NFPA No.
255

TEST METHODS

SURFACE BURNING — BUILDING MATERIALS 1966

Fifty Cents

NATIONAL FIRE PROTECTION ASSOCIATION
International
60 Batterymarch Street, Boston, Mass. 02110

5M-6-66-WP-SM
Printed in U.S.A.

National Fire Protection Association
International

Official NFPA Definitions

Adopted Jan. 23, 1964. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

SHALL is intended to indicate requirements.

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

APPROVED means acceptable to the authority having jurisdiction. The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of nationally recognized testing laboratories,* i.e., laboratories qualified and equipped to conduct the necessary tests, in a position to determine compliance with appropriate standards for the current production of listed items, and the satisfactory performance of such equipment or materials in actual usage.

*Among the laboratories nationally recognized by the authorities having jurisdiction in the United States and Canada are the Underwriters' Laboratories, Inc., the Factory Mutual Engineering Division, the American Gas Association Laboratories, the Underwriters' Laboratories of Canada, the Canadian Standards Association Testing Laboratories, and the Canadian Gas Association Approvals Division.

LISTED: Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

LABELED: Equipment or materials to which has been attached a label of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling is indicated compliance with nationally recognized standards or the conduct of tests to determine suitable usage in a specified manner.

AUTHORITY HAVING JURISDICTION: The organization, office or individual responsible for "approving" equipment, an installation, or a procedure.

Units of Measurements

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters. One foot = 0.3048 meters. One inch = 25.40 millimeters. One pound per square inch = 0.06805 atmospheres = 2.307 feet of water. One pound = 453.6 grams.

Method of Test of

Surface Burning Characteristics of Building Materials

NFPA No. 255 — May 1966

This standard was adopted by the National Fire Protection Association on May 19, 1966 on recommendation of the Committee on Fire Tests to supersede the standard adopted in 1961.

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

Committee on Fire Tests

Jack A. Bono, *Chairman*,
Underwriters' Laboratories, Inc., P. O. Box 247, Northbrook, Ill. 60062

Professor Gerald L. Maatman, *Secretary*,
Kemper Insurance Group

Paul Baseler, Building Officials Conference of America.

Richard W. Bletzacker, The Ohio State University.

C. C. Carlson, Portland Cement Assn.

F. E. Hodgdon, American Gas Assn. Laboratories.

Dennis Lawson, British Joint Fire Research Organization.

M. H. Nickerson, Lexsuco Inc.

Norman S. Pearce, Underwriters' Laboratories of Canada.

W. W. Pritsky, American Insurance Assn.

Dr. A. F. Robertson, National Bureau of Standards.

Louis Segal, Fire Marshals Assn. of North America.

Gordon W. Shorter, National Research Council.

A. J. Steiner, Chicago, Ill.

Norman J. Thompson, Dover, Mass.

Lewis W. Vaughan, Canadian Sheet Steel Building Institute.

J. A. Wilson, Factory Mutual Engineering Division.

Calvin H. Yuill, Southwest Research Institute.

Alternate.

W. F. Maroni, Factory Mutual Engineering Division.
(Alternate to J. A. Wilson.)

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, 1961 and 1966.

The 1961 edition of the Standard was adopted by the American Standards Association on Oct. 29, 1963.

1966 Revision

This 1966 edition involves only a revision of Section 6(a).

METHOD OF TEST OF SURFACE BURNING CHARACTERISTICS OF BUILDING MATERIALS

NFPA No. 255 — 1966

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 17½ inches ± ½ inch, a depth of 12 inches ± ½ 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

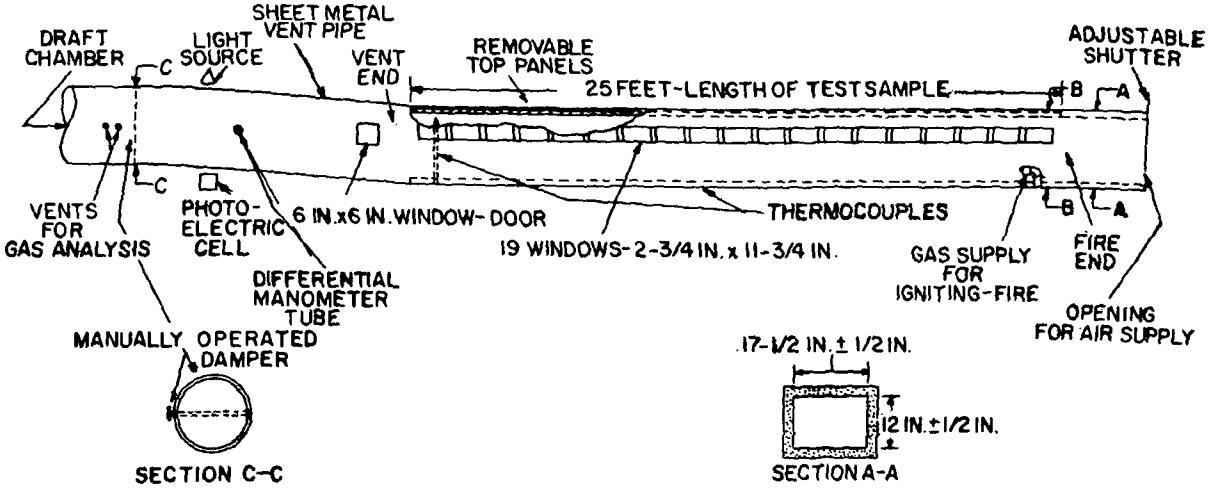

Figure 1. Details of test furnace.

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.

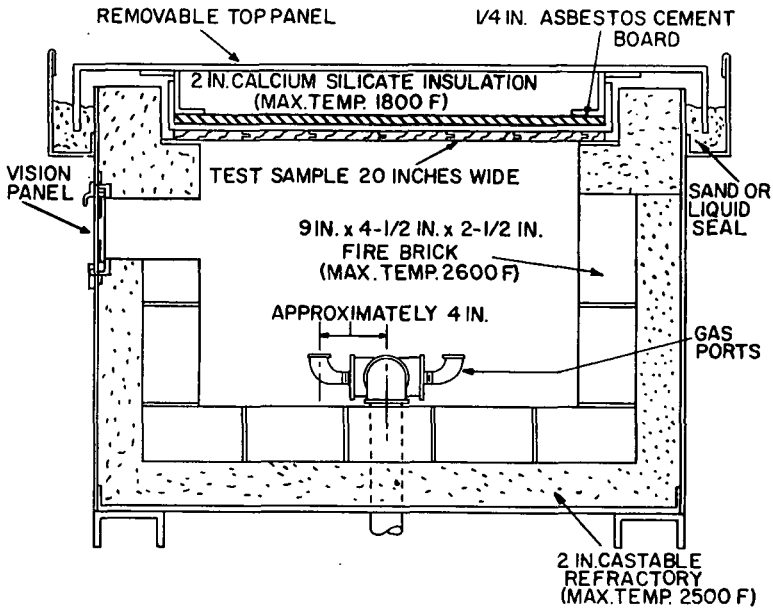

Figure 2. Cross section of furnace at BB of Figure 1.

(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 7½ inches ± ½ 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 ⅛ 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 ¼-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 ¼-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 ± 5°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 ¼-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.

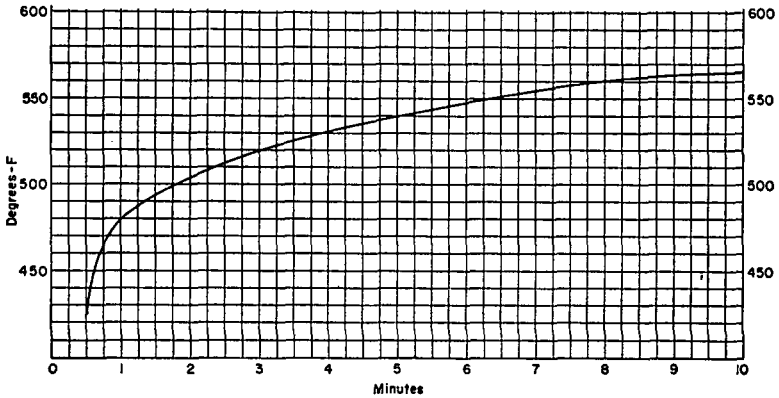

Figure 3. Preheat temperature.

(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 ± 5°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, 19½ feet from the end of the ignition fire. The end of the ignition fire shall be considered as being 4½ feet from the burners. The flame shall reach the end point in 5½ 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 19½ feet from the end of the igniting flame in 5½ 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.

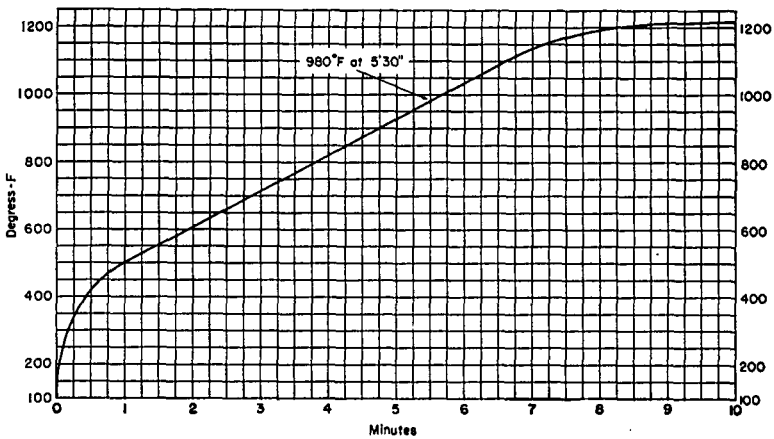

Figure 4. Fuel contributed, measured by temperature — red oak.

(j) Following the calibration tests for red oak, a similar test or tests shall be conducted on samples of ¼-inch asbestos-cement board. The ¼-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.

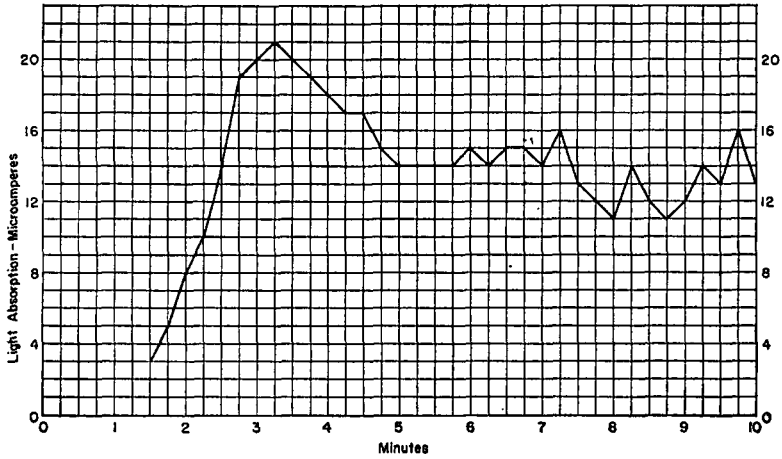

Figure 5. Smoke density — red oak.

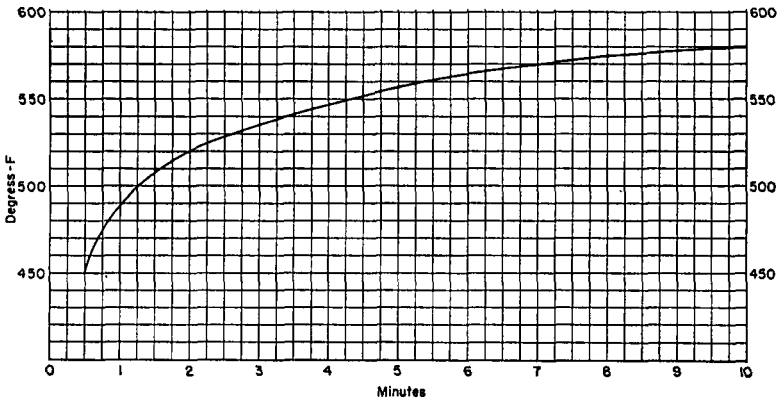

Figure 6. Fuel contributed, measured by temperature — asbestos-cement board.

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 adequate 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 ± 5°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 19½ feet from the end of the igniting fire in 5½ minutes ± 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 paragraphs (a) and (b) of Section 6.

6. Classification

The flame spread classification (FSC) shall be determined as follows: