose of establishing the conditions that will exist following successive tests and to indicate the control of the heat input into the test chamber. If appreciable variation from the temperatures shown in the representative preheat curve is observed, because of variation in the characteristics of the gas used, suitable adjustments in the fuel supply may be made prior to proceeding with the red-oak calibration tests.

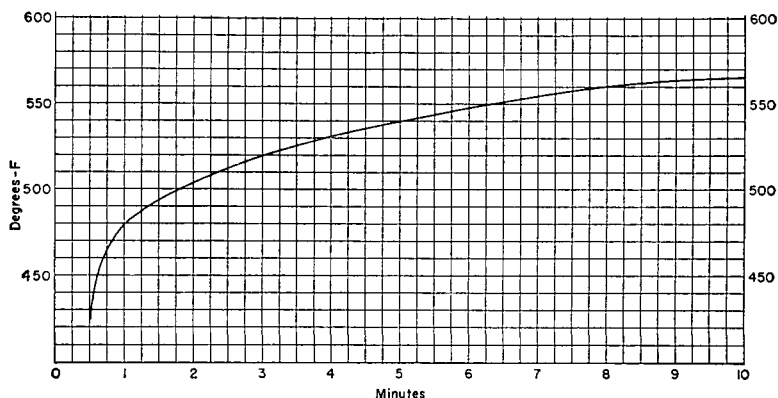


Figure 3. Preheat temperature.

(g) The furnace shall be allowed to cool after each test, and the next specimen shall not be placed in position and the test shall not be run until the floor thermocouple shows a temperature of $105 \pm 5^{\circ}\text{F}$.

(h) With the test equipment adjusted and conditioned as described in paragraphs (b), (c), (d) and (f), a test or series of tests shall be made, using select-grade red-oak flooring as the sample. Observations shall be made continually and the time recorded when the flame reaches the end of the specimen, that is, $19\frac{1}{2}$ feet from the end of the ignition fire. The end of the ignition fire shall be considered as being $4\frac{1}{2}$ feet from the burners. The flame shall reach the end point in $5\frac{1}{2}$ minutes ± 15 seconds. (Note to observer:

The flame may be judged to have reached the end point when the vent-end thermocouple registers a temperature of 980°F). The temperatures measured by the thermocouple near the vent end shall be recorded at least every 30 seconds. The photoelectric-cell output shall be recorded immediately prior to the test and at least every 15 seconds during the test.

(i) The results of tests of select-grade red-oak flooring in which the flame spreads $19\frac{1}{2}$ feet from the end of the igniting flame in $5\frac{1}{2}$ minutes shall be considered as representing a classification of 100. The temperature and change in photoelectric-cell readings shall be plotted separately on suitable co-ordinate paper. Figures 4 and 5 are representative curves for red-oak fuel contribution and smoke, respectively.

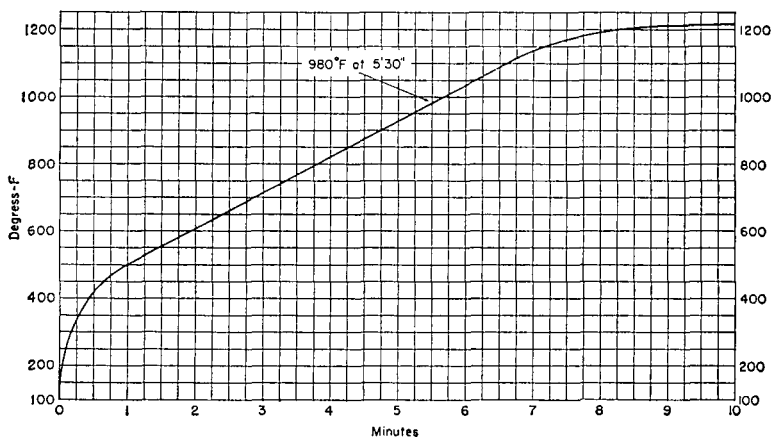


Figure 4. Fuel contributed, measured by temperature — red oak.

(j) Following the calibration tests for red oak, a similar test or tests shall be conducted on samples of $\frac{1}{4}$ -inch asbestos-cement board. The $\frac{1}{4}$ -inch asbestos-cement board attached to the furnace top shall be used as the test specimen. The results shall be considered as representing a classification of zero. The temperature readings shall be plotted separately on suitable co-ordinate paper. Figure 6 is a representative fuel-contributed curve for asbestos-cement board.

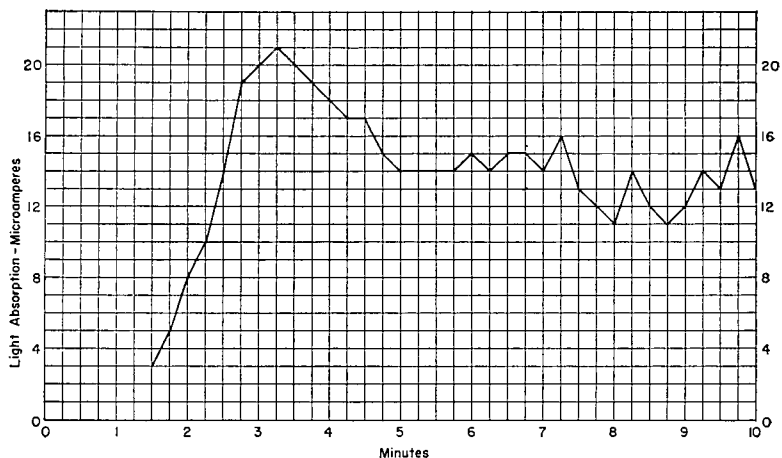


Figure 5. Smoke density — red oak.

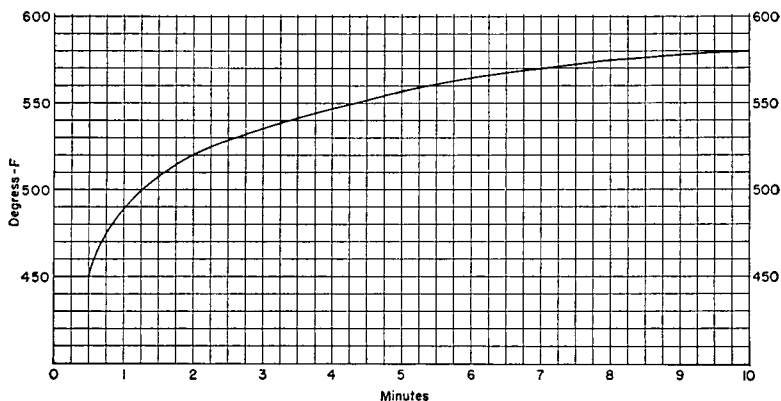


Figure 6. Fuel contributed, measured by temperature — asbestos-cement board.

4. Test Specimens

(a) The test specimen shall be at least 2 inches wider than the interior width of the tunnel and shall be the full length of the tunnel. It shall be truly representative of the material for which classification is desired. Properties ade-

quate for identification of the materials or ingredients (or both) of which the test specimen is made shall be determined and recorded.

(b) The test specimen shall be conditioned to a constant weight at a temperature of $70 \pm 5^{\circ}\text{F}$ and at a relative humidity of 35 to 40 per cent.

(c) The test specimen shall be attached to the underside of the removable top or placed on the test chamber.

5. Test Procedure

(a) The specimen and removable top shall be placed in position and all joints sealed against infiltration of air.

(b) The test equipment shall be adjusted and conditioned as described in paragraphs (b), (c), (d) and (g) of Section 3.

(c) The igniting flame shall be lighted and adjusted so that a test sample of select-grade red-oak flooring will spread flame $19\frac{1}{2}$ feet from the end of the igniting fire in $5\frac{1}{2}$ minutes $\pm$ 15 seconds. The test shall be continued for a 10-minute period unless the sample is completely consumed in the fire area before that time, in which case the test shall be ended after complete combustion occurs.

(d) The temperature measured by the thermocouple near the vent end shall be recorded at least every 30 seconds. The photoelectric-cell output shall be recorded immediately prior to the test and at least every 15 seconds during test.

(e) The gas pressure, the pressure differential across the orifice plate, and the volume of gas used shall be recorded in each test.

(f) When the test is ended, the gas supply shall be shut off, smoldering and other conditions within the test duct shall be observed, and the sample removed for further examination.

(g) The temperature and change in photoelectric-cell readings shall be plotted separately on the same co-ordinate paper as used in paragraph (i), Section 3 for use in determining the fuel-contributed and smoke-developed classifications as outlined in paragraph (a) of Section 6.