

NFPA 258

Recommended Practice for Determining Smoke Generation of Solid Materials

2001 Edition



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An International Codes and Standards Organization

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NFPA 258

Recommended Practice for

Determining Smoke Generation of Solid Materials

2001 Edition

This edition of NFPA 258, *Recommended Practice for Determining Smoke Generation of Solid Materials*, was prepared by the Technical Committee on Fire Tests and acted on by the National Fire Protection Association, Inc., at its November Meeting held November 12–15, 2000, in Orlando, FL. It was issued by the Standards Council on January 13, 2001, with an effective date of February 9, 2001, and supersedes all previous editions.

This edition of NFPA 258 was approved as an American National Standard on February 9, 2001.

Origin and Development of NFPA 258

The smoke problem that develops during unwanted fires has been recognized for years. There is continuing recognition of the major role of combustion products in the majority of fire fatalities. Fire fighters are faced with the smoke problem daily in their work.

The many ways in which fire gases influence a hazard to life have, to date, precluded their exact technical assessment. A test method, such as the one described here, has obvious merit as a measurement tool for assisting in research, development, and production quality control of materials and products. Use of this test method for rough analysis of the smoke production during an actual fire is informative in demonstrating the magnitude of the smoke problem.

The smoke density chamber provides a means for characterizing smoke production with an accuracy far in excess of any application requirements. It also provides a means for reporting the rate of smoke production and the time at which specific smoke levels are reached under the test conditions applied.

The concept of specific optical density, while outdated in terms of photometric practice, was first introduced for measuring smoke as part of the smoke density chamber test method. It is based on Bouguer's law and permits reporting smoke developed in terms that recognize the area of the specimen involved, the volume of the box, and the optical path length of the photometer. The test method was developed at the National Bureau of Standards and first described publicly in 1967. Since then, there have been numerous publications reporting on its application and on studies of the correlation of results of interlaboratory tests through its use.

NFPA 258 was tentatively adopted by the NFPA as a standard in 1974. A revised edition was adopted as a standard in 1976 and reconfirmed at the NFPA 1981 and 1986 Fall Meetings. The 1989 edition reflected a minor revision to the scope statements of the standard.

The 1994 edition was a reconfirmation of the 1989 edition with minor editorial changes and updating of the references within the document.

The 1997 edition was also a reconfirmation of the earlier edition. The committee recognized that this standard is used by many in industries and governmental agencies for determination of smoke generation from specific solid materials. The original intent during the development of this standard was that the standard was to be used for a research and development tool. The committee developed a proposed standard NFPA 270, *Determination of Specific Official Density of Smoke*, which can be used for regulatory purposes. This proposed standard will replace the current edition of NFPA 258.

As noted previously, the 2001 edition of NFPA 258 has been revised as a recommended practice because NFPA 270 is now available as a standard. NFPA 258 will be maintained for a time since it is recognized that there are some government agencies, organizations, and manufacturers that still use it for product classification and development.

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of Solid Materials****2001 Edition**

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 7 and Appendix E.

Chapter 1 General**1.1 Scope.**

1.1.1* This test method provides a procedure for assessing the smoke obscuration caused by the burning of solid materials and assemblies in thicknesses up to and including 1 in. (25.4 mm) where subjected to specific test conditions in a closed chamber. The test is used as a research and development tool only and should not be used as a basis for determining ratings for building codes or other regulatory purposes.

1.1.2 Measurement is made of the attenuation of a light beam by the suspended solid or liquid particles — that is, smoke — that accumulate within a closed chamber. The smoke is due to either nonflaming, pyrolytic decomposition or flaming combustion of a relatively small sample of material. The radiant heat source is an electric furnace. NFPA 270, *Standard Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber*, has subsequently been developed using an improved-design radiant heat source within the same closed chamber.

1.1.3* Test results are expressed in terms of specific optical density, which is a dimensionless property derived from the measured light transmission and geometric measurements of the chamber and the specimen.

1.1.4 This test is intended to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled conditions. It is not intended to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions.

1.2 Significance.

1.2.1* This test method provides a means for comparing the specific optical density of the smoke that is generated by materials and assemblies in the form and thickness tested and under the specified exposure conditions.

1.2.2 Values that are determined by this test are specific to the specimen or assembly material in the form and thickness that are tested, and they should not be considered inherent, fundamental properties of a given material.

1.2.3 The values that are stated in U.S. customary units should be regarded as the standard. The metric equivalents of U.S. customary units given herein are approximate.

1.2.4 No basis is provided for predicting the density of smoke that can be generated by materials upon exposure to heat and flame under other fire conditions or in other atmospheres.

1.2.5 Values that are determined by this test are specific with respect to the effect of attenuation of light transmission within the chamber of the smoke that is generated by the material in the form, thickness, and quantity tested where subjected to the specified energy sources. These values by themselves do not provide a basis for predicting material performance in actual fires.

1.3 Summary of Method.

1.3.1 This method for measuring the smoke that is generated by materials employs an electrically heated, radiant energy source mounted within an insulated ceramic tube. This radiant energy source is positioned to produce an irradiance level of 2.2 Btu/sec · ft² (2.5 W/cm²) averaged over the central 1¹/₂-in. (38.1-mm) diameter area of a vertically mounted specimen facing the radiant heater. The nominal 3-in. × 3-in. (76.2-mm × 76.2-mm) specimen should be mounted within a holder that exposes an area measuring 2⁹/₁₆ in. × 2⁹/₁₆ in. (65.1 mm × 65.1 mm). The holder can accommodate specimens that are up to 1 in. (25.4 mm) thick. This exposure provides the nonflaming condition of the test.

1.3.2 For the flaming condition, a six-tube burner should be used to apply a row of equidistant, premixed — that is, air-propane — flamelets across the lower edge of the exposed specimen area and into the specimen holder trough. This application of flame, in addition to the specified irradiance level from the heating element, should constitute the flaming combustion exposure.

1.3.3 The test specimens should be exposed to the flaming and nonflaming conditions within a closed 18-ft³ (0.51-m³) chamber. A photometric system with a 36-in. (914-mm) vertical light path measures the continuous decrease in light transmission as smoke accumulates. Exposure should be continued for 20 minutes or until minimum light transmission is reached, whichever occurs first.

1.3.4 Calibration procedures for the test equipment, such as those described in Section B.2, should be followed.

1.3.5* The light transmittance measurements should be used to express the smoke that is generated by the test materials, in terms of the specific optical density during the time necessary to reach the maximum value.

Chapter 2 Test Apparatus

2.1* General. The apparatus should be essentially as shown in Figures 2.1(a) and (b). It should include the components given in Sections 2.2 through 2.11.

FIGURE 2.1(a) Smoke density chamber.

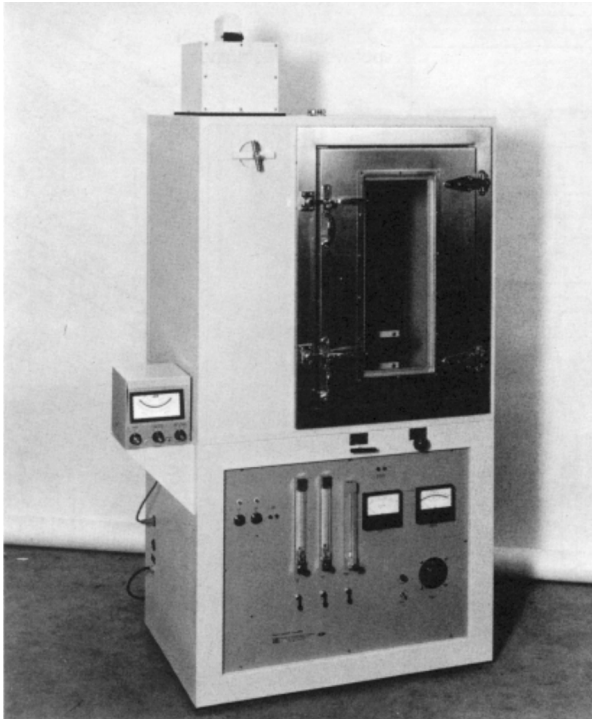
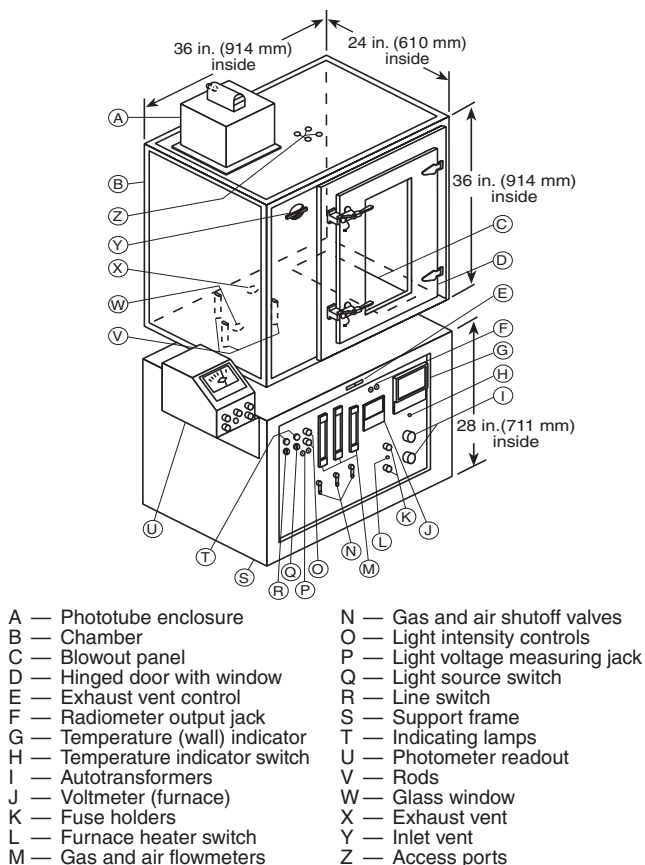


FIGURE 2.1(b) Smoke density chamber assembly.



2.2 Test Chamber.

2.2.1 As shown in Figure 2.1(b), the test chamber should be fabricated from laminated panels to provide inside dimensions of 36 in. × 24 in. × 36 in. $\pm 1/8$ in. (914 mm × 610 mm × 914 mm ± 3 mm) for width, depth, and height, respectively.

2.2.2* The interior surfaces should consist of porcelain-enamelled metal or equivalent coated metal that is resistant to chemical attack and corrosion and suitable for periodic cleaning.

2.2.3 Sealed openings should be provided to accommodate a vertical photometer, power and signal connectors, air and gas supply tubes, exhaust blower, inlet and exhaust vents, pressure and gas sampling taps, a pressure relief valve, a rod for remote positioning of the specimen holder, an aluminum foil [0.0010 in. (approximately 0.025 mm) or less in thickness] safety-blowout panel that is at least 125 in.² (80,650 mm²) in area, and a hinged, front-mounted door with an observation port or window.

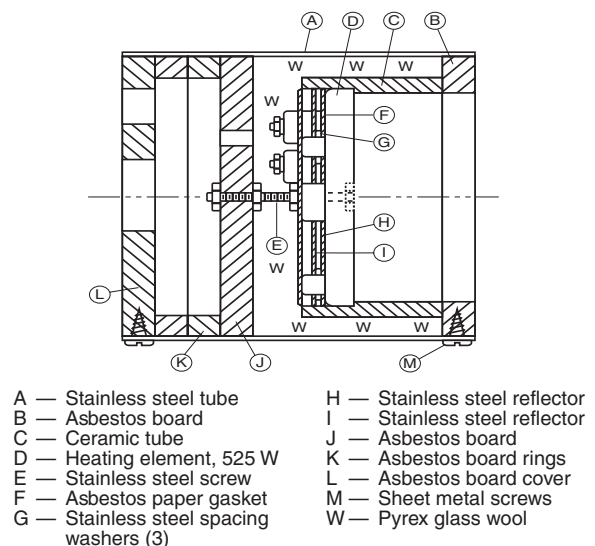
2.2.4 All openings should be located on the floor of the chamber.
Exception: The gas sampling taps, the positioning rod, and an inlet vent.

2.2.5 Where all openings are closed, the chamber should be capable of developing and maintaining positive pressure during test periods in accordance with Section 2.10.

2.3 Radiant Heat Furnace.

2.3.1 An electric furnace, as shown in Figure 2.3, with a 3-in. (76.2-mm) diameter opening should be used to provide a constant irradiance on the specimen surface.

FIGURE 2.3 Electric furnace section.



2.3.2 The furnace should be located along the centerline, equidistant between the front and back of the chamber, with the opening facing toward and approximately 12 in. (305 mm) from the right wall.

2.3.3 The centerline of the furnace should be approximately $7\frac{3}{4}$ in. (197 mm) above the chamber floor.

2.3.4 The furnace control system should maintain the required irradiance level, under steady-state conditions with the chamber door closed, to within ± 0.04 Btu/sec · ft² (± 0.05 W/cm²) for 20 minutes.