Errata

NFPA 90A

Standard for the Installation of Air-Conditioning and Ventilating Systems

2002 Edition

Reference: 4.3.10.2.4
Errata No.: 90A-02-2

The Committee on Air Conditioning notes the following error in the 2002 edition of NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.

1. Revise 4.3.10.2.4 as follows:

4.3.10.2.4 Materials used in the construction of a ceiling plenum shall be suitable for continuous exposure to the temperature and humidity conditions of the environmental air in the plenum.

4.3.10.2.4.1 Materials used in the construction of a plenum space between the ceiling and roof (or floor) of other than the fire-resistive assemblies covered in 5.3.3 shall be permitted as specified in 4.3.10.2.4.2 and 4.3.10.2.4.3

4.3.10.2.4.2 The ceiling material shall have a flame spread index of not more than 25, and a smoke developed index not more than 50. All surfaces, including those that would be exposed by cutting through the material in any way, shall meet these requirements.

4.3.10.2.4.3 The ceiling materials shall be supported by noncombustible construction.

Issue Date: May 6, 2005

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Errata

NFPA 90A

Standard for the Installation of Air-Conditioning and Ventilating Systems

2002 Edition

Reference: 4.3.10.6.5.1
Errata No.: 90A-02-1

The Committee on Air Conditioning notes the following error in the 2002 edition of NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.

1. Revise 4.3.10.6.5.1 as follows:

4.3.10.6.5.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft.) or less when tested in accordance with NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.*

Issue Date: January 2, 2003

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NFPA 90A

Standard for the Installation of Air-Conditioning and Ventilating Systems

2002 Edition

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NFPA 90A

Standard for the

Installation of Air-Conditioning and Ventilating Systems

2002 Edition

This edition of NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, was prepared by the Technical Committee on Air Conditioning and acted on by NFPA at its May Association Technical Meeting held May 19–23, 2002, in Minneapolis, MN. It was issued by the Standards Council on July 19, 2002, with an effective date of August 8, 2002, and supersedes all previous editions.

This edition of NFPA 90A was approved as an American National Standard on July 19, 2002.

Origin and Development of NFPA 90A

This standard dates from 1899, when committee attention was first given to blower and exhaust systems. Prior to 1936, the subject of air conditioning was covered in NFPA 91, *Standard on Blower Systems*. In 1937, a separate document, NFPA 90, *Standard on Air Conditioning, Warm Air Heating, Air Cooling and Ventilating Systems*, was developed. This standard was initially adopted in 1937, with many subsequent amendments through the 1978 edition. Since 1955, the two parts of NFPA 90 have been published separately as NFPA 90A and NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*.

The 1985 edition amended the 1981 edition, which was a complete revision. The 1989 edition was a complete rewrite, which was drafted using the "clean sheet" approach. In 1989, the protection methods specified as well as the chapter organization differed from earlier editions.

The 1993 edition instituted changes in plenum cavity materials use, fire damper testing–acceptance criteria, and testing and maintenance of systems.

The 1996 edition contained revisions that were minor in nature. Some of these revisions were to be consistent with NFPA *101®*, *Life Safety Code®*, to update reference documents, and to provide editorial clarification.

The 1999 edition clarified requirements for fire properties of supplementary materials in plenums. Figure 3.3 was relocated to Appendix A, as it depicted examples of requirements in the standard. Other changes were minor or editorial in nature.

The 2002 edition incorporated format changes required by the NFPA *Manual of Style*. Significant changes consisted of new requirements for removal of accessible abandoned materials in concealed and plenum spaces and requirement for cables and wires to meet limited combustibility requirements.

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Committee Scope: This Committee shall have primary responsibility for documents on the construction, installation, operation, and maintenance of systems for air conditioning, warm air heating, and ventilating including filters, ducts, and related equipment to protect life and property from fire, smoke, and gases resulting from fire or from conditions having manifestations similar to fire.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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NFPA 90A

Standard for the

Installation of Air-Conditioning and Ventilating Systems

2002 Edition

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

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet between the paragraphs that remain.

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, Annex C lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the appropriate technical committee.

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

Chapter 1 Administration

1.1* Scope. This standard shall cover construction, installation, operation, and maintenance of systems for air conditioning and ventilating, including filters, ducts, and related equipment, to protect life and property from fire, smoke, and gases resulting from fire or from conditions having manifestations similar to fire.

1.2 Purpose. This standard shall prescribe minimum requirements for safety to life and property from fire. These requirements shall be intended to accomplish the following:

(1) Restrict the spread of smoke through air duct systems within a building or into a building from the outside
(2) Restrict the spread of fire through air duct systems from the area of fire origin, whether located within the building or outside
(3) Maintain the fire-resistive integrity of building components and elements such as floors, partitions, roofs, walls, and floor- or roof-ceiling assemblies affected by the installation of air duct systems
(4) Minimize the ignition sources and combustibility of the elements of the air duct systems
(5) Permit the air duct systems in a building to be used for the additional purpose of emergency smoke control

1.3 Application. This standard shall apply to all systems for the movement of environmental air in structures that serve the following:

(1)*Spaces of over 708 m^3 (25,000 ft^3) in volume
(2)*Buildings of Types III, IV, and V construction over three stories in height, regardless of volume
(3)*Buildings and spaces not covered by other applicable NFPA standards
(4)*Occupants or processes not covered by other applicable NFPA standards

1.4 Retroactivity. The provisions of this standard shall not be intended to be applied retroactively. Where a system is being altered, extended, or renovated, the requirements of this standard shall apply only to the work being undertaken.

1.5 Equivalency. Nothing in this standard shall be intended to prevent the use of new methods or devices, provided that sufficient technical data are submitted to the authority having jurisdiction to demonstrate that the proposed method or device is equivalent in quality, strength, durability, and safety to that prescribed by this standard.

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. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 30, *Flammable and Combustible Liquids Code,* 2000 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* 2001 edition.

NFPA 54, *National Fuel Gas Code,* 2002 edition.

NFPA 70, *National Electrical Code®,* 2002 edition.

NFPA 72®, National Fire Alarm Code®, 2002 edition.

NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment,* 1999 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows,* 1999 edition.

NFPA *101®, Life Safety Code®,* 2000 edition.

NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials,* 1999 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials,* 2000 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* 1998 edition.

NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces,* 2002 edition.

2.3 Other Publications.

2.3.1 ASHRAE Publications. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle NE, Atlanta, GA 30329-2305.

ANSI/ASHRAE 15, *Safety Code for Mechanical Refrigeration,* 1998.

ASHRAE Handbook — *HVAC Systems and Equipment,* 2000.

2.3.2 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM C 411, *Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation,* 1997.

ASTM D 93, *Standard Test Methods for Flashpoint by Pensky-Martens Closed Cup Tester,* 2000.

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ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C,* 1999.

2.3.3 GA Publication. Gypsum Association, 810 First Street NE, Suite 510, Washington, DC 20002.

Fire Resistance Design Manual, 16th edition, 2000.

2.3.4 SMACNA Publications. Sheet Metal and Air-Conditioning Contractors' National Assn., Inc., 4201 Lafayette Center Drive, Chantilly, VA 22021-1209.

Fibrous Glass Duct Construction Standard, 6th edition, 1992.

HVAC Air Duct Leakage Test Manual, 1st edition, 1985.

HVAC Duct Construction Standards — Metal and Flexible, 2nd edition, 1995.

2.3.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors,* 1996.

UL 181A, *Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors,* 1994.

UL 181B, *Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors,* 1995.

UL 555, *Standard for Safety Fire Dampers,* 1999.

UL 555C, *Standard for Safety Ceiling Dampers,* 1996.

UL 555S, *Standard for Safety Smoke Dampers,* 1999.

UL 867, *Standard for Safety Electrostatic Air Cleaners,* 2000.

UL 900, *Standard for Safety Air Filter Units,* 1994.

UL 1820, *Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics,* 1997.

UL 1887, *Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics,* 1996.

UL 1995, *Standard for Safety Heating and Cooling Equipment,* 1995.

UL 2024, *Standard for Safety Optical-Fiber Cable Raceway,* 1995.

UL 2043, *Standard for Safety Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces,* 1996.

UL *Fire Resistance Directory,* 2002.

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 included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.4 Shall. Indicates a mandatory requirement.

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

3.3 General Definitions.

3.3.1 Accessible. Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building.

3.3.2 Air Cleaner. A device used to reduce or remove airborne solids from heating, ventilating, and air-conditioning systems by electrostatic means.

3.3.3* Air Connector. A conduit for transferring air between an air duct or plenum and an air terminal unit or an air inlet or air outlet.

3.3.4 Air Distribution System. A continuous passageway for the transmission of air that, in addition to air ducts, can include air connectors, air duct fittings, dampers, plenums, fans, and accessory air-handling equipment but that does not include conditioned spaces.

3.3.5 Air Duct. A conduit or passageway for conveying air to or from heating, cooling, air conditioning, or ventilating equipment, but not including the plenum. [**97:**1.2]

3.3.6 Air Duct Covering. A material such as an adhesive, insulation, banding, a coating(s), film, or a jacket used to cover the outside surface of an air duct, fan casing, or duct plenum.

3.3.7 Air Duct Lining. A material such as an adhesive, insulation, a coating(s), or film used to line the inside surface of an air duct, fan casing, or duct plenum.

3.3.8 Air Filter. A device used to reduce or remove airborne solids from heating, ventilating, and air conditioning.

3.3.9* Air Inlet. Any opening through which air is removed from a space and returned to an air distribution system.

3.3.10* Air Outlet. Any opening through which air is delivered to a space from an air distribution system.

3.3.11 Air Terminal Unit. An appliance receiving, conditioning, and delivering air supplied through an air distribution system.

3.3.12 Air Transfer Opening. An opening designed to allow the movement of environmental air between two contiguous spaces.

3.3.13 Damper.

3.3.13.1* Ceiling Radiation Damper. A device installed to limit radiant heat transfer through an air outlet or air inlet opening in the ceiling of a floor- or roof-ceiling assembly having not less than a 1-hour fire resistance rating. Such a device is described in the construction details for some tested floor- or roof-ceiling assemblies.

3.3.13.2 Combination Fire and Smoke Damper. A device that meets both the fire damper and smoke damper requirements.

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3.3.13.3* Fire Damper. A device, installed in an air distribution system, designed to close automatically upon detection of heat, to interrupt migratory airflow, and to restrict the passage of flame. [**221:**1.5]

3.3.13.4* Smoke Damper. A device within the air distribution system to control the movement of smoke.

3.3.14 Environmental Air. Air that is supplied, returned, recirculated, or exhausted from spaces for the purpose of modifying the existing atmosphere within the building.

3.3.15 Fan. An assembly comprising blades or runners and housings or casings and being either a blower or exhauster. [**211:**1.5]

3.3.16* Fire Resistance Rating. The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with the test procedures of NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials.*

3.3.17 Fire Wall. A wall separating buildings or subdividing a building to prevent the spread of fire and having a fire resistance rating and structural stability.

3.3.18* Flame Spread Index. A comparative measure expressed as a dimensionless number derived from visual measurements or the spread of flame versus time in NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

3.3.19 Limited-Combustible Material. A building construction material that does not comply with the definition of noncombustible material, that, in the form in which it is used, has a potential heat value not exceeding 8141 kJ/kg (3500 Btu/lb) *(see NFPA 259, Standard Test Method for Potential Heat of Building Materials),* and that complies with either of the following (a) or (b). Materials subject to increase in combustibility or flame-spread rating beyond the limits herein established through the effects of age, moisture, or other atmospheric condition shall be considered combustible. (a) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 3.2 mm (⅛ in.), and with a flame-spread rating not greater than 50; (b) Materials in the form and thickness used, other than as described in (a), having neither a flame-spread rating greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame-spread rating greater than 25 nor evidence of continued progressive combustion. [**96:**1.2]

3.3.20 Noncombustible Material. A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C,* shall be considered noncombustible materials. [**220:**2.1]

3.3.21 Plenum. A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

3.3.22 Smoke. The airborne solid and liquid particulates and gases evolved when a material undergoes pyrolysis or combustion, together with the quantity of air that is entrained or otherwise mixed into the mass.

3.3.23* Smoke Barrier. A continuous membrane, either vertical or horizontal, such as a wall, floor, or ceiling assembly, that is designed and constructed to restrict the movement of smoke.

3.3.24 Smoke Control. A system that utilizes fans to produce pressure differences so as to manage smoke movement.

3.3.25* Smoke Detector. A device that senses visible or invisible particles of combustion.

3.3.26* Smoke Developed Index. A comparative measure expressed as a dimensionless number, derived from measurements of smoke obstruction versus time in NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

Chapter 4 HVAC Systems

4.1 General Requirements for Equipment.

4.1.1 Access. Equipment shall be arranged to afford access for inspection, maintenance, and repair.

4.1.2 Equipment shall be selected and installed based on its application with respect to the manufacturer's installation instructions and listing as applicable.

4.1.3 Protection.

4.1.3.1 Equipment shall be guarded for personnel protection.

4.1.3.2 Equipment shall be guarded against the intake of foreign matter into the system.

4.1.4 Electrical wiring and equipment shall be installed in accordance with NFPA 70, *National Electrical Code®*.

4.1.5 Air-handling equipment rooms shall meet the requirements of Section 5.1.

4.2 System Components.

4.2.1 Outside Air Intakes.

4.2.1.1 Outside air intakes shall be located to avoid drawing in combustible material or flammable vapor.

4.2.1.1.1 Outside air intakes shall be located to minimize the hazard from fires in other structures.

4.2.1.2 Outside air intakes shall be protected by screens of corrosion-resistant material not larger than 12.7 mm (0.5 in.) mesh.

4.2.1.3 Outside air intakes shall be located so as to minimize the introduction of fire into the building from combustible buildings and hazardous facilities.

4.2.1.3.1 Outside intakes shall be equipped with an approved fire damper when not located to meet the requirements of 4.2.1.3.

4.2.1.4 Outside air intakes shall be located so as to minimize the introduction of smoke into the building.

4.2.1.4.1 Outside intakes shall be equipped with an approved smoke damper when not located to meet the requirements of 4.2.1.4. *(See Section 6.3 for smoke damper operation to restrict the intake of smoke.)*

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4.2.2 Air Cleaners and Air Filters.

4.2.2.1 Electrostatic air cleaners shall be listed in accordance with UL 867, *Standard for Safety Electrostatic Air Cleaners.*

4.2.2.1.1 Electrostatic air cleaners shall be installed in conformance with the conditions of the manufacturer's listing.

4.2.2.2* Air filters shall be rated either as Class 1 or Class 2 in accordance with UL 900, *Standard for Safety Air Filter Units.*

4.2.2.3 Liquid adhesive coatings used on air filters shall have a minimum flash point of 163°C (325°F) as determined by ASTM D 93, *Standard Test Methods for Flashpoint by Pensky-Martens Closed Cup Tester.*

4.2.2.4 Where air filters are flushed with liquid adhesives, the system shall be arranged so that the air cleaner cannot be flushed while the fan is in operation.

4.2.2.5 Combustible adhesive coatings shall be stored in accordance with NFPA 30, *Flammable and Combustible Liquids Code.*

4.2.3 Fans.

4.2.3.1 Installation.

4.2.3.1.1 Fans shall be installed in accordance with the applicable NFPA standards and the manufacturer's instructions.

4.2.3.1.2 Fans shall be approved for the specific installation.

4.2.3.2 Access. Fans shall be located, arranged, and installed to afford access for inspection and maintenance.

4.2.3.3 Exposed Inlets. Exposed fan inlets shall be protected with metal screens to prevent the entry of paper, trash, and foreign materials.

4.2.4 Air-Cooling and Heating Equipment.

4.2.4.1 Installation.

4.2.4.1.1 Heating and cooling equipment shall be installed in accordance with the applicable NFPA standards and the manufacturer's instructions.

4.2.4.1.2 The equipment shall be approved for the specific installation. *(See 4.3.3.1.)*

4.2.4.2 Materials. Materials used in the manufacturing of fan coil units, self-contained air-conditioning units, furnaces, heat pumps, humidifiers, and all similar equipment shall meet the requirements of 4.3.3.1 and 4.3.3.2 unless otherwise provided in 4.2.4.2.1 or 4.2.4.2.2.

4.2.4.2.1 The requirements of 4.3.3.1 and 4.3.3.2 shall not apply to equipment tested and listed in accordance with UL 1995, *Standard for Safety Heating and Cooling Equipment.*

4.2.4.2.2 Unlisted solar energy air distribution system components shall be accompanied by supportive information demonstrating that the components have flame spread and smoke developed indexes that are not in excess of those of the air duct system permitted by this standard.

4.2.4.3 Mechanical Cooling.

4.2.4.3.1 Mechanical refrigeration used with air duct systems shall be installed in accordance with recognized safety practices.

4.2.4.3.2 Installations conforming to ANSI/ASHRAE 15, *Safety Code for Mechanical Refrigeration,* shall be considered to be in compliance with these requirements.

4.2.4.4 Furnaces.

4.2.4.4.1 Heating furnaces combined with cooling units in the same air duct system shall be installed in accordance with NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* where oil fired.

4.2.4.4.2 Heating furnaces combined with cooling units in the same air duct system shall be installed in accordance with NFPA 54, *National Fuel Gas Code,* where gas fired.

4.2.4.5 Duct Heaters.

4.2.4.5.1 Where electrical resistance or fuel-burning heaters are installed in air ducts, the air duct coverings and their installation shall comply with the provisions of 4.3.5.3.

4.2.4.5.2 The installation of electrical duct heaters shall comply with the provisions of NFPA 70, *National Electrical Code,* Article 424, Part F, "Duct Heaters."

4.2.4.6 Evaporative Coolers. Combustible evaporation media shall not be used, unless they meet the requirements of 4.2.2.2.

4.2.4.7 Heat Recovery Equipment. Equipment not covered by other provisions of this standard and used for heat transfer or air movement shall be constructed so that all material in the air path meets the requirements of Section 4.2.

4.3 Air Distribution.

4.3.1 Air Ducts.

4.3.1.1 Air ducts shall be constructed of iron, steel, aluminum, copper, concrete, masonry, or clay tile. Air ducts constructed of gypsum board shall be permitted when in compliance with 4.3.1.3.

4.3.1.2 Class 0 or Class 1 rigid or flexible air ducts tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors,* and installed in conformance with the conditions of listing shall be permitted to be used for ducts when air temperature in the ducts does not exceed 121°C (250°F) or when used as vertical ducts up to two stories in height.

4.3.1.3 Gypsum Board Air Ducts.

4.3.1.3.1 Gypsum board having a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials,* shall be permitted to be used for negative pressure exhaust and return ducts where the temperature of the conveyed air does not exceed 52°C (125°F) in normal service.

4.3.1.3.2 The air temperature limits of 4.3.1.3.1 shall not apply when gypsum board material is used for emergency smoke exhaust air ducts.

4.3.1.4 All air duct materials shall be suitable for continuous exposure to the temperature and humidity conditions of the environmental air in the air duct.

4.3.1.5 The materials, thickness, construction, and installation of ducts shall provide structural strength and durability in conformance with recognized good practice.

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4.3.1.5.1 Air ducts shall be considered to be in compliance with this requirement where constructed and installed in accordance with the ASHRAE Handbook — *HVAC Systems and Equipment* and with one of the following as applicable:

(1)*SMACNA *Fibrous Glass Duct Construction Standard*
(2) SMACNA *HVAC Duct Construction Standards — Metal and Flexible*
(3) SMACNA *HVAC Air Duct Leakage Test Manual*

4.3.1.6 Where no standard exists for the construction of air ducts, the ducts shall be constructed to withstand both the positive and negative pressures of the system.

4.3.2 Air Connectors.

4.3.2.1 Air connectors are limited-use, flexible air ducts that shall not be required to conform to the provisions for air ducts where they meet the requirements of 4.3.2.1.1 through 4.3.2.1.5.

4.3.2.1.1 Air connectors shall conform to the requirements for Class 0 or Class 1 connectors when tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors.*

4.3.2.1.2 Class 0 or Class 1 air connectors shall not be used for ducts containing air at temperatures in excess of 121°C (250°F).

4.3.2.1.3 Air connector runs shall not exceed 4.27 m (14 ft) in length.

4.3.2.1.4 Air connectors shall not pass through any wall, partition, or enclosure of a vertical shaft that is required to have a fire resistance rating of 1 hour or more.

4.3.2.1.5 Air connectors shall not pass through floors.

4.3.2.2 Vibration isolation connectors in duct systems shall be made of an approved flame-retardant fabric or shall consist of sleeve joints with packing of approved material, each having a maximum flame spread index of 25 and a maximum smoke developed index of 50.

4.3.2.3 Approved flame-retardant fabric having a maximum length of 254 mm (10 in.) in the direction of airflow shall be permitted to be used.

4.3.3 Supplementary Materials for Air Distribution Systems.

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.2 or 4.3.3.1.3, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. *(See 4.2.4.2.)*

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.1.3 Smoke detectors required by 6.4.4 shall not be required to meet flame spread index or smoke developed index requirements.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors,* shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

(1) UL 181A, *Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors*
(2) UL 181B, *Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors*

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, *Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation,* at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.4 Air Duct Access and Inspection.

4.3.4.1* A service opening shall be provided in air ducts adjacent to each fire damper, smoke damper, and smoke detector.

4.3.4.1.1 The opening shall be large enough to permit maintenance and resetting of the device.

4.3.4.2 Service openings shall be identified with letters having a minimum height of 1.27 cm (½ in.) to indicate the location of the fire protection device(s) within.

4.3.4.3 Horizontal air ducts and plenums shall be provided with service openings to facilitate the removal of accumulations of dust and combustible materials.

4.3.4.3.1 Service openings shall be located at approximately 6.1 m (20 ft) intervals along the air duct and at the base of each vertical riser, unless otherwise provided in 4.3.4.3.2 through 4.3.4.3.4.

4.3.4.3.2 Removable air outlet or air inlet devices of adequate size shall be permitted in lieu of service openings.

4.3.4.3.3 Service openings shall not be required in supply ducts where the supply air has previously passed through an air filter, an air cleaner, or a water spray.

4.3.4.3.4 Service openings shall not be required where all the following conditions exist:

(1) The occupancy has no process that produces combustible material such as dust, lint, or greasy vapors. Such occupancies include banks, office buildings, churches, hotels,

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and health care facilities (but not kitchens, laundries, and manufacturing portions of such facilities).
(2) The air inlets are at least 2.13 m (7 ft) above the floor or are protected by corrosion-resistant metal screens of at least 14 mesh (0.07 in.) that are installed at the inlets so that they cannot draw papers, refuse, or other combustible solids into the return air duct.
(3) The minimum design velocity in the return duct for the particular occupancy is 5.08 m/sec (1000 ft/min).

4.3.4.4 Inspection windows shall be permitted in air ducts provided they are glazed with wired glass.

4.3.4.5 Service openings shall be provided as required in 4.3.4.1.

4.3.4.6 Openings in walls or ceilings shall be provided so that service openings in air ducts are accessible for maintenance and inspection needs.

4.3.4.7 Where a service opening is necessary in an air duct located above the ceiling of a floor- or roof-ceiling assembly that has been tested and assigned a fire resistance rating in accordance with NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials,* access shall be provided in the ceiling.

4.3.4.8 The service opening shall be designed and installed so that it does not reduce the fire resistance rating of the assembly.

4.3.5 Air Duct Integrity.

4.3.5.1 Air ducts shall be located where they are not subject to damage or rupture, or they shall be protected to maintain their integrity.

4.3.5.2 Where an air duct is located outdoors, the air duct, together with its covering or lining, shall be protected from harmful elements.

4.3.5.3 Where electrical, fossil fuel, or solar energy collection heat sources are installed in air ducts, the installation shall avoid the creation of a fire hazard.

4.3.5.3.1 For air ducts rated as Class 1 in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors,* air duct coverings and linings shall be interrupted at the immediate area of operation of such heat sources in 4.3.5.3 in order to meet the clearances specified as a condition of the equipment listing, unless otherwise permitted in 4.3.5.3.2 or 4.3.5.3.3.

4.3.5.3.2 Appliances listed for zero clearance from combustibles shall be permitted to be installed in accordance with the conditions of their listings.

4.3.5.3.3 Insulation specifically suited for the maximum temperature that reasonably can be anticipated on the duct surface shall be permitted to be installed at the immediate area of operation of such appliances.

4.3.6 Air Outlets.

4.3.6.1 General. Air supplied to any space shall not contain flammable vapors, flyings, or dust in quantities and concentrations that would introduce a hazardous condition.

4.3.6.2 Construction of Air Outlets.

4.3.6.2.1 Air outlets shall be constructed of noncombustible material, except under the conditions of 4.3.6.2.2.

4.3.6.2.2 Air outlets shall be permitted to be constructed of a material that has a maximum flame spread index of 25 and a maximum smoke developed index of 50.

4.3.6.3 Location of Air Outlets.

4.3.6.3.1 Air outlets shall be located at least 76 mm (3 in.) above the floor, unless provisions have been made to prevent dirt and dust accumulations from entering the system.

4.3.6.3.2 Where located less than 2.13 m (7 ft) above the floor, outlet openings shall be protected by a grille or screen having openings through which a 12.7 mm (½ in.) sphere cannot pass.

4.3.7 Air Inlets — Return or Exhaust or Return and Exhaust.

4.3.7.1 General. Air shall not be recirculated from any space in which flammable vapors, flyings, or dust are present in quantities and concentrations that would introduce a hazardous condition into the return air system.

4.3.7.2 Construction of Air Inlets. Air inlets shall be constructed of noncombustible material or a material that has a maximum flame spread index of 25 and a maximum smoke developed index of 50.

4.3.7.3 Location of Air Inlets.

4.3.7.3.1 Air inlets shall be located at least 76 mm (3 in.) above the floor, unless provisions have been made to prevent dirt and dust accumulations from entering the system.

4.3.7.3.2 Where located less than 2.13 m (7 ft) above the floor, inlet openings shall be protected by a grille or screen having openings through which a 12.7 mm (½ in.) sphere cannot pass.

4.3.8 Fire Dampers.

4.3.8.1 Approved fire dampers shall be provided as required in Chapter 5.

4.3.8.2 Approved fire dampers shall be installed in conformance with the conditions of their listings.

4.3.9 Smoke Dampers.

4.3.9.1 Approved smoke dampers shall be provided as required in Chapter 5.

4.3.9.1.1 Approved smoke dampers shall be installed in conformance with the conditions of their listings.

4.3.9.2 Smoke dampers shall be installed in systems with a capacity greater than 7080 L/sec (15,000 ft^3/min) to isolate the air-handling equipment, including filters, from the remainder of the system in order to restrict the circulation of smoke, unless specifically exempted by 4.3.9.2.1 or 4.3.9.2.2.

4.3.9.2.1 Air-handling units located on the floor they serve and serving only that floor shall be exempt from the requirements of 4.3.9.2.

4.3.9.2.2 Air-handling units located on the roof and serving only the floor immediately below the roof shall be exempt from the requirements of 4.3.9.2.

4.3.10 Plenums.

4.3.10.1 Storage.

4.3.10.1.1 Plenums shall not be used for occupancy or storage.

4.3.10.1.2 Accessible abandoned material shall be deemed to be storage and shall not be permitted to remain.

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4.3.10.2 Ceiling Cavity Plenum. The space between the top of the finished ceiling and the underside of the floor or roof above shall be permitted to be used to supply air to the occupied area, or return or exhaust air from the occupied area, provided that the conditions in 4.3.10.2.1 through 4.3.10.2.8 are met:

4.3.10.2.1 The integrity of the fire stopping for penetrations shall be maintained.

4.3.10.2.2 Light diffusers, other than those made of metal or glass, used in air-handling light fixtures shall be listed and marked "Fixture Light Diffusers for Air-Handling Fixtures."

4.3.10.2.3 The temperature of air delivered to these plenums shall not exceed 121°C (250°F).

4.3.10.2.4 Materials used in the construction of a ceiling plenum shall be suitable for continuous exposure to the temperature and humidity conditions of the environmental air in the plenum.

4.3.10.2.5 Where the plenum is a part of a floor-ceiling or roof-ceiling assembly that has been tested or investigated and assigned a fire resistance rating of 1 hour or more, the assembly shall meet the requirements of 5.3.3.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.*

4.3.10.2.6.2 Pneumatic tubing for control systems shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1820, *Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.*

4.3.10.2.6.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, *Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.*

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, *Standard for Safety Optical-Fiber Cable Raceway.*

4.3.10.2.6.5 Loudspeakers and recessed lighting fixtures, including their assemblies and accessories, shall be permitted in the ceiling cavity plenum where listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a peak heat release rate of 100 kW or less when tested in accordance with UL 2043, *Standard for Safety Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.*

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

4.3.10.2.6.7 Smoke detectors shall not be required to meet the provisions of this section.

4.3.10.2.7 The accessible portion of abandoned materials exposed to airflow shall not be permitted to remain.

4.3.10.3 Duct Distribution Plenum. A duct enclosure used for the multiple distribution or gathering of ducts or connectors shall be constructed of materials and methods specified in 4.3.1.

4.3.10.4 Apparatus Casing Plenum.

4.3.10.4.1 A fabricated plenum and apparatus casing shall be permitted to be used for supply, return, or exhaust air service.

4.3.10.4.2 Fabricated plenum and apparatus casing shall be constructed of materials and methods specified in 4.3.1 and in accordance with the following:

(1) The casing and plenum construction standards in SMACNA *HVAC Duct Construction Standards — Metal and Flexible*
(2) ASHRAE Handbook — *HVAC Systems and Equipment*
(3) Subsection 4.3.3 for all air duct coverings, duct lining, acoustical liner/cells, and miscellaneous materials

4.3.10.5 Air-Handling Unit Room Plenum.

4.3.10.5.1 Individual rooms containing an air-handling unit(s) shall gather return air from various sources and combine the return air within the room for returning to the air-handling unit.

4.3.10.5.2 Duct covering, duct lining, acoustical liner/cells, and miscellaneous materials shall comply with 4.3.3.

4.3.10.5.3 Air-handling unit room plenums shall not be used for storage or occupancy other than during equipment servicing.

4.3.10.5.4 Accessible abandoned materials shall be deemed to be storage and shall not be permitted to remain.

4.3.10.6 Raised Floor Plenum.

4.3.10.6.1 The space between the top of the finished floor and the underside of a raised floor shall be permitted to be used to supply air to the occupied area, or return or exhaust air from or return and exhaust air from the occupied area, provided that the conditions in 4.3.10.6.2 through 4.3.10.6.8 are met.

4.3.10.6.2 The integrity of the firestopping for penetrations shall be maintained.

4.3.10.6.3 The temperature of air delivered to these plenums shall not exceed 121°C (250°F).

4.3.10.6.4 Materials used in the construction of a raised floor plenum shall be suitable for continuous exposure to the temperature and humidity conditions of the environmental air in the plenum.

4.3.10.6.5 Materials exposed to the airflow shall be noncombustible or limited combustible and shall have a maximum smoke developed index of 50.

4.3.10.6.5.1 Electrical wires and cables and optical fiber cables shall be noncombustible or limited combustible and

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have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.*

4.3.10.6.5.2 Pneumatic tubing for control systems shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1820, *Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.*

4.3.10.6.5.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, *Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.*

4.3.10.6.5.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, *Standard for Safety Optical-Fiber Cable Raceway.*

4.3.10.6.5.5 Raised floors, intermachine cables, electrical wires, listed plenum communication and optical-fiber raceways, and optical-fiber cables in computer/data processing rooms where these rooms are designed and installed in accordance with NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment,* shall be permitted.

4.3.10.6.5.6 Loudspeakers and recessed lighting fixtures, including their assemblies and accessories and other discrete products, shall be permitted in the raised floor plenum where listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a peak heat release rate of 100 kW or less when tested in accordance with UL 2043, *Standard for Safety Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.*

4.3.10.6.6 Smoke detectors shall not be required to meet the requirements of 4.3.10.6.1.

4.3.10.6.7 Supplementary materials for air distribution systems shall be permitted when complying with 4.3.3.

4.3.10.6.8 The accessible portion of abandoned materials exposed to airflow shall not be permitted to remain.

4.3.11 Corridor Air Systems.

4.3.11.1* Egress Corridors.

4.3.11.1.1 Egress corridors in health care, detention and correctional, and residential occupancies shall not be used as a portion of a supply, return, or exhaust air system serving adjoining areas unless otherwise permitted by 4.3.11.1.2.1 through 4.3.11.1.2.4.

4.3.11.1.2 An air transfer opening(s) shall not be permitted in walls or in doors separating egress corridors from adjoining areas.

4.3.11.1.2.1 An air transfer opening(s) shall be permitted in walls or doors from toilet rooms, bathrooms, shower rooms, sink closets, and similar auxiliary spaces opening directly onto the egress corridor.

4.3.11.1.2.2 Where door clearances do not exceed those specified for fire doors in NFPA 80, *Standard for Fire Doors and Fire Windows,* air transfer caused by pressure differentials shall be permitted.

4.3.11.1.2.3 Use of egress corridors shall be permitted as part of an engineered smoke-control system.

4.3.11.1.2.4 Air transfer opening(s) shall be permitted in walls or in doors separating egress corridors from adjoining areas in detention and correctional occupancies with corridor separations of open construction (e.g., grating doors or grating partitions).

4.3.11.2 Exits. Exit passageways, stairs, ramps, and other exits shall not be used as a part of a supply, return, or exhaust air system serving other areas of the building.

4.3.12* Smoke Control. Where a smoke-control or exhaust system is required, it shall conform to the requirements of the building code of the authority having jurisdiction.

Chapter 5 Integration of a Ventilation and Air-Conditioning System(s) with Building Construction

5.1 Air-Handling Equipment Rooms.

5.1.1 General. Air-handling equipment rooms shall be classified into the following three categories:

(1) Those used as air plenums (usually return air)
(2) Those with air ducts that open directly into a shaft
(3) Other air-handling unit rooms

5.1.2 Air-Handling Equipment Rooms Used as Plenum Space. Air-handling unit rooms used as plenums for supply or return air shall comply with 4.3.10.5.

5.1.3 Air-Handling Equipment Rooms That Have Air Ducts That Open Directly into a Shaft.

5.1.3.1 Air-handling equipment rooms, including the protection of openings, shall be separated from shafts by construction having a fire resistance rating not less than that required for the shaft by 5.3.4.

5.1.3.2 Fire-resistant separation shall not be required for air-handling equipment rooms that are enclosed by construction having a fire resistance rating not less than that required for the shaft.

5.1.4 Other Spaces Housing Air-Handling Units. Other spaces housing air-handling units shall meet the requirements of the building code of the authority having jurisdiction.

5.2 Building Construction.

5.2.1 Air Duct Clearance.

5.2.1.1 The clearance from metal air ducts used for heating to assemblies constructed of combustible materials, including plaster on wood lath, shall be not less than 12.7 mm (½ in.), or the combustible material shall be protected with minimum 6.35 mm (¼ in.) approved insulating material.

5.2.1.2 The integrity of the firestopping and smokestopping shall be maintained.

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5.2.1.3 The clearances provided in 5.2.1.1 shall not apply to systems used solely for ventilation, air cooling, or air conditioning without heating.

5.2.2 Structural Members. The installation of air ducts, including the hangers, shall not reduce the fire resistance rating of structural members.

5.2.3 Ceiling Assemblies. Where the installation of the hangers for the components of an air duct system penetrates an existing ceiling of a fire-resistive floor- or roof-ceiling assembly and necessitates removal of a portion of that ceiling, the replacement material shall be identical to that which was removed, or shall be approved as equivalent to that which was removed.

5.2.4 As an alternative to repairing the existing ceiling, a new ceiling shall be permitted to be installed below the air duct system, provided the fire resistance rating of the floor- or roof-ceiling design is not reduced.

5.3* Penetrations — Protection of Openings.

5.3.1 Fire-Rated Walls and Partitions.

5.3.1.1* Approved fire dampers shall be provided where air ducts penetrate or terminate at openings in walls or partitions required to have a fire resistance rating of 2 hours or more.

5.3.1.1.1* Fire dampers shall not be required where other openings through the wall are not required to be protected.

5.3.1.2 Approved fire dampers shall be provided in all air transfer openings in partitions that are required to have a fire resistance rating and in which other openings are required to be protected.

5.3.2 Floors Required to Have a Fire Resistance Rating.

5.3.2.1 Where air ducts extend through only one floor and serve only two adjacent stories, the air ducts shall be enclosed *(see 5.3.4.1)*, or fire dampers shall be installed at each point where the floor is penetrated.

5.3.2.2 Air ducts serving air-conditioning terminal devices on the floor above shall be permitted, provided a fire test conducted in accordance with NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials,* determines that the fire resistance rating of the floor is maintained.

5.3.3* Floor- or Roof-Ceiling Assemblies Having a Fire Resistance Rating.

5.3.3.1 Where air ducts and openings for air ducts are used in a floor- or roof-ceiling assembly that is required to have a fire resistance rating, all the materials and the construction of the assembly, including the air duct materials and the size and protection of the openings, shall conform with the design of the fire-resistive assembly, as tested in accordance with NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials.*

5.3.3.2 Where dampers are required, see 5.4.4.

5.3.4 Shafts.

5.3.4.1 Air ducts that pass through the floors of buildings that require the protection of vertical openings shall be enclosed with partitions or walls constructed of materials as permitted by the building code of the authority having jurisdiction, as indicated in 5.3.4.2 or 5.3.4.3, unless otherwise permitted by 5.3.4.3.1.

5.3.4.2 The shaft enclosure shall have a minimum fire resistance rating (based on possible fire exposure from either side of the partition or wall) of 1 hour where such air ducts are located in a building less than four stories in height.

5.3.4.3 The shaft enclosure shall have a minimum fire resistance rating (based on possible fire exposure from either side of the partition or wall) of 2 hours where such air ducts are located in a building four stories or more in height.

5.3.4.3.1 Where an air duct penetrates only one floor, or one floor and an air-handling equipment penthouse floor, and the air duct contains a fire damper located where the duct penetrates the floor, an air duct enclosure shall not be required.

5.3.4.4 A fire-resistive enclosure used as an air duct shall conform with 4.3.1 and 5.3.4.2 through 5.3.4.3.

5.3.4.4.1 Gypsum board systems shall be constructed in accordance with the Gypsum Association *Fire Resistance Design Manual.*

5.3.4.5 Shafts that constitute air ducts or that enclose air ducts used for the movement of environmental air shall not enclose the following:

(1) Exhaust ducts used for the removal of smoke- and grease-laden vapors from cooking equipment
(2) Ducts used for the removal of flammable vapors
(3) Ducts used for moving, conveying, or transporting stock, vapor, or dust
(4) Ducts used for the removal of nonflammable corrosive fumes and vapors
(5) Refuse and linen chutes
(6) Piping, except for noncombustible piping conveying water or other nonhazardous or nontoxic materials
(7) Combustible storage

5.3.4.6 Fire dampers shall be installed at each direct or ducted opening into or out of enclosures required by 5.3.4.1, unless otherwise permitted by 5.3.4.6.1 or 5.3.4.6.2.

5.3.4.6.1 A fire damper shall not be required where an air duct system serving only one story is used only for exhaust of air to the outside and is contained within its own dedicated shaft.

5.3.4.6.2 A fire damper shall not be required where the following occur:

(1) Branch ducts connect to enclosed exhaust risers meeting the requirements of 5.3.4.1 or 5.3.4.4
(2) The airflow moves upward
(3) Steel subducts at least 560 mm (22 in.) in length are carried up inside the riser from each inlet
(4) The riser is appropriately sized to accommodate the flow restriction created by the subduct

5.3.5 Smoke Barriers.

5.3.5.1 Smoke dampers shall be installed at or adjacent to the point where air ducts pass through required smoke barriers, but in no case shall a smoke damper be installed more than 0.6 m (2 ft) from the barrier, or after the first air duct inlet or outlet, whichever is closer to the smoke barrier, unless otherwise permitted by 5.3.5.1.1 through 5.3.5.1.5.

5.3.5.1.1 Smoke dampers shall not be required on air systems other than where necessary for the proper function of that system where the system is designed specifically to accomplish the following:

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(1) Function as an engineered smoke-control system, including the provision of continuous air movement with the air-handling system
(2) Provide air to other areas of the building during a fire emergency
(3) Provide pressure differentials during a fire emergency

5.3.5.1.2 Smoke dampers shall not be required to be located within a prescribed distance of a smoke barrier where isolation smoke dampers complying with 4.3.9.2 are used in air-handling equipment.

5.3.5.1.3 Smoke dampers shall not be required where the air inlet or outlet openings in ducts are limited to a single smoke compartment.

5.3.5.1.4 Smoke dampers shall not be required in ducts where the air continues to move and the air-handling system installed is arranged to prevent recirculation of exhaust or return air under fire emergency conditions.

5.3.5.1.5* Smoke dampers shall not be required in health care occupancies where exempted by NFPA *101®, Life Safety Code®*.

5.3.5.2 Where penetration of a smoke barrier is required to be provided with a fire damper, a combination fire and smoke damper equipped and arranged to be both smoke responsive and heat responsive shall be permitted.

5.4 Fire Dampers, Smoke Dampers, and Ceiling Dampers.

5.4.1 Fire Dampers.

5.4.1.1 Fire dampers used for the protection of openings in walls, partitions, or floors with fire resistance ratings of less than 3 hours shall have a 1½-hour fire protection rating in accordance with UL 555, *Standard for Safety Fire Dampers.*

5.4.2 Fire dampers used for the protection of openings in walls, partitions, or floors having a fire resistance rating of 3 hours or more shall have a 3-hour fire protection rating in accordance with UL 555, *Standard for Safety Fire Dampers.*

5.4.3* Smoke Dampers. Smoke dampers used for the protection of openings in smoke barriers or in engineered smoke-control systems shall be classified in accordance with UL 555S, *Standard for Safety Smoke Dampers.*

5.4.4 Ceiling Dampers.

5.4.4.1 Ceiling dampers or other methods of protecting openings in rated floor- or roof-ceiling assemblies shall comply with the construction details of the tested floor- or roof-ceiling assembly or with listed ceiling air diffusers or listed ceiling dampers.

5.4.4.2 Ceiling dampers shall be tested in accordance with UL 555C, *Standard for Safety Ceiling Dampers.*

5.4.5 Damper Closure.

5.4.5.1 All fire dampers and ceiling dampers shall close automatically.

5.4.5.1.1 All fire dampers and ceiling dampers shall remain closed upon the operation of a listed fusible link or other approved heat-actuated device located where readily affected by an abnormal rise of temperature in the air duct.

5.4.5.2 Fusible Links.

5.4.5.2.1 Fusible links shall have a temperature rating approximately 28°C (50°F) above the maximum temperature that normally is encountered when the system is in operation or shut down.

5.4.5.2.2 Fusible links shall have a temperature rating not less than 71°C (160°F).

5.4.5.2.2.1* Where combination fire and smoke dampers are located within air ducts that are part of an engineered smoke-control system, fusible links or other approved heat-responsive devices shall have a temperature rating approximately 28°C (50°F) above the maximum smoke-control system designed operating temperature.

5.4.5.2.2.2 The combination fire and smoke dampers shall not exceed the UL 555S, *Standard for Safety Smoke Dampers,* degradation test temperature rating of the combination fire and smoke damper.

5.4.5.2.2.3 The combination fire and smoke dampers shall not exceed a maximum temperature rating of 177°C (350°F).

5.4.5.3 A provision for remote opening of combination fire and smoke dampers, where necessary for smoke removal, shall be permitted.

5.4.5.3.1 Combination fire and smoke dampers permitted in 5.4.5.3 shall have provisions that allow them to reclose automatically upon reaching the damper's maximum degradation test temperature in accordance with UL 555S, *Standard for Safety Smoke Dampers.*

5.4.5.4* Dampers shall close against the maximum calculated airflow of that portion of the air duct system in which they are installed.

5.4.5.4.1 Fire dampers shall be tested for closure in accordance with UL 555, *Standard for Safety Fire Dampers.*

5.4.5.4.2 Smoke dampers shall be tested for closure in accordance with UL 555S, *Standard for Safety Smoke Dampers.*

5.4.5.4.3 Combination fire and smoke dampers shall not be required to have provisions that allow them to reclose automatically where provisions for automatic fan or airflow shutdown, in the event of a fire, are provided.

5.4.6 Installation.

5.4.6.1 The locations and mounting arrangement of all fire dampers, smoke dampers, ceiling dampers, and fire protection means of a similar nature required by this standard shall be shown on the drawings of the air duct systems.

5.4.6.2* Fire dampers, including their sleeves, smoke dampers, and ceiling dampers shall be installed in accordance with the conditions of their listings and the manufacturer's installation instructions.

5.4.6.3 The thickness of sleeves for fire dampers shall not be less than that associated with the conditions of rating required by Section 5.4.

5.4.6.3.1 Where UL 555, *Standard for Safety Fire Dampers,* permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in Table 5.4.6.3.1.

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Table 5.4.6.3.1 Minimum Sleeve Thickness Permitted in Accordance with UL 555

Air Duct Diameter or Maximum Width		Minimum Sleeve Thickness	
mm	in.	gauge	in.
305	12 or less	26	0.018
330–762	13–30	24	0.024
787–1372	31–54	22	0.030
1397–2134	55–84	20	0.036
2159 or more	85 or more	18	0.047

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

(1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides
(2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

5.4.6.5 Where fire dampers are installed, proper clearance for expansion shall be maintained. *(See 5.4.6.)*

5.4.7 Maintenance. At least every 4 years, the following maintenance shall be performed:

(1) Fusible links (where applicable) shall be removed.
(2) All dampers shall be operated to verify that they close fully.
(3) The latch, if provided, shall be checked.
(4) Moving parts shall be lubricated as necessary.

Chapter 6 Controls

6.1 Wiring. The installation of electrical wiring and equipment associated with the operation and control of air-conditioning and ventilating systems shall be in accordance with NFPA 70, *National Electrical Code.*

6.2 Manual Control.

6.2.1 Each air distribution system shall be provided with at least one manually operable means for stopping the operation of the supply, return, and exhaust fan(s) in an emergency.

6.2.2 The means of manual operation shall be located at an approved location.

6.3* Smoke Dampers.

6.3.1 Smoke dampers shall be controlled by an automatic alarm-initiated device.

6.3.2* Smoke dampers shall be permitted to be positioned manually from a command station.

6.3.3 Smoke dampers installed to isolate the air-handling system in accordance with 4.3.9.2 shall be arranged to close automatically when the system is not in operation.

6.3.4* Smoke dampers installed in smoke barriers shall be permitted to remain open during fan shutdown, provided their associated controlling damper actuators and smoke detectors remain operational.

6.4* Smoke Detection for Automatic Control.

6.4.1 Testing. All automatic shutdown devices shall be tested at least annually.

6.4.2* Location.

6.4.2.1 Smoke detectors listed for use in air distribution systems shall be located as follows:

(1) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 944 L/sec (2000 ft^3/min)
(2) At each story prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 7080 L/sec (15,000 ft^3/min) and serving more than one story

6.4.2.2 Return system smoke detectors shall not be required where the entire space served by the air distribution system is protected by a system of area smoke detectors.

6.4.2.3 Smoke detectors shall not be required for fan units whose sole function is to remove air from the inside of the building to the outside of the building.

6.4.3* Function.

6.4.3.1 Smoke detectors provided as required by 6.4.2 shall automatically stop their respective fan(s) on detecting the presence of smoke.

6.4.3.2 Where the return air fan is functioning as part of an engineered smoke-control system and a different mode is required, the smoke detectors shall not be required to automatically stop their respective fans.

6.4.4 Installation.

6.4.4.1 Smoke detectors shall be installed, tested, and maintained in accordance with *NFPA 72®, National Fire Alarm Code®.*

6.4.4.2 In addition to the requirements of 6.4.3, where an approved fire alarm system is installed in a building, the smoke detectors required by the provisions of Section 6.4 shall be connected to the fire alarm system in accordance with the requirements of *NFPA 72, National Fire Alarm Code.*

6.4.4.2.1 Smoke detectors used solely for closing dampers or for heating, ventilating, and air-conditioning system shutdown shall not be required to activate the building evacuation alarm.

6.4.4.3 Where smoke detectors required by Section 6.4 are installed in a building not equipped with an approved fire alarm system as specified by 6.4.4.2, the following shall occur:

(1) Smoke detector activation required by Section 6.4 shall cause a visual and audible signal in a normally occupied area.
(2) Smoke detector trouble conditions shall be indicated visually or audibly in a normally occupied area and shall be identified as air duct detector trouble.

6.4.4.4 Smoke detectors powered separately from the fire alarm system for the sole function of stopping fans shall not require standby power.

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Chapter 7 Acceptance Testing

7.1 General.

7.1.1* An acceptance test shall be performed to determine that the protective measures required in this standard function when needed in order to restrict the spread of fire and smoke.

7.1.2 Records shall be maintained on acceptance test results.

7.1.2.1 Records shall be available for inspection.

7.2 Fire Dampers, Smoke Dampers, and Ceiling Dampers. All fire dampers, smoke dampers, and ceiling dampers shall be operated prior to the occupancy of a building to determine that they function in accordance with the requirements of this standard.

7.3 Controls and Operating Systems.

7.3.1* Controls required by this standard shall be tested for compliance with the requirements of this standard.

7.3.2 Acceptance tests of fire protection devices in air-conditioning and ventilating systems shall, as far as practicable, be performed under normal operating conditions.

7.3.3 Portions of control or alarm systems are permitted to have standby power or other emergency modes of operation.

7.3.4 The tests shall be performed to determine that the system operates under the standby power or emergency operation mode conditions as well as under normal conditions.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 An air duct system has the potential to convey smoke, hot gases, and flame from area to area and to supply air to aid combustion in the fire area. For these reasons, fire protection of an air duct system is essential to safety to life and the protection of property. However, an air duct system's fire integrity also enables it to be used as part of a building's fire protection system.

Guidance for the design of smoke-control systems is provided in NFPA 92A, *Recommended Practice for Smoke-Control Systems.*

Pertinent information on maintenance is provided in Annex B.

A.1.3(1) For the purpose of this standard, a space is considered as an entire building or a portion thereof separated from all other portions of the building by fire resistance rated construction and whose environmental air does not mix with that of any other space. [For spaces not exceeding 707.9 m^3 (25,000 ft^3) in volume, see NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.*]

A.1.3(2) For construction types, see NFPA 220, *Standard on Types of Building Construction.*

A.1.3(3) Such applicable standards include, but are not limited to, NFPA 70, *National Electrical Code* (see Ventilation in index), and NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.*

A.1.3(4) Such applicable standards include, but are not limited to, NFPA 31, *Standard for the Installation of Oil-Burning Equipment;* NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials;* NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids;* NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals;* NFPA 70, *National Electrical Code* (see Ventilation in index); NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment;* NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids;* and NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.*

A.3.2.1 Approved. 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, 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 an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.3 Air Connector. Some such devices are listed in UL *Gas and Oil Equipment Directory* under the category "Connectors (ALNR)." These devices, since they do not meet all the requirements for air ducts, have limitations on their use, length, and location. (For limitations on the use of air connectors, see 4.3.2.1.)

A.3.3.9 Air Inlet. For further discussion of various types of air inlet devices, see *ASHRAE Handbook — Fundamentals,* Chapter 32, "Space Air Diffusion."

A.3.3.10 Air Outlet. For further discussion of various types of air outlet devices, see *ASHRAE Handbook — Fundamentals,* Chapter 32, "Space Air Diffusion."

A.3.3.13.1 Ceiling Radiation Damper. Some such devices are listed in UL *Fire Resistance Directory* under the category of "Ceiling Damper (CABS)."

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A.3.3.13.3 Fire Damper. Some such devices are listed in UL *Building Materials Directory* under the category of "Fire Dampers (ALBR)."

A.3.3.13.4 Smoke Damper. Smoke dampers are subjected to various pressure differentials, are exposed to elevated temperatures, and can be required to open or close against mechanically induced airflow. Some such devices are listed in UL *Building Materials Directory* under the category "Leakage Rated Dampers (OOYZ)."

A.3.3.16 Fire Resistance Rating. Some such assemblies are listed in UL *Fire Resistance Directory* under the categories of "Floors," "Roofs," and "Walls and Partitions."

A.3.3.18 Flame Spread Index. Flame spread indexes for some materials are listed in UL *Building Materials Directory.* Classifications have been developed using flame spread index values.

A.3.3.23 Smoke Barrier. See also NFPA *101, Life Safety Code,* Chapter 8, for additional guidance.

A.3.3.25 Smoke Detector. See *NFPA 72, National Fire Alarm Code.*

A.3.3.26 Smoke Developed Index. Smoke developed indexes for some materials are listed in UL *Building Materials Directory.* Classifications have been developed using smoke developed index values.

A.4.2.2.2 For care and maintenance, see Annex B.

A.4.3.1.5.1(1) See NAIMA *Fibrous Glass Duct Construction Manual* for additional information.

A.4.3.3.5 See NAIMA *Fibrous Glass Duct Liner Standard* for additional information.

A.4.3.4.1 Access doors for fire dampers should be located so that the spring catch and fusible links are accessible when the damper is closed. Where the size of the duct permits, the minimum access door size should be 457 mm × 406 mm (18 in. × 16 in.). For dampers that are too large for an ordinary person's arms to reach from outside the duct to reset the damper and replace the fusible link, the minimum size for the access door should be increased to 610 mm × 406 mm (24 in. × 16 in.) to allow the entrance of an individual.

Access doors should be located as close as practicable to fire dampers and smoke dampers. If feasible, the underside of the duct should be used rather than a side door.

Many fire dampers and smoke dampers are preloaded with powerful springs that force the damper to shut. These dampers need to be opened against these springs, which could necessitate the ability to get two arms into the duct.

A.4.3.11.1 This requirement is not intended to prohibit the use of mechanical ventilation for corridors or prohibit the use of a corridor as a source of makeup air through normal leakage around doors due to pressure differentials created by exhaust fans in kitchens and bathrooms. This requirement is not intended to prohibit incidental air movement between rooms and corridors because of pressure differentials in special institutional occupancies. In such cases, the direction of airflow is not the important issue. For the purpose of fire protection, the important criterion is that the air transfer be incidental.

A.4.3.12 For further information, see NFPA 92A, *Recommended Practice for Smoke-Control Systems,* or NFPA 92B, *Guide for Smoke Management Systems in Malls, Atria, and Large Areas.*

A.5.3 For examples of the application of the penetration protection requirements, see Figure A.5.3.

A.5.3.1.1 Duct penetrations of fire walls should be avoided.

A.5.3.1.1.1 Fire dampers are recommended in order to isolate specific hazards.

A.5.3.3 For information on designs of fire-resistive assemblies incorporating air-handling components, see UL *Fire Resistance Directory,* "Floor-Ceiling Designs" or "Roof-Ceiling Designs."

A.5.3.5.1.5 Smoke dampers exempted by NFPA *101, Life Safety Code,* for health care occupancies include dampers in duct penetrations of smoke barriers in fully ducted heating, ventilating, and air-conditioning systems.

A.5.4.3 The designer should specify the leakage class, maximum pressure, maximum velocity, installation mode (horizontal or vertical), and degradation test temperature of the damper.

A.5.4.5.2.2.1 The exception to this paragraph in earlier editions applied to fire dampers, due to the fact that UL 555S, *Standard for Safety Smoke Dampers,* which tested combination dampers, was not available. Fire dampers in accordance with UL 555, *Standard for Safety Fire Dampers,* are listed with maximum 141°C (286°F) links. It is recognized that, in some unusual cases, an engineered smoke-control system can make higher temperature links desirable for proper operation. This arrangement necessitates a case-by-case consideration and concurrence with the authority having jurisdiction.

A.5.4.5.4 On closure of certain smoke dampers in smoke-control systems, the total system flow decreases, but the duct velocity at open fire dampers can be as high as roughly 600 percent of the initial duct design velocity. The dynamic airflow and pressure rating of the damper must be adequate for the damper to close under airflow at the damper's closure pressure. The damper face velocity and closure pressure can be approximated by calculation. The calculated values must be specified because UL labels dynamic fire dampers at 5 m/sec (1000 ft/min) increments starting 10 m/sec (2000 ft/min).

A.5.4.6.2 Fire dampers are of no fire protection value unless they remain in place in the protected opening in the event that the ductwork collapses during a fire. To accomplish this, ductwork should not be continuous through a partition opening but instead should connect on each side of the partition to a damper installed in a sleeve or frame secured by perimeter-mounting angles on both sides of the opening, or be installed per the listing of the device. For specific details regarding sleeve thickness, perimeter angle dimensions, size and frequency of fasteners, clearance for expansion, duct-sleeve connections, and fire damper access doors, the manufacturer's installation instructions and SMACNA *Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems,* should be referenced.

A.6.3 The dampers should close as quickly as practicable, subject to requirements of the system fan and air duct characteristics. The designer should evaluate whether the smoke dampers normally should be open or closed and should consider the fail-safe position of the dampers during an event such as a power failure.

A.6.3.2 Within the scope of this document, smoke dampers reduce the possibility of smoke transfer within ductwork or through wall openings. Activation of smoke dampers can be by

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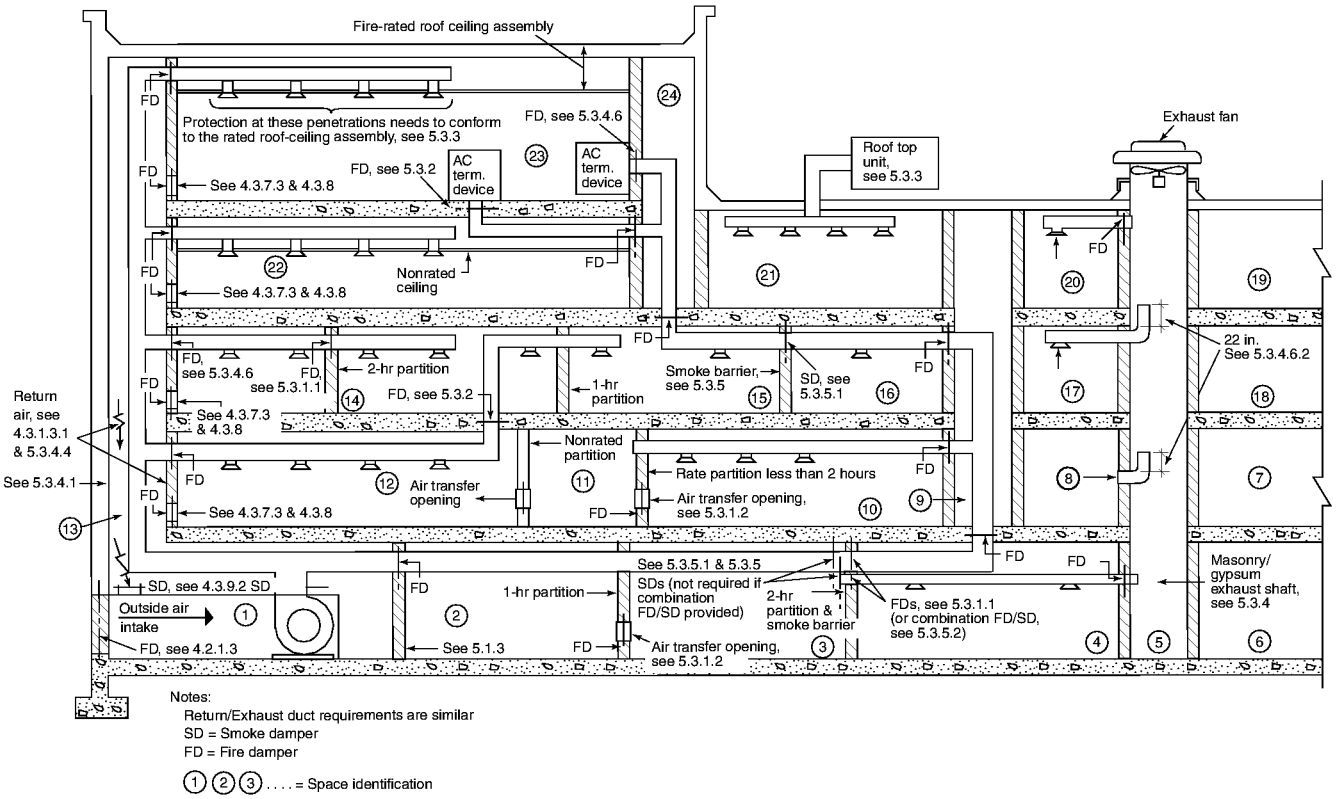

FIGURE A.5.3 Application of Penetration Requirements.

area detectors that are installed in the related smoke compartment or by detectors that are installed in the air duct systems. See *NFPA 72, National Fire Alarm Code.*

A.6.3.4 Although permitted to remain open during fan shutdown, smoke dampers and combination fire and smoke dampers installed in smoke barriers should be arranged to close automatically when the fan system(s) they are serving is not in operation.

A.6.4 The use of smoke detectors in relationship to HVAC systems and high air movement areas and the details regarding their optimum installation are covered in Section 5.7 of *NFPA 72, National Fire Alarm Code.*

Protection provided by the installation of smoke detectors and related requirements is intended to prevent the distribution of smoke through the supply air duct system and, preferably, to exhaust a significant quantity of smoke to the outside. Neither function, however, guarantees either the early detection of fire or the detection of smoke concentrations prior to dangerous smoke conditions where smoke movement is other than through the supply air system.

Where smoke-control protection for a facility is determined to be needed, see NFPA 92A, *Recommended Practice for Smoke-Control Systems.*

A.6.4.2 The summation of the capacities of individual supply-air fans should be made where such fans are connected to a common supply air duct system (i.e., all fans connected to a common air duct supply system should be considered as constituting a single system with respect to the applicability of the Chapter 6 provisions that are dependent on system capacity).

A.6.4.3 Where automatic water sprinklers are provided and zoned to coordinate with the HVAC zones, their water flow switches should initiate devices for the functions described in Chapter 6.

Sprinklers are often tested weekly. Where it is desirable to prevent the accompanying automatic shutdown of the fan system(s) referred to in 6.4.3, a means can be permitted to be used to avoid such shutdown temporarily, provided one of the following occurs:

(1) A trouble signal is sustained in the sprinkler supervisory system until the automatic shutdown provision is restored.
(2) The automatic shutdown provision is restored at the end of the time period necessary to test the sprinkler system, its alarms, and related elements.

A.7.1.1 Many of the fire protection measures required in this standard are passive and only function in emergencies. Therefore, acceptance testing needs to be performed so that all parts of air-conditioning systems are ready for a fire emergency. The access openings required in 4.3.4 should be checked for proper location, function, and size during the acceptance testing.

Maintenance recommendations, including cleaning, repairing, and periodic testing, are provided in Annex B.

A.7.3.1 Generally, tests can be included with acceptance testing of the air-conditioning controls or fire alarm systems.

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Annex B Maintenance

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 General.

B.1.1 Owners should develop a greater awareness of the life and property protection abilities of air-conditioning systems and should establish a planned maintenance schedule. Failure to maintain proper conditions of cleanliness in air duct systems and carelessness in connection with repair operations have been important contributing causes of several fires that have involved air-conditioning systems. The recommendations in this annex apply, in general, to the period of operation of the system; systems operating only part of the year should be given a thorough general checkup before starting operation and again after a shutdown.

B.1.2 The interval of testing and maintenance varies widely depending on the duration of system operation, condition of fresh air, amount of dust in return air, and other factors. The intervals specified in this standard are intended to be the maximum and should be shortened if system conditions warrant.

B.1.3 The use of an inspection form to obtain a thorough inspection is recommended. The form should fit the system or systems involved, listing the items needing attention. However, it is recommended that provision be made on the form for equipment location, inspection frequency, due date, inspection date, inspector, and record of discrepancies found.

B.2 Fire Dampers, Smoke Dampers, and Ceiling Dampers.

B.2.1 Each damper should be examined every 2 years to ensure that it is not rusted or blocked, giving attention to hinges and other moving parts. It is recommended that dampers operate with normal system airflow to ensure that they close and are not held open by the airstream. Care should be exercised to ensure that such tests are performed safely and do not cause system damage.

B.2.2 Refer to NFPA 92A, *Recommended Practice for Smoke-Control Systems,* for maintenance of smoke and combination fire/smoke dampers for each damper installed as part of a smoke control system.

B.3 Filters.

B.3.1 All air filters should be kept free of excess dust and combustible material. Unit filters should be renewed or cleaned when the resistance to airflow has increased to two times the original resistance or when the resistance has reached a value of recommended replacement by the manufacturer. A suitable draft gauge should be provided for the purpose. Where the filters are of the automatic liquid adhesive type, sludge should be removed from the liquid adhesive reservoir regularly.

B.3.2 Where replacing filters, care should be taken to use the proper type and size and to avoid gaps between filter sections, mounting frames, or hardware. Damaged filter sections or media should not be used.

B.3.3 Filters designed and manufactured to be thrown away after use should never be cleaned and reused.

B.3.4 Care should be exercised in the use of liquid adhesives. Use of an adhesive of low flash point creates a serious hazard.

B.3.5 Electrical equipment of automatic filters should be inspected semiannually, observing the operation cycle to ensure that the motor, relays, and other controls function as intended. Drive motors and gear reductions also should be inspected at least semiannually and lubricated when necessary.

B.4 Inspection and Cleaning of Ducts.

B.4.1 Inspections to determine the amount of dust and waste material in the ducts (both discharge and return) should be made quarterly. However, if, after several inspections, such frequent inspection is determined to be unnecessary, the interval between inspections can be permitted to be adjusted to suit the conditions.

B.4.2 Cleaning should be undertaken whenever an inspection indicates the need.

B.4.3 Cooling and heating coils should be cleaned, if necessary, at the time ducts are cleaned. Thorough cleaning of ducts can require scraping, brushing, or other positive means. Vacuum cleaning might not remove dust of an oily or sticky nature or heavy accumulations in the elbows or seams. The amount and kind of dust and dirt depend greatly on the occupancy and the arrangement of the duct system. Additional access doors or panels could be needed for a complete cleaning of duct systems.

B.5 Inspection and Cleaning of Plenums.

B.5.1 Apparatus casing and air-handling unit plenums should be inspected monthly. However, if, after several inspections, such frequent inspection is determined to be unnecessary, the interval between inspections can be adjusted to suit the conditions.

B.5.2 Ceiling cavity, raised floor, and duct distribution plenums should be inspected in a manner similar to that of ducts, beginning with quarterly inspections and adjusting the frequency to suit dirt buildup conditions.

B.5.3 Cleaning should be undertaken whenever an inspection indicates the need, especially in common plenums serving more than one fan or system. Where plenum chambers being used for storage exist, arrangements, such as keeping the doors locked, should be made to prevent such usage. *(See 4.3.10.)*

B.6 Repair Work. Extreme caution should be exercised in the use of open flames or spark-emitting devices inside ducts or plenum chambers or near air intakes.

B.7 Outside Air Intakes.

B.7.1 Conditions outside the outside air intake should be examined at the time ducts are inspected. Items to be noted include the following:

(1) Accumulations of combustible material near the intake
(2) The presence of buildings or structures that could present an exposure to the intake, allowing smoke and fire to be drawn in
(3) The operating condition of any automatic damper designed to protect the opening against exposure fire

B.7.2 Where accumulations of combustible material are noted, they should be removed immediately and arrangements made to avoid such accumulations. Inspections should thereafter be made more frequently. If newly erected exposures are noticed, consideration should be given to the protection at the intake to ensure that it is adequate. *(See 4.4.1.)*

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B.8 Fans and Fan Motors.

B.8.1 Fans and fan motors should be inspected at least quarterly and cleaned and lubricated when necessary. Care should be exercised in lubricating fans to avoid allowing lubricant to run onto the fan blades. Fans also should be checked for alignment and checked to see that they are running freely.

B.8.2 The alignment of fan belt drives should be checked, since improper alignment can cause motor overheating as well as premature belt failure.

B.9 Controls. Fan controls should be examined and activated at least annually to ensure that they are in operable condition.

Annex C Informational References

C.1 Referenced Publications. The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not part of the requirements of this document unless also listed in Chapter 2.

C.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 2001 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 2000 edition.

NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*, 2000 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2000 edition.

NFPA 70, *National Electrical Code®*, 2002 edition.

NFPA 72®, National Fire Alarm Code®, 2002 edition.

NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment*, 1999 edition.

NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, 2002 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 1999 edition.

NFPA 92A, *Recommended Practice for Smoke-Control Systems*, 2000 edition.

NFPA 92B, *Guide for Smoke Management Systems in Malls, Atria, and Large Areas*, 2000 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 2001 edition.

NFPA *101®, Life Safety Code®*, 2000 edition.

NFPA 220, *Standard on Types of Building Construction*, 1999 edition.

C.1.2 Other Publications.

C.1.2.1 ASHRAE Publication. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329-2305.

ASHRAE Handbook — Fundamentals, 2001.

C.1.2.2 NAIMA Publications. North American Insulation Manufacturers Association, 44 Canal Center Plaza, Suite 310, Alexandria, VA 22314.

Fibrous Glass Duct Construction Manual, 4th edition, 2000.

Fibrous Glass Duct Liner Standard, 1994.

C.1.2.3 SMACNA Publication. Sheet Metal and Air-Conditioning Contractors' National Assn., Inc., 4201 Lafayette Center Drive, Chantilly, VA 22021-1209.

Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 1992.

C.1.2.4 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 555, *Standard for Safety Fire Dampers*, 1999.

UL 555S, *Standard for Safety Smoke Dampers*, 1999.

Building Materials Directory, 2002.

Fire Resistance Directory, 2002.

Gas and Oil Equipment Directory, 2002.

C.2 Informational References. (Reserved)

C.3 References for Extracts. The following documents are listed here to provide reference information, including title and edition, for extracts given throughout this standard as indicated by a reference in brackets [ ] following a section or paragraph. These documents are not a part of the requirements of this document unless also listed in Chapter 2 for other reasons.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 2001 edition.

NFPA 97, *Standard Glossary of Terms Relating to Chimneys, Vents, and Heat-Producing Appliances*, 2000 edition.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, 2000 edition.

NFPA 220, *Standard on Types of Building Construction*, 1999 edition.

NFPA 221, *Standard for Fire Walls and Fire Barrier Walls*, 2000 edition.

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