NFPA No.

255

TEST METHODS

SURFACE BURNING— BUILDING MATERIALS 1972

$1.00

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

5M-6-72-FP
Printed in U.S.A.

Official NFPA Definitions

Adopted Jan. 23, 1964: Revised Dec. 9, 1969. 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 Research Corp., 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, symbol or other identifying mark 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 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.

Statement on NFPA Procedures

This material has been developed in the interest of safety to life and property under the published procedures of the National Fire Protection Association. These procedures are designed to assure the appointment of technically competent Committees having balanced representation from those vitally interested and active in the areas with which the Committees are concerned. These procedures provide that all Committee recommendations shall be published prior to action on them by the Association itself and that following this publication these recommendations shall be presented for adoption to the Annual Meeting of the Association where anyone in attendance, member or not, may present his views. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

Method of Test of

Surface Burning Characteristics of Building Materials

NFPA No. 255 — May 1972

This standard was adopted by the National Fire Protection Association on May 17, 1972 on recommendation of the Committee on Fire Tests to supersede the standard adopted in 1969.

Changes from the 1969 edition included in this 1972 edition are: the additions of 1(b) and 1(d).

Committee on Fire Tests

SCOPE: To develop standards for fire testing procedures when such standards are not available; review existing fire test standards and recommend appropriate action to NFPA; recommend the application of and advise on the interpretation of acceptable test standards for fire problems of concern to NFPA Technical Committees and members; act in a liaison capacity between NFPA and the committees of other organizations writing fire test standards.

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 and 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, 1966, 1969 and 1972.

METHOD OF TEST OF SURFACE BURNING CHARACTERISTICS OF BUILDING MATERIALS

NFPA No. 255 — 1969 72

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, when exposed to a test fire and to thus establish a basis on which surface burning characteristics of different materials may be compared without specific consideration of all end use parameters that might affect the surface burning characteristics.

(b) Fuel contributed and smoke density as well as the flame spread rate are recorded in this test. However, there is not necessarily a relationship among these three measurements.

(c) 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.

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.

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

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.

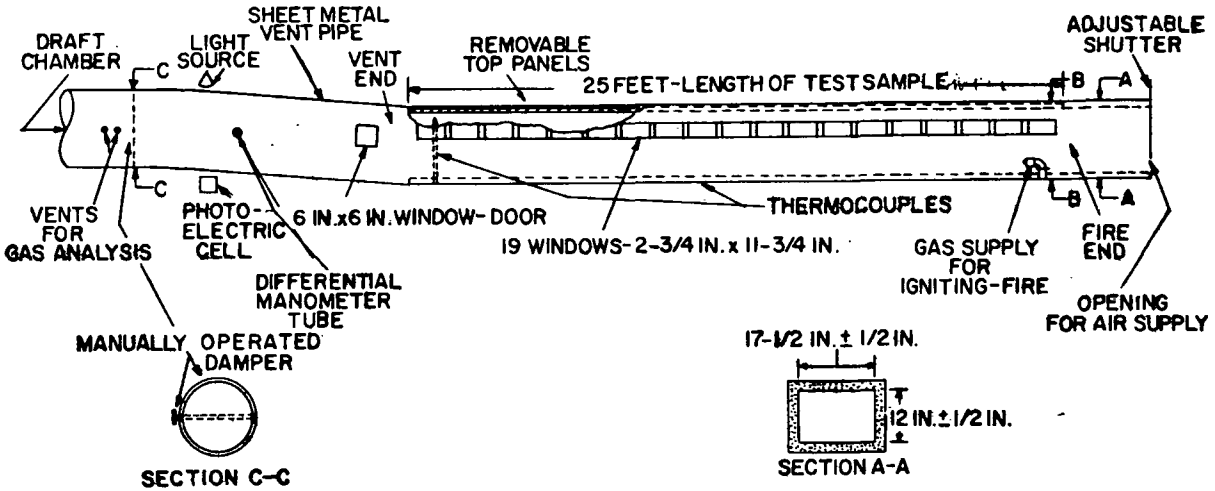

Figure 1. Details of test furnace.

One side shall be provided with draft-tight observation 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.

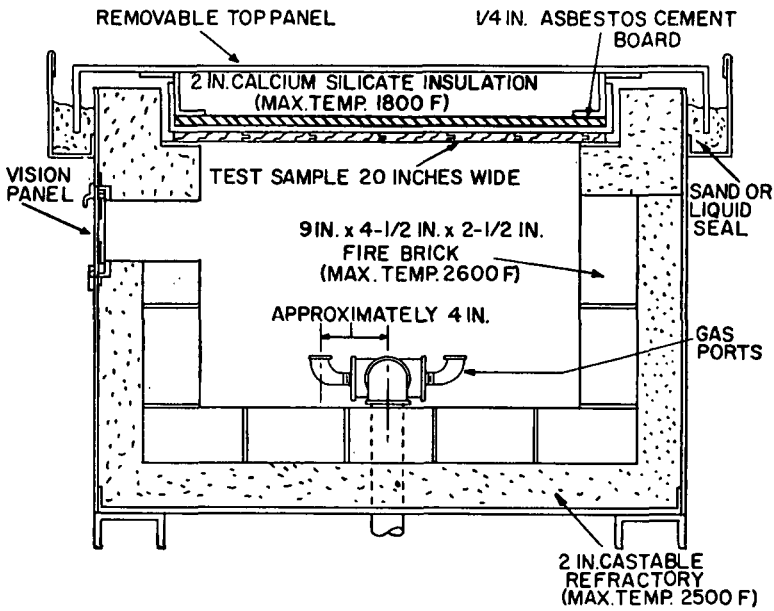

Figure 2. Cross section of furnace at BB of Figure 1.

(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 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. 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.

4. Calibration of Test Equipment

(a) A 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 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 ± 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.

(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:

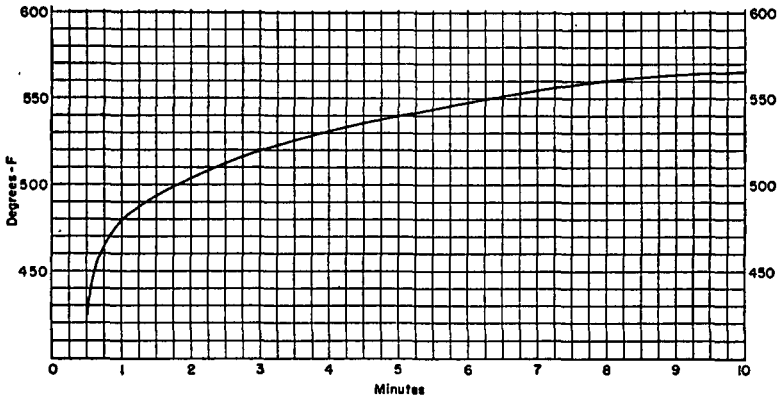

Figure 3. Preheat temperature.

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.

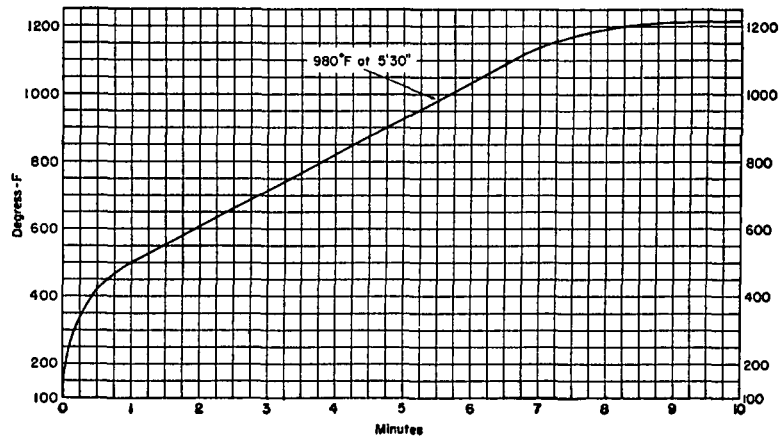

Figure 4. Fuel contributed, measured by temperature — red oak.

(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.

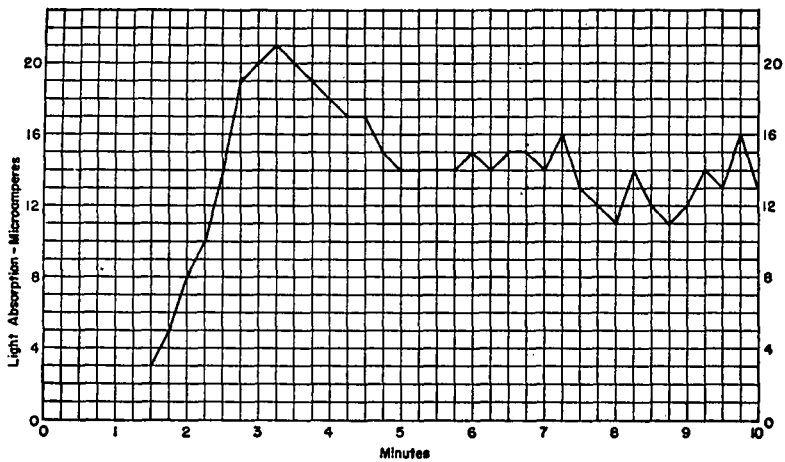

Figure 5. Smoke density — red oak.

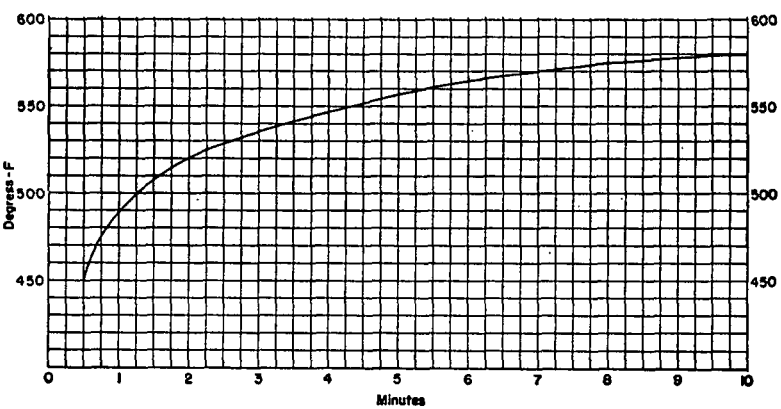

Figure 6. Fuel contributed, measured by temperature — asbestos-cement board.

(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 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.

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 4.

(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 4 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:

(a) For materials on which the flame spreads 19½ feet;

(1) In 5½ minutes or less, the classification shall be 100 times 5½ minutes divided by the time in minutes (t) in which the flame spreads 19½ feet. (FSC=550/t).

(2) In more than 5½ minutes but not more than 10 minutes the classification shall be 100 times 5½ minutes divided by the time in minutes (t) that the flame spreads 19½ feet plus ½ the difference of 100 minus this result. (FSC=50+275/t).

(b) For materials on which the flame spreads less than 19½ feet and then ceases to continue or recedes in a 10-minute test period;

(1) When the extreme flame spread distance (d) is more than 13½ feet and less than 19½ feet, the classification shall be 100 times 5.5 minutes times the distance (d) divided by 19½ feet times 10 minutes; plus ½ the difference of 100 minus this result. (FSC=50+1.41d).

(2) When the extreme flame spread distance (d) is 13½ feet or less, the classification shall be 100 times the distance (d) divided by 19½ feet. (FSC=5.128d).

(c) The test results for fuel contributed and smoke shall be plotted, using the same co-ordinates, and comparison of the areas under the respective curves will establish a numerical classification by which the performance of the material may be compared with that of asbestos-cement board and select-grade red-oak flooring which have been arbitrarily established as zero and 100, respectively. Materials of zero flame-spread classification having highly insulating properties may show an apparent contribution of fuel due to the lessened heat loss through the sample.

NOTE: Allowance should be made for accumulation of soot and dust on the photoelectric cell during the test.

7. Analysis of Products of Combustion

Although not required as a part of this method, products of combustion may be drawn from the test duct during the progress of the test for chemical analysis to determine the degree of toxicity or other characteristics that might be of concern considering the intended use of the material undergoing test.

8. Report

(a) Description of the material being tested,

(b) Test results as calculated in 6. Classification,

(c) Details of the method used in placing the specimen in the test chamber or in attaching it to the removable top, and

(d) Observations of the burning characteristics of the specimen during test exposure, such as delamination, sagging, shrinkage, fall-out, etc.

APPENDIX

GUIDE TO MOUNTING METHODS

A.1. Introduction

(a) This guide has been compiled as an aid in selecting a method for mounting various building materials in the fire test chamber. These mountings are suggested for test method uniformity and convenience; they are not meant to imply restriction in the specific details of field installation.

(b) For some building materials none of the methods described may be applicable. In such cases, other means of support may have to be devised.

(c) These suggested mounting methods are grouped according to building materials to be tested which are broadly described either by usage or by form of the material.

A.2 Acoustical and Other Similar Panel Products Less Than 20 In.

(a) For acoustical materials and other similar panel products whose maximum dimension is less than 20 in., metal splines or wood furring strips and metal fasteners shall be used.

(b) Steel tee splines for mounting kerfed-acoustical tile shall be nominal ½-in. web by ¾-in. flange, formed No. 24 MS gage sheet metal.

(c) Wood furring frames for mounting acoustical materials and other similar panel products less than 20 in. shall be nominal 1 by 2 in. wood furring joined with corrugated-metal fasteners. Use two frames as shown in Figure A1.

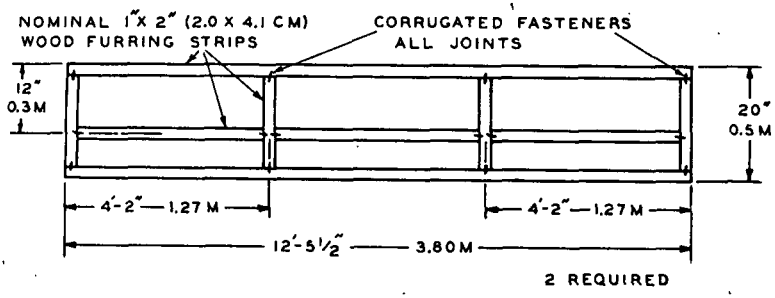

Figure A1 — Wood Frame for Acoustical Materials and Other Similar Panel Products Less Than 20 In.

A.3. Adhesives, Cementitious Mixtures, and Sprayed Fiber

(a) Adhesives, cementitious mixtures, and sprayed fibers are defined as factory prepared mixtures which may be dry and which may require only the addition of water in preparation for application.

(b) Such mixtures shall be mixed as specified in the manufacturer's instructions and shall be applied to ¼-in. thick asbestos-cement board in the thickness or at the coverage rate or density recommended by the manufacturer.

A.4. Batt or Blanket-Type Insulating Materials

(a) Batt or blanket materials which do not have sufficent rigidity or strength to support themselves shall be supported by metal rods not more than ¼-in. in diameter inserted through the material in such a way as to span the tunnel width and not be actually exposed to the flame.

A.5. Coating Materials

(a) Coating materials intended for application to wood surfaces shall be applied to a substrate made of surfaced tongue-and-groove Douglas fir lumber. The lumber may have a limited number of small imperfections that can