

NFPA®

262

**Standard Method of Test for
Flame Travel and Smoke of
Wires and Cables for Use in
Air-Handling Spaces**

2019



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NFPA® 262

Standard Method of

Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

2019 Edition

This edition of NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces*, was prepared by the Technical Committee on Fire Tests. It was issued by the Standards Council on November 5, 2018, with an effective date of November 25, 2018, and supersedes all previous editions.

This edition of NFPA 262 was approved as an American National Standard on November 25, 2018.

Origin and Development of NFPA 262

The test procedure covered by this standard was originally developed by Underwriters Laboratories Inc. and published as UL 910, *Standard for Safety Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air*. It is an adaptation of the Steiner tunnel test (NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*; ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*; UL 723, *Tests for Surface Burning Characteristics of Building Materials*), which was designed to provide information for evaluating the potential for fire spread along cables and wires housed in a plenum or other environmental space. The original 1985 edition was reconfirmed in 1990. The 1994 edition contained minor editorial changes.

The 1999 edition was revised to reflect the practices that were used with this type of test apparatus and procedure. Revisions were made to the requirements associated with the fire test chamber transition, exhaust blower instrumentation, and data acquisition. The title and scope were editorially revised to reflect the true application of the test procedures for the testing of flame travel and optical density of smoke for wires and cables used in an air-handling space.

The 2002 edition was revised to conform with NFPA's formatting requirements, in compliance with the provisions of the *Manual of Style for NFPA Technical Committee Documents*. The chapters were reorganized to reflect the NFPA standard document format, metric conversions were reviewed and revised, and some editorial clarifications were made.

There were no substantive changes in the 2007 edition.

The 2011 edition was revised to create consistency with other test standards. Provisions on the Standard Insulated Conductor Test were removed and replaced with an annex on Reference Cable Tests (Annex D).

There were no substantive changes in the 2015 edition, and no substantive changes have been made in the 2019 edition.

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Contents

Chapter 1 Administration	262– 5	7.2 Determination of Specimen Diameter.	262– 14
1.1 Scope.	262– 5	7.3 Number of Cable Lengths.	262– 15
1.2 Purpose.	262– 5	7.4 Cable Mounting.	262– 15
1.3 Application.	262– 5	Chapter 8 Test Procedure	262– 15
1.4 Units.	262– 5	8.1 Procedure.	262– 15
1.5 Summary of Test Method.	262– 5	8.2 Exhaust Duct Velocity Measurement Calculations.	262– 16
Chapter 2 Referenced Publications	262– 6	Chapter 9 Post-Test Cleanup and Inspection	262– 16
2.1 General.	262– 6	9.1 Debris.	262– 16
2.2 NFPA Publications. (Reserved)	262– 6	9.2 Windows.	262– 16
2.3 Other Publications.	262– 6	9.3 Supports.	262– 16
2.4 References for Extracts in Mandatory Sections.	262– 6	9.4 Damaged Boards.	262– 16
Chapter 3 Definitions	262– 6	9.5 Preparation for Next Test.	262– 16
3.1 General.	262– 6	9.6 Cleanliness of Smoke Measurement System.	262– 16
3.2 NFPA Official Definitions.	262– 6	Chapter 10 Calculations	262– 16
3.3 General Definitions.	262– 6	10.1 Optical Density of Smoke.	262– 16
Chapter 4 Test Apparatus	262– 6	10.2 Exhaust Duct Velocity Measurement Calculations.	262– 17
4.1 Fire Test Room.	262– 6	Chapter 11 Report	262– 17
4.2 Fire Test Apparatus.	262– 6	11.1 Data.	262– 17
4.3 Fire Test Chamber Airflow System.	262– 11	Chapter 12 Precision and Bias	262– 17
4.4 Ladder Cable Tray.	262– 11	12.1 Applicability.	262– 17
4.5 Fire Test Chamber Temperature Measurement Instruments.	262– 12	Annex A Explanatory Material	262– 17
4.6 Data Acquisition Equipment.	262– 12	Annex B Smoke and Heat Release Measurements ..	262– 18
Chapter 5 Test Specimens	262– 12	Annex C Smoke Measurement System and Chamber-Brick Configuration: Detail Drawings	262– 21
5.1 Specimens.	262– 12	Annex D Standard Reference Cable Test	262– 32
Chapter 6 Maintenance and Calibration of Test Equipment	262– 12	Annex E Informational References	262– 33
6.1 Maintenance.	262– 12	Index	262– 34
6.2 Frequency of Calibration.	262– 12		
6.3 Airflow.	262– 12		
6.4 Smoke Measurement System Calibration Test. ..	262– 13		
6.5 Fuel.	262– 14		
6.6 Uncoated Fiber-Reinforced Cement Board Test.	262– 14		
Chapter 7 Test Specimen Preparation	262– 14		
7.1 Specimen Conditioning.	262– 14		

NFPA 262

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

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex E. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex E.

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard shall prescribe the methodology to measure flame travel distance and optical density of smoke for insulated, jacketed, or both, electrical wires and cables and optical fiber cables that are to be installed in plenums and other spaces used to transport environmental air without being enclosed in raceways.

1.1.2 This test method shall not provide information on the fire performance of insulating materials contained in electrical or optical cables in fire conditions other than the ones specifically used in Section 6.6 of this standard, nor shall it measure the contribution of the cables to a developing fire condition.

Δ 1.1.3* Although this test uses equipment similar to that used in ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or in UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*, sufficient changes have been made to the chamber so that a test conducted in the apparatus used for ASTM E84 or UL 723 shall not be considered identical or productive of comparable results.

1.1.4 Because this standard does not purport to address all of the safety problems associated with its use, it shall be the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

1.2 Purpose.

1.2.1 The purpose of this test shall be to measure and record the fire and smoke characteristics of insulated, jacketed, or both, electrical wires and cables and optical fiber cables that are to be installed in ducts, plenums, and other spaces used to transport environmental air without being enclosed in raceways.

1.2.1.1 The test shall measure the flame travel distance and optical density of smoke when a specimen is exposed to the test fire.

1.2.1.2 Optional measurements shall be permitted to include heat and smoke release rates.

1.2.2 Optical density of smoke and flame travel distance shall be recorded in this test; however, there is not necessarily a relationship between these measurements.

1.3* Application.

1.3.1 This test shall be designed to provide comparative test data on insulated, jacketed, or both, electrical wires and cables and optical fiber cables that are to be installed in ducts, plenums, and other spaces used to transport environmental air without being enclosed in raceways.

1.3.2 Test data shall be used to evaluate the potential for the spread of fire along electrical cables or wires or along optical fiber cables and to evaluate the potential for the development of high smoke levels in these spaces if the wires and cables are exposed to fire.

1.3.3 This test method shall not be used to investigate circuit integrity characteristics or other such functionality performance during or after the fire test.

1.3.4 This test method shall not be used to investigate the toxicity of the products of combustion or decomposition.

1.4 Units.

1.4.1 SI Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI).

1.4.2 Primary and Equivalent Values. If a value for a measurement as given in this standard is followed by an equivalent value in other units, both values shall be regarded as complying with the requirements.

1.5 Summary of Test Method.

1.5.1 This test method shall use the apparatus described in Chapter 4 to determine flame travel distance and optical density of smoke from insulated, jacketed, or both, electrical

wires and cables and optical fiber cables that are to be installed in ducts, plenums, and other spaces used to transport environmental air without being enclosed in raceways.

1.5.2 The test method shall expose a set of wire or cable specimens, 7.32 m (24 ft) long and installed on a horizontal ladder-type cable tray, to a controlled air and flaming fire exposure in a fire test chamber.

1.5.3 A special specimen holder shall be used to expose the test specimens.

1.5.4 The specimen holder shall be filled with one layer of test specimens.

1.5.5 The specimens shall be exposed to a 86 kW (294,000 Btu/hr) fire, 1.37 m (4.5 ft) long, for a period of 20 minutes, with an initial draft of 73 m/min (240 ft/min) through the chamber.

1.5.6 During the test, flame travel distance and optical density of smoke shall be measured, and peak and average optical density of smoke shall be calculated.

1.5.7 Optional measurements shall be permitted to include heat and smoke release rates from the burning sample.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. (Reserved)

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM C1186, *Standard Specification for Flat Fiber-Cement Sheets*, 2008 (2016).

ASTM C1288, *Standard Specification for Fiber-Cement Interior Substrate Sheets*, 2017.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2018.

2.3.2 UL Publications. Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*, 2008, revised 2017.

2.3.3 Other Publications. Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. Merriam-Webster's Collegiate

Dictionary, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1 Shall. Indicates a mandatory requirement.

3.2.2 Should. Indicates a recommendation or that which is advised but not required.

3.2.3 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix or annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Flame Travel Distance. Distance that the flame travels beyond the extent of the gas burner flame.

3.3.2 Optical Density of Smoke (OD). Smoke obscuration described in terms of logarithmic ratio of initial light intensity to instantaneous light intensity.

Chapter 4 Test Apparatus

4.1 Fire Test Room.

4.1.1 The fire test room in which the test chamber and smoke measurement system are located shall have provision for a free inflow of air to maintain the room at controlled pressure of 0–12 Pa (0–0.05 in. of water column) greater than ambient barometric pressure and at a temperature of 18.3°C–26.7°C (65°F–80°F) and relative humidity of 45–60 percent throughout each test run.

4.1.2 The fire test room and smoke measurement area shall have controllable lighting.

4.2 Fire Test Apparatus. The fire test apparatus shall consist of the following:

- (1) Air-inlet chamber
- (2) Air-inlet shutter
- (3) Fire test chamber
- (4) Gas burner
- (5) Removable top cover
- (6) Exhaust transition
- (7) Exhaust duct
- (8) Exhaust duct velocity measurement system
- (9) Smoke measurement system
- (10) Exhaust duct damper

4.2.1 Air-Inlet Chamber.

4.2.1.1 The fire test chamber air-inlet transition shall consist of an L-shaped galvanized steel unit secured to the air-inlet end of the fire test chamber.

4.2.1.2 The unit shall contain a 298.5 mm ± 6 mm × 464 mm ± 6 mm (11.8 in. ± 0.25 in. × 18.25 in. ± 0.25 in.) rectangular

opening to allow air to enter the fire test chamber through the chamber air-inlet shutter.

4.2.1.3 A schematic of the air-inlet chamber shall be as shown in Figure 4.2.1.3.

4.2.2 Air-Inlet Shutter.

4.2.2.1 A vertically sliding shutter, extending the entire width of the test chamber, shall be provided at the air-inlet end of the fire test chamber.

4.2.2.2 The shutter shall be positioned to provide an air-inlet opening $76 \text{ mm} \pm 2 \text{ mm}$ ($3 \text{ in.} \pm 0.08 \text{ in.}$) high, measured from the floor level of the test chamber and across the full width of the chamber, as shown in Figure 4.2.1.3. [See also Figure 4.2.3.1(a).]

4.2.3 Fire Test Chamber.

4.2.3.1 The fire test chamber shall consist of a horizontal duct of the shapes and sizes shown in Figure 4.2.3.1(a) and Figure 4.2.3.1(b).

4.2.3.2* The sides and base of the duct shall be lined with insulating masonry, consisting of refractory firebrick, as illustrated in Figure 4.2.3.1(b).

4.2.3.3* One side of the fire test chamber shall be provided with a row of two panes of 6 mm ($\frac{1}{4} \text{ in.}$) thick high-temperature glass, pressure-tight observation windows, with the inside pane mounted flush with the inner wall. [See Figure 4.2.3.1(b).]

4.2.3.4 The exposed window area shall be $70 \text{ mm} \pm 6 \text{ mm} \times 280 \text{ mm} \pm 38 \text{ mm}$ ($2.75 \text{ in.} \pm 0.25 \text{ in.} \times 11 \text{ in.} \pm 1.5 \text{ in.}$).

4.2.3.5 The windows shall be located so that the gas burner and the length of the specimens being tested, from the point at which the test fire ends, can be observed from outside the fire test chamber.

4.2.3.6* The top cover support ledges shall be fabricated of a structural material capable of withstanding the abuse of continuous testing.

4.2.3.7 The ledges shall be level with respect to length and width of the chamber and with respect to each other.

4.2.3.8 To provide air turbulence for combustion, turbulence-inducing baffles shall be provided by positioning six 229 mm long $\times$ 114.5 mm wide $\times$ 64 mm thick (9 in. long $\times$ 4.5 in. wide $\times$ 2.5 in. thick) refractory firebricks (long dimension vertical and 114.5 mm dimension parallel to the wall) along the side walls of the chamber at distances of $1.98 \text{ m} \pm 152 \text{ mm}$ ($6.5 \text{ ft} \pm 0.5 \text{ ft}$), $3.96 \text{ m} \pm 152 \text{ mm}$ ($13 \text{ ft} \pm 0.5 \text{ ft}$), and $5.79 \text{ m} \pm 152 \text{ mm}$ ($19 \text{ ft} \pm 0.5 \text{ ft}$) on the window side (do not obstruct the windows) and $1.37 \text{ m} \pm 152 \text{ mm}$ ($4.5 \text{ ft} \pm 0.5 \text{ ft}$), $2.90 \text{ m} \pm 152 \text{ mm}$ ($9.5 \text{ ft} \pm 0.5 \text{ ft}$), and $4.88 \text{ m} \pm 152 \text{ mm}$ ($16 \text{ ft} \pm 0.5 \text{ ft}$) on the opposite side, as measured from the centerline of the gas burner to the centerline of the firebricks.

4.2.4 Gas Burners.

4.2.4.1 Positioning.

4.2.4.1.1 One end of the test chamber, designated as the air-inlet end in Figure 4.2.3.1(a), shall be provided with a dual-port gas burner, delivering flames upward, to engulf the test specimens.

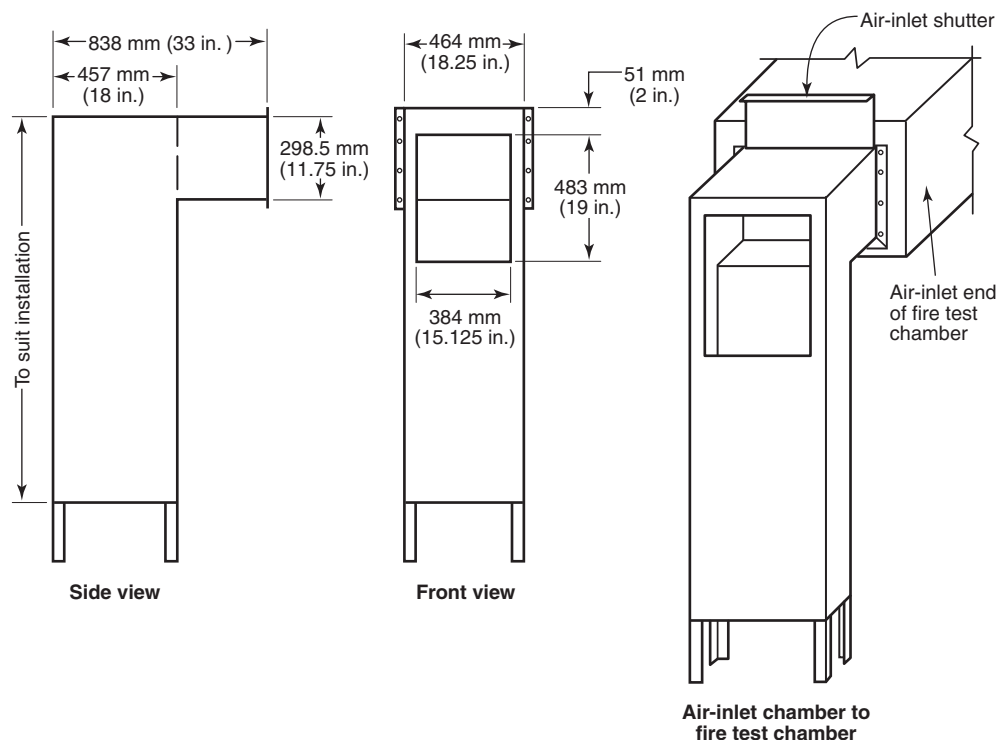


FIGURE 4.2.1.3 Schematic of the Air-Inlet Chamber. Tolerances are contained in applicable paragraphs. Otherwise, dimensions are nominal.

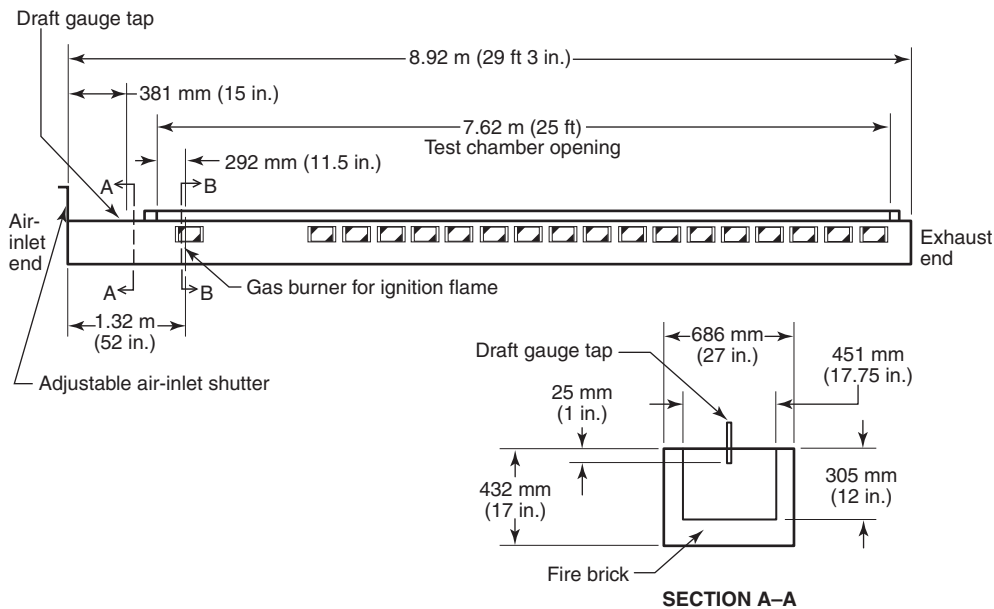


FIGURE 4.2.3.1(a) Details of Fire Test Chamber. Tolerances are contained in applicable paragraphs. Otherwise, dimensions are nominal.

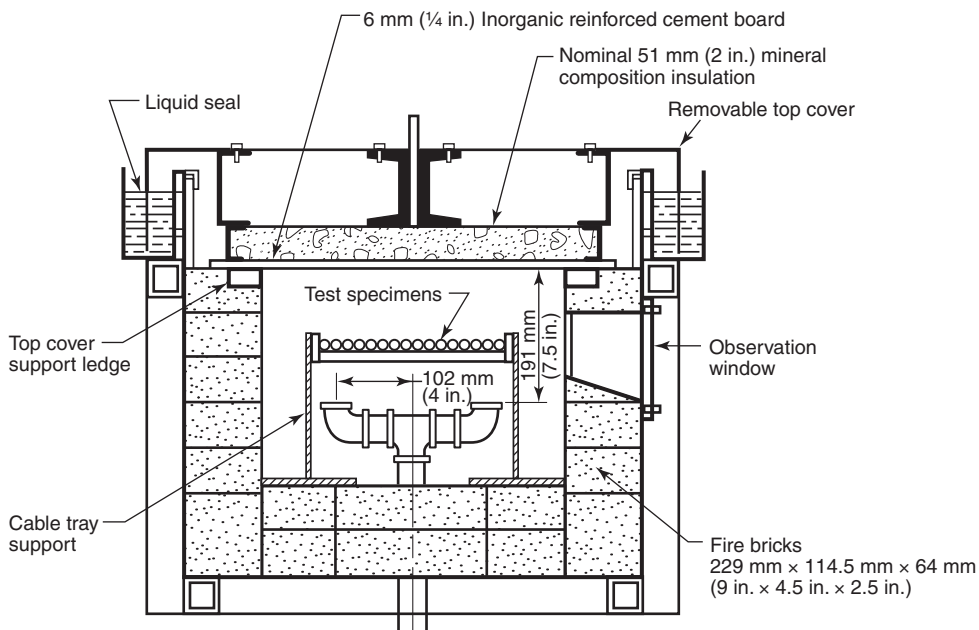


FIGURE 4.2.3.1(b) Cross-Section of the Fire Test Chamber. Tolerances are contained in applicable paragraphs. Otherwise, dimensions are nominal.

4.2.4.1.2 As shown in Figure 4.2.3.1(b), the burner shall be positioned transversely to each side of the centerline of the furnace so that the flame is evenly distributed over the width of the specimens.

4.2.4.1.3 The burner shall be spaced $292 \text{ mm} \pm 6 \text{ mm}$ (11.5 in. ± 0.25 in.) from the air-inlet end of the test chamber, and $191 \text{ mm} \pm 6 \text{ mm}$ (7.5 in. ± 0.25 in.) below the removable top cover [see Figure 4.2.3.1(a) and Figure 4.2.3.1(b)].

4.2.4.1.4 The burner shall be located $1320 \text{ mm} \pm 51 \text{ mm}$ (52 in. ± 2 in.) downstream of the air-inlet shutter, as measured from the burner centerline to the outside surface of the shutter.

4.2.4.2 Burner.

4.2.4.2.1 Gas to the burner shall be provided through a single inlet pipe, distributed to each port burner through a tee-section.

4.2.4.2.2 The outlet shall be a nominal 19 mm (¾ in.) elbow.

4.2.4.2.3 The plane of the ports shall be parallel to the chamber floor, such that the gas is directed upward toward the specimen.

4.2.4.2.4 Each port shall be positioned with its centerline 102 mm ± 6 mm (4 in. ± 0.25 in.) on each side of the centerline of the fire test chamber so that the burner flame is evenly distributed [see Figure 4.2.3.1(b)].

4.2.4.3 Ignition.

4.2.4.3.1 The gas burner shall be ignited remotely, using an electronic ignition system.

4.2.4.3.2 The controls used to maintain a constant flow of methane gas to the burners shall consist of the following:

- (1) A pressure regulator
- (2) A gas meter calibrated to read in increments of not more than 2.8 L (0.1 ft³)
- (3) A gauge to indicate gas pressure in Pa (or inches of water column)
- (4) A quick-acting gas shutoff valve
- (5) A gas metering valve
- (6) An orifice plate in combination with a manometer to assist in maintaining uniform gas flow conditions

4.2.4.3.3 Alternative control equipment, if shown to be equivalent, shall be permitted.

4.2.5 Removable Top Cover.

4.2.5.1 The removable top cover shall consist of a metal and mineral insulation composite unit whose insulation consists of nominal 51 mm ± 6 mm (2 in. ± 0.25 in.) thick mineral composition material.

4.2.5.1.1 The top unit, shown in Figure 4.2.3.1(b), shall completely cover the fire test chamber.

4.2.5.1.2* The metal and mineral composite material shall have physical characteristics as follows:

- (1) Maximum effective use temperature of not less than 650°C (1200°F)
- (2) Bulk density of 335 kg/m³ ± 20 kg/m³ (21 lb/ft³ ± 1.5 lb/ft³)
- (3) Thermal conductivity of

[4.2.5.1.2a]

$$0.072 \text{ to } 0.102 \frac{\text{W}}{\text{m} \cdot \text{K}} \text{ at } 150^\circ \text{ to } 370^\circ \text{C}$$

$$\left(0.50 \text{ to } 0.71 \frac{\text{Btu} \cdot \text{in.}}{\text{ft}^3 \cdot \text{hr} \cdot ^\circ \text{F}} \text{ at } 300^\circ \text{ to } 700^\circ \text{F} \right)$$

- (4) $K_p c$ product of

[4.2.5.1.2b]

$$1 \times 10^4 \text{ to } 4 \times 10^4 \frac{\text{W}^2 \cdot \text{sec}}{\text{m}^2 \cdot \text{k}^2}$$

$$\left(1 \text{ to } 4 \frac{\text{Btu}^2 \cdot \text{in.}}{\text{ft}^2 \cdot \text{hr} \cdot ^\circ \text{F}^2} \right)$$

4.2.5.2 The entire top panel unit shall be protected with flat sections of uncoated fiber-reinforced cement board.

4.2.5.2.1 The fiber-cement board shall comply with either ASTM C1186, *Standard Specification for Flat Fiber-Cement Sheets, Grade II*, or ASTM C1288, *Standard Specification for Fiber-Cement Interior Substrate Sheets*, and with the following additional specifications:

- (1) The board shall have a nominal thickness of 6 mm (1/4 in.)
- (2) The board shall have a density of 1442 kg/m³ ± 160 kg/m³ (90 lb/ft³ ± 10 lb/ft³).
- (3) The board shall be uncoated.
- (4) The board shall remain in place throughout the test.
- (5) The board shall be suitable for test sample adhesion.

4.2.5.2.2 The board shall be maintained in an unwarped and uncracked condition through continued replacement.

4.2.5.2.3 While in place, the top panel shall rest on a nominal 3 mm (⅛ in.) thick woven fiberglass belting, positioned on the top cover support ledges.

4.2.5.2.4* The top panel shall be completely sealed against the leakage of air into the fire test chamber during the test.

4.2.6 Exhaust Transition.

4.2.6.1 The exhaust end of the fire test chamber shall be fitted with a transition piece.

4.2.6.1.1 The exhaust transition shall consist of a stainless steel unit composed of a 902 mm ± 6 mm long × 686 mm ± 6 mm wide × 438 mm ± 6 mm high (35.5 in. ± 0.25 in. long × 27 in. ± 0.25 in. wide × 17 in. ± 0.25 in. high) rectangular section and a 457 mm ± 6 mm (18 in. ± 0.25 in.) long rectangular-to-round transition section connected to the 406 mm ± 3 mm (16 in. ± 0.125 in.) inside diameter (I.D.) exhaust duct, as shown in Figure 4.2.6.1.1.

4.2.6.1.2 The outside of the transition section shall be insulated with a nominal 51 mm (2 in.) ceramic-fiber blanket [nominal density 130 kg/m³ (8 lb/ft³)].

4.2.6.2 The unit shall be secured to the exhaust end of the fire test chamber.

4.2.7 Exhaust Duct.

4.2.7.1 The 406 mm ± 3 mm (16 in. ± 0.125 in.) I.D. exhaust duct shall be constructed from stainless steel and shall extend 4.88 m to 5.49 m (16 ft to 18 ft) horizontally from the vent end of the transition to the centerline of the smoke measurement system, to provide for a fully mixed exhaust gas flow.

4.2.7.2 The exhaust duct shall extend a minimum of 8.53 m (28 ft) from the vent end of the exhaust transition section.

4.2.7.3* The exhaust duct shall be insulated with at least 51 mm (2 in.) of high-temperature mineral composition material from the beginning of the exhaust transition piece up to and including the smoke measurement system.

4.2.8 Exhaust Duct Velocity Measurement.

4.2.8.1 The velocity in the exhaust duct shall be determined by measuring the differential pressure in the flow path with a bidirectional probe connected to an electronic pressure gauge or with an equivalent measuring system and a thermocouple.

4.2.8.1.1 The probe, as shown in Figure 4.2.8.1.1, shall consist of a stainless steel cylinder with a cylinder length that is nominally two times the outside diameter of the cylinder, with a

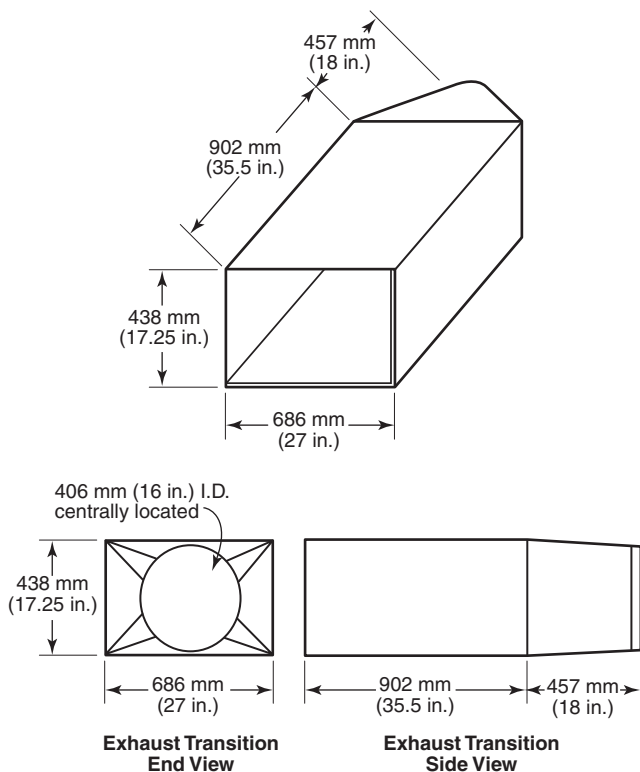


FIGURE 4.2.6.1.1 Exhaust Transition. Tolerances are contained in applicable paragraphs. Otherwise, dimensions are nominal.

minimum length of 25.4 mm (1 in.) and a maximum length of 51 mm (2 in.) with a solid diaphragm in the center.

4.2.8.1.2 The pressure taps on either side of the diaphragm shall support the probe.

4.2.8.1.3 The axis of the probe shall run along the centerline of the duct.

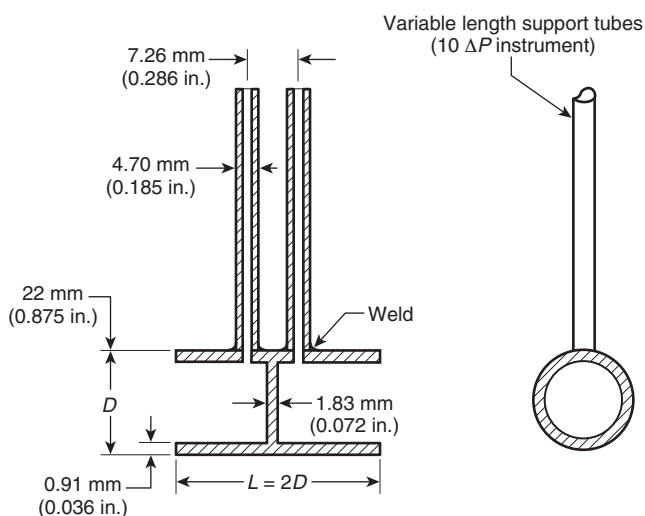


FIGURE 4.2.8.1.1 Bidirectional Probe.

4.2.8.1.4 The pressure taps specified in 4.2.8.1.2 shall be connected to a pressure transducer that is able to resolve pressure differences of 0.25 Pa (0.001 psi water column).

4.2.8.1.5 The response time to a stepwise change of the duct flow rate shall not exceed 5 seconds to reach 90 percent of the final value.

4.2.8.2 The temperature of the exhaust gas shall be measured within 152 mm (6 in.) from the probe and at the centerline of the duct, with a 28 AWG Type K thermocouple having an Inconel® sheath.

4.2.9 Smoke Measurement System.

4.2.9.1* A 12 V sealed-beam, clear lens, auto spot lamp shall be mounted on a horizontal section of the exhaust duct as shown in Figure 4.2.9.1.

4.2.9.2 The lamp shall be located at a point that is preceded by a straight run of round pipe at least 4.88 m (16 ft) and not greater than 5.49 m (18 ft) from the vent end of the exhaust transition section.

4.2.9.3 The light beam shall be directed upward along the vertical axis of the exhaust duct.

4.2.9.4 A photoelectric cell having an output directly proportional to the amount of light received shall be mounted over the light source, with an overall light-to-cell path distance of 914 mm ± 51 mm (36 in. ± 2 in.).

4.2.9.5 The light source and photoelectric cell shall be located such that they are open to the environment of the test room.

4.2.9.6 The cylindrical light beam shall pass through 76 mm ± 3 mm (3 in. ± 1/8 in.) diameter openings at the top and bottom of the 406 mm (16 in.) I.D. duct, with the resultant light beam centered on the photoelectric cell.

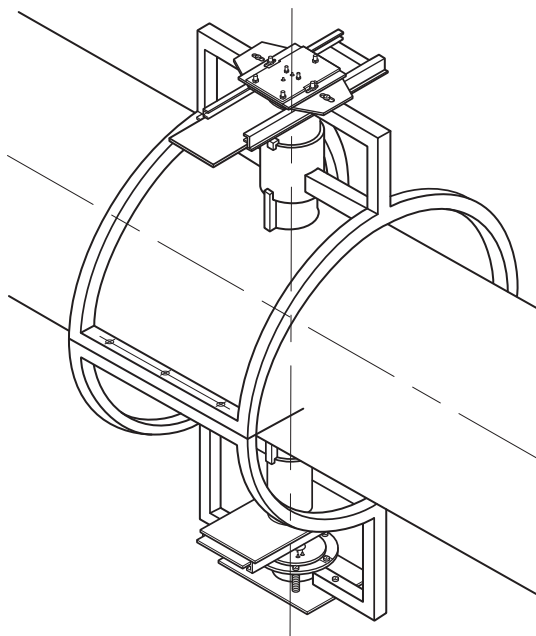


FIGURE 4.2.9.1 Smoke Measurement System.