NFPA® 90A

Standard for the Installation of Air-Conditioning and Ventilating Systems

2009 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA DOCUMENTS

NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF NFPA DOCUMENTS

NFPA codes, standards, recommended practices, and guides, of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this document available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the NFPA list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

ADDITIONAL NOTICES AND DISCLAIMERS

Updating of NFPA Documents

Users of NFPA codes, standards, recommended practices, and guides should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of Tentative Interim Amendments. An official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments or corrected through the issuance of Errata, consult appropriate NFPA publications such as the National Fire Codes® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed below.

Interpretations of NFPA Documents

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights asserted in connection with any items which are mentioned in or are the subject of NFPA codes, standards, recommended practices, and guides, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on these documents. Users of these documents are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

NFPA adheres to applicable policies of the American National Standards Institute with respect to patents. For further information contact the NFPA at the address listed below.

Law and Regulations

Users of these documents should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

This document is copyrighted by the NFPA. It is made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making this document available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to this document.

Use of NFPA documents for regulatory purposes should be accomplished through adoption by reference. The term "adoption by reference" means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA documents, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA codes, standards, recommended practices, and guides and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

For more information about NFPA, visit the NFPA website at www.nfpa.org.

NFPA® 90A

Standard for the

Installation of Air-Conditioning and Ventilating Systems

2009 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 June Association Technical Meeting held June 2–5, 2008, in Las Vegas, NV. It was issued by the Standards Council on July 24, 2008, with an effective date of September 5, 2008, and supersedes all previous editions.

This edition of NFPA 90A was approved as an American National Standard on September 5, 2008.

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, because 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 *Manual of Style for NFPA Technical Committee Documents*. 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.

The 2009 edition has been updated to refine and recognize new criteria in a number of areas, most notably those dealing with the types, quantities, and permitted use of various materials in plenum spaces. Specific criteria have been provided to govern materials such as plenum cable, the type of cable, and the test protocols to determine the fire and smoke characteristics of the cable and wiring components. These changes have helped to define the areas of responsibility between NFPA 90A and *NFPA 70®*, *National Electrical Code®*, with regard to this issue.

In addition, the requirements for the maintenance of fire dampers have been removed and replaced with a reference to NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, where such requirements now reside. A reference to NFPA 105, *Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives*, for the maintenance of smoke dampers was also added.

Technical Committee on Air Conditioning

David P. Demers, *Chair*
Demers Associates Inc., MA [SE]

Charles E. Altizer, DHCD-Jackson Center, VA [E]
Rep. International Fire Marshals Association
Jesse J. Beitel, Hughes Associates, Inc., MD [SE]
Merton W. Bunker, Jr., U.S. Department of State, VA [U]
Laurence W. Caraway, Jr., Kitchen Klean Inc., NH [IM]
Rep. National Air Duct Cleaners Association
Michael Earl Dillon, Dillon Consulting Engineers, Inc., CA [SE]
James T. Dollard, Jr., IBEW Local Union 98, PA [L]
Rep. International Brotherhood of Electrical Workers
Thomas M. Dusza, Schirmer Engineering Corporation, CA [I]
Douglas P. Erickson, American Society for Healthcare Engineering, VI [U]
Rep. American Society for Healthcare Engineering
Victor Ferrante, U.S. Department of Housing and Urban Development, DC [U]
Thomas P. Hammerberg, Automatic Fire Alarm Association, Inc., FL [M]
Rep. Automatic Fire Alarm Association, Inc.
John C. Harrington, FM Global, MA [I]
Marcelo M. Hirschler, GBH International, CA [M]
Rep. American Fire Safety Council/Plenum Cable Association
Charles C. Holt, National Energy Management Institute, PA [L]
Rep. Sheet Metal Workers' International Association
Winfield T. Irwin, Irwin Services, PA [M]
Rep. North American Insulation Manufacturers Association
Michael J. Jontry, State of Illinois, IL [E]
S. D. Kahn, Tri-City Electric Company, Inc., CA [IM]
Rep. National Electrical Contractors Association
Marvin A. Koerber, ATCO Rubber Products Inc., SC [M]
Rep. Air Diffusion Council
Richard E. Loyd, R and N Associates, AZ [M]
Rep. American Iron and Steel Institute
Timothy J. Orris, AMCA International, Inc., IL [M]
Rep. Air Movement and Control Association
Richard P. Owen, City of St. Paul, MN [E]
Rep. National Electrical Code Correlating Committee
Suresh K. Shah, U.S. Department of Health and Human Services, TX [U]
Dwayne E. Sloan, Underwriters Laboratories Inc., NC [RT]
George A. Straniero, Tyco/AFC Cable Systems, Inc., NJ [M]
Rep. National Electrical Manufacturers Association
Randolph W. Tucker, The RJA Group, Inc., TX [SE]
Robert J. Wasilewski, Sheet Metal and Air Conditioning Contractors National Association, VA [IM]
Robert A. Wessel, Gypsum Association, DC [M]

Alternates

Diane B. Copeland, Dillon Consulting Engineers, Inc., CA [SE]
(Alt. to M. E. Dillon)
David L. Hall, Air Products and Controls Inc., MI [M]
(Alt. to T. P. Hammerberg)
Eli P. Howard, III, Sheet Metal and Air Conditioning Contractors Natl. Association, VA [IM]
(Alt. to R. J. Wasilewski)
Ralph A. Koerber, ATCO Rubber Products, Inc., SC [M]
(Alt. to M. A. Koerber)
William E. Koffel, Koffel Associates, Inc., MD [M]
(Voting Alt. to SPI Rep.)
Vijay Kotian, Albermarle Corporation, LA [M]
(Alt. to M. M. Hirschler)
Randall K. Laymon, Underwriters Laboratories Inc., IL [RT]
(Alt. to D. E. Sloan)
Harold C. Ohde, IBEW-NECA Technical Institute, IL [L]
(Alt. to J. T. Dollard, Jr.)
Isaac I. Papier, Honeywell, Inc., IL [M]
(Alt. to G. A. Straniero)
Thomas E. Ponder, CertainTeed Corporation, PA [M]
(Alt. to W. T. Irwin)
Michael J. Rzeznik, Schirmer Engineering Corporation, NY [I]
(Alt. to T. M. Dusza)
Robert Van Becelaere, Ruskin Manufacturing, MO [M]
(Alt. to T. J. Orris)
Robert J. Wills, American Iron and Steel Institute, AL [M]
(Alt. to R. E. Loyd)

Allan Fraser, NFPA Staff Liaison

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.

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.

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.

Contents

NFPA 90A

Standard for the

Installation of Air-Conditioning and Ventilating Systems

2009 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, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex 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, Quincy, MA 02169-7471.

NFPA 30, *Flammable and Combustible Liquids Code,* 2008 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* 2006 edition.

NFPA 54, *National Fuel Gas Code,* 2009 edition.

NFPA 70®, *National Electrical Code®,* 2008 edition.

NFPA 72®, National Fire Alarm Code®, 2007 edition.

NFPA 75, *Standard for the Protection of Information Technology Equipment,* 2009 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives,* 2007 edition.

NFPA *101®, Life Safety Code®,* 2009 edition.

NFPA 105, *Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives,* 2007 edition.

NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials,* 2006 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* 2008 edition.

NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces,* 2007 edition.

NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth,* 2006 edition.

NFPA 5000®, Building Construction and Safety Code®, 2009 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*, 2001.

ASHRAE Handbook — HVAC Systems and Equipment, 2000.

2.3.2 ASTM International Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, 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*, 2006.

ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2006a.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, 2004.

ASTM E 2231, *Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics*, 2007.

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

Fire Resistance Design Manual, 18th edition, 2006.

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

Fibrous Glass Duct Construction Standard, 5th edition, 2002.

2.3.5 SMACNA Publications. Sheet Metal and Air Conditioning Contractors' National Association, 4201 Lafayette Center Drive, Chantilly, VA 22151-1209.

Fibrous Glass Duct Construction Standard, 7th edition, 2003.

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

HVAC Duct Construction Standards — Metal and Flexible, 2nd edition, 1995 with addendum #1, November 1997.

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

ANSI/UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*, 2005.

ANSI/UL 181A, *Standard for Safety Closure Systems for Use with Rigid Air Ducts*, 2005.

ANSI/UL 181B, *Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors*, 2005.

ANSI/UL 555, *Standard for Safety Fire Dampers*, 2006.

ANSI/UL 555C, *Standard for Safety Ceiling Dampers*, 2006.

ANSI/UL 555S, *Standard for Safety Smoke Dampers*, 2006.

ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2003.

ANSI/UL 867, *Standard for Safety Electrostatic Air Cleaners*, 2004.

ANSI/UL 900, *Standard for Safety Air Filter Units*, 2004.

ANSI/UL 1820, *Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics*, 2004.

ANSI/UL 1887, *Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics*, 2004.

ANSI/UL 1995, *Standard for Safety Heating and Cooling Equipment*, 2003, revised 2005.

ANSI/UL 2024, *Standard for Optical-Fiber and Communications Cable Raceway*, 2004.

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, revised 2001.

2.3.7 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel–Burning Appliances*, 2006 edition.

NFPA 220, *Standard on Types of Building Construction*, 2009 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, 2009 edition.

NFPA 5000®, Building Construction and Safety Code®, 2009 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or 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.

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.

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**, 2009]

3.3.13.4* *Smoke Damper.* A device within an air-distribution system to control the movement of smoke. [**5000,** 2009]

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**, 2006]

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 Resistance 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 ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard for Safety Test for Surface Burning Characteristics of Building Materials.*

3.3.19 Foam Plastic Insulation. A cellular plastic, used for thermal insulating or acoustical applications, having a density of 20 lb/ft^3 (320 kg/m^3) or less, containing open or closed cells, and formed by a foaming agent. [**5000,** 2009]

3.3.20* Limited-Combustible (Material). Refers to a building construction material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg), where tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and includes either of the following: (1) materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of ⅛ in. (3.2 mm) that has a flame spread index not greater than 50; and (2) materials, in the form and thickness used, having neither a flame spread index 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 index greater than 25 nor evidence of continued progressive combustion, when tested in accordance with ASTM E 84, *Standard Test Method of Surface Burning Characteristics of Building Materials*, or ANSI/UL 723 *Standard Test Method for Surface Burning Characteristics of Building Materials.*

3.3.21 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,** 2009]

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

3.3.22.1 *Air-Handling Unit Room Plenum.* An individual room containing an air-handling unit(s) used to gather air from various sources and combine the air within the room for returning to the air-handling unit.

3.3.22.2 *Apparatus Casing Plenum.* A sheet metal construction attached directly to a fan enclosure, fan coil unit, air-handling unit, or furnace bonnet for the purpose of connecting distribution ducts.

3.3.22.3 *Ceiling Cavity Plenum.* The space between the top of the finished ceiling and the underside of the floor or roof above where used to supply air to the occupied area, or to return or exhaust air from the occupied area.

3.3.22.4 *Raised Floor Plenum.* The space between the top of the finished floor and the underside of a raised floor where used to supply air to the occupied area, or to return or exhaust air from the occupied area.

3.3.23 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.

3.3.24* 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.

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

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

3.3.27* Smoke Developed Index. A comparative measure expressed as a dimensionless number, derived from measurements of smoke obstruction versus time in ASTM E 84 *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method for 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 protected by screens of corrosion-resistant material not larger than 12.7 mm (0.5 in.) mesh.

4.2.1.2* Outside air intakes shall be located so as to minimize the introduction of fire or smoke into the building.

4.2.1.2.1 Outside air intakes shall be equipped with an approved fire and/or smoke damper when not located to meet the requirements of 4.2.1.2. *(See Section 6.3 for smoke damper operation to restrict the intake of smoke.)*

4.2.2 Air Cleaners and Air Filters.

4.2.2.1 Electrostatic air cleaners shall be listed in accordance with ANSI/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 ANSI/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 ANSI/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 Oil-burning 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.*

4.2.4.4.2 Gas-burning heating furnaces combined with cooling units in the same air duct system shall be installed in accordance with NFPA 54, *National Fuel Gas Code*.

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 VI, "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, except as otherwise permitted in 4.3.1.2 or 4.3.1.3.

4.3.1.2 Class 0 or Class 1 rigid or flexible air ducts tested in accordance with ANSI/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 serving not more than two adjacent 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 ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method for 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.

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) NAIMA *Fibrous Glass Duct Construction Standard*
(2) SMACNA *Fibrous Glass Duct Construction Standard*
(3) SMACNA *HVAC Duct Construction Standards — Metal and Flexible*
(4) 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 maximum positive and negative pressures of the system at fan shutoff.

4.3.1.7 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

4.3.1.7.1 Electrical wires and cables or optical fiber cables, or optical-fiber and communications raceways within a duct enclosure shall comply with 4.3.4.

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 ANSI/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.

4.3.2.4 Wiring shall not be installed in air connectors.

4.3.3 Supplementary Materials for Air Distribution Systems.

4.3.3.1* Pipe and duct insulation and 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 4.3.3.1.1 or 4.3.3.1.2, 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 ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or with ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*. Pipe and duct insulation and coverings, duct linings and their adhesives, and tapes shall use the specimen preparation and mounting procedures of ASTM E 2231, *Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics*.

4.3.3.1.1 The flame spread index and smoke developed index requirements of 4.3.3.1 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.

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

4.3.3.3 Coverings and linings for air ducts, pipes, plenums, and panels, including all pipe and duct insulation materials, shall not flame, glow, smolder, or smoke when tested in accordance with 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. 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 NFPA 80, *Standard for Fire Doors and Other Opening Protectives*.

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.

4.3.3.7* Wall or ceiling finish in plenums shall comply with 4.3.10.

4.3.4 Materials for Operation and Control of the Air Distribution System.

4.3.4.1* Wiring shall not be installed in air ducts, except as permitted in 4.3.4.2 through 4.3.4.4.

4.3.4.2 Wiring shall be permitted to be installed in air ducts, only if the wiring is directly associated with the air distribution system and does not exceed 1.22 m (4 ft).

4.3.4.3 Wiring permitted by 4.3.4.2 shall be as short as practicable.

4.3.4.4* Electrical wires and cables and optical fiber cables shall consist of wires or cables listed as having a maximum peak optical density of 0.50 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*, or shall be installed in metal raceways or metal sheathed cable.

4.3.4.5 Nonmetallic pneumatic tubing for control systems shall be permitted to have up to 45.72 cm (18 in.) of tubing that meets the requirements of 4.3.11.2.6.2 to connect to equipment.

4.3.5 Air Duct Access and Inspection.

4.3.5.1 A service opening shall be provided in air ducts adjacent to each fire damper, smoke damper, and any smoke detectors that need access for installation, cleaning, maintenance, inspection, and testing.

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

4.3.5.2 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.

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

4.3.5.3.1 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 permitted in 4.3.5.3.2 through 4.3.5.3.4.

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

4.3.5.3.3 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.

4.3.5.3.4 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, 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 [0.18 cm (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).

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

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

4.3.5.6 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 Resistance of Building Construction and Materials*, access shall be provided in the ceiling.

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

4.3.6 Air Duct Integrity.

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

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

4.3.6.3 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.

4.3.6.3.1 For air ducts rated as Class 1 in accordance with ANSI/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.

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

4.3.6.3.3 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.

4.3.7 Air Outlets.

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

4.3.7.2 Construction of Air Outlets. Air outlets shall be constructed of noncombustible material or of a material that has a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*.

4.3.7.3 Location of Air Outlets.

4.3.7.3.1 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.

4.3.7.3.2 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.

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

4.3.8.1 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.

4.3.8.2 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 when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*.

4.3.8.3 Location of Air Inlets.

4.3.8.3.1 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.

4.3.8.3.2 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.

4.3.9 Fire Dampers.

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

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

4.3.10 Smoke Dampers.

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

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

4.3.10.2 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 on both the building supply and return sides, in order to restrict the circulation of smoke, unless specifically exempted by 4.3.10.2.1 or 4.3.10.2.2.

4.3.10.2.1 Air-handling units located on the floor they serve and serving only that floor shall be exempt from the requirements of 4.3.10.2.

4.3.10.2.2 Air-handling units located on the roof and serving only the floor immediately below the roof shall be exempt from the requirements of 4.3.10.2.

4.3.11 Plenums.

4.3.11.1 Storage.

4.3.11.1.1 Plenums shall not be used for occupancy or storage.

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

4.3.11.2 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 4.3.11.2.1 through 4.3.11.2.7 are met.

4.3.11.2.1 The integrity of the fire and smoke stopping for penetrations shall be maintained.

4.3.11.2.2 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."

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

4.3.11.2.4 Materials used in the construction of a ceiling plenum shall be noncombustible or shall be limited combustible having a maximum smoke developed index of 50, except as permitted in 4.3.11.2.4.1 through 4.3.11.2.4.3, and shall be suitable for continuous exposure to the temperature and humidity conditions of the environmental air in the plenum.

4.3.11.2.4.1 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 4.3.11.2.4.2 and 4.3.11.2.4.3.

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

4.3.11.2.4.3 The ceiling materials shall be supported by noncombustible material.

4.3.11.2.5 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.

4.3.11.2.6 Materials within a ceiling cavity plenum exposed to the airflow shall be noncombustible or comply with one of the following.

4.3.11.2.6.1* Electrical wires and cables and optical fiber cables shall be listed as having a maximum peak optical density of 0.50 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*, or shall be installed in metal raceways, metal sheathed cable, or totally enclosed non-ventilated busway.

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

4.3.11.2.6.3 Nonmetallic 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 ANSI/UL 1887, *Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics*.

4.3.11.2.6.4 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 ANSI/UL 2024, *Standard for Safety Optical-Fiber and Communications Cable Raceway*.

4.3.11.2.6.5* Loudspeakers, recessed lighting fixtures, and other electrical equipment with combustible enclosures, including their assemblies and accessories, cable ties, and other discrete products 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*.

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

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

4.3.11.2.6.8 Air ducts complying with 4.3.1.2 and air connectors complying with 4.3.2 shall be permitted.

4.3.11.2.6.9 Materials that, in the form in which they are used, have a potential heat value not exceeding 8141 kJ/kg (3500 Btu/lb), where tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and include either of the following:

(1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 3.2 mm (⅛ in.) that has a flame spread index not greater than 50

(2) Materials, in the form and thickness used, having neither a flame spread index 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 index greater than 25 nor evidence of continued progressive combustion, when tested in accordance with ASTM E 84, *Standard Test Method of Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method of Surface Burning Characteristics of Building Materials*

4.3.11.2.7 The accessible portion of abandoned materials exposed to airflow shall be removed.

4.3.11.3 Apparatus Casing Plenum.

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

4.3.11.3.2 Fabricated plenum and apparatus casing shall be constructed of materials and by 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

4.3.11.3.3 Electrical wires and cables or optical fiber cables, or optical fiber and communications raceways shall comply with 4.3.4.

4.3.11.4 Air-Handling Unit Room Plenum.

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

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

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

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

4.3.11.4.5 Materials used in the construction of an air-handling unit room plenum shall be noncombustible or shall be limited combustible having a maximum smoke developed index of 50 and shall be suitable for continuous exposure to the temperature and humidity conditions of the environmental air in the plenum.

4.3.11.4.6* Electrical wires and cables and optical fiber cables shall be listed as having a maximum peak optical density of 0.50 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*, or shall be installed in metal raceways, metal sheathed cable, or totally enclosed nonventilated busway.

4.3.11.5 Raised Floor Plenum.

4.3.11.5.1 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 4.3.11.5.2 through 4.3.11.5.8 are met.

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

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

4.3.11.5.4 Materials used in the construction of a raised floor plenum shall be noncombustible or limited combustible materials, shall have a maximum peak smoke developed index of 50, and shall be suitable for continuous exposure to the temperature and humidity conditions of the environmental air in the plenum.

4.3.11.5.5 Materials within a raised floor plenum exposed to the airflow shall comply with 4.3.11.5.5.1 through 4.3.11.5.5.8, as applicable.

4.3.11.5.5.1* Electrical wires and cables and optical fiber cables shall be listed as having a maximum peak optical density of 0.50 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*, or shall be installed in metal raceways, metal sheathed cable, or totally enclosed nonventilated busway.

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

4.3.11.5.5.3 Nonmetallic 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 ANSI/UL 1887, *Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics*.

4.3.11.5.5.4 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 ANSI/UL 2024, *Standard for Safety Optical-Fiber and Communication Cable Raceway*. Cables installed within these raceways shall be listed as plenum cable in accordance with the requirements in 4.3.11.5.5.1.

4.3.11.5.5.5 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 Information Technology Equipment*, shall be permitted.

4.3.11.5.5.6 Loudspeakers, recessed lighting fixtures, and other electrical equipment with combustible enclosures, including their assemblies and accessories, cable ties, 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*.

4.3.11.5.5.7 Air ducts complying with 4.3.1.2 and air connectors complying with 4.3.2 shall be permitted.

4.3.11.5.5.8 Materials that, in the form in which they are used, have a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg), where tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and include either of the following:

(1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of ⅛ in. (3.2 mm) that has a flame spread index not greater than 50
(2) Materials, in the form and thickness used, having neither a flame spread index 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 index greater than 25 nor evidence of continued progressive combustion, when tested in accordance with ASTM E 84, *Standard Test Method of Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*

4.3.11.5.6 Smoke detectors shall not be required to meet the requirements of 4.3.11.5.1.

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

4.3.11.5.8 The accessible portion of abandoned materials exposed to airflow shall be removed.

4.3.11.6 Wall or Ceiling Finish in Plenums.

4.3.11.6.1 Wall or ceiling finish in plenums, except as indicated in 4.3.11.6.2, shall be noncombustible or shall exhibit a flame spread index of 25 or less and a smoke developed index of 50 or less, when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* or ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*, at the maximum thickness intended for use.

4.3.11.6.2 Foam plastic insulation shall not be used as wall or ceiling finish in plenums, unless the insulation meets one of the criteria shown in 4.3.11.6.2.1, 4.3.11.6.2.2, or 4.3.11.6.2.3.

4.3.11.6.2.1 The foam plastic insulation material both (a) exhibits a flame spread index of 25 or less and a smoke developed index of 50 or less, when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* or ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*, at the maximum thickness intended for use, and (b) complies with the following criteria: (1) flame does not spread to the ceiling during the 40 kW exposure, (2) flame does not spread to the outer extremities of the sample, (3) flashover does not occur, (4) the peak heat release rate does not exceed 800 kW, and (5) the total smoke release does not exceed 1000 m^2 (1196 yd^2) when tested in accordance with NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth* (where the testing shall be performed on the finished foam plastic assembly related to the actual end-use configuration and on the maximum thickness intended for use).

4.3.11.6.2.2 The foam plastic insulation material both (a) is covered by corrosion-resistant steel having a base metal thick-

ness of not less than 0.0160 in. (0.4 mm) and (b) exhibits a flame spread index of 75 or less and a smoke developed index of 450 or less, when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*, at the maximum thickness intended for use.

4.3.11.6.2.3 The foam plastic insulation material both (a) is separated from the plenum by an approved thermal barrier of 12.7 mm (0.5 in.) gypsum wallboard or equivalent material that will limit the average temperature rise of the unexposed surface to not more than 139°C (250°F) after 15 minutes of fire exposure, complying with the standard time-temperature curve of NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*, and (b) exhibits a flame spread index of 75 or less and a smoke developed index of 450 or less when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method for Surface Burning Characteristics of Building Materials*, at the maximum thickness intended for use.

4.3.12 Corridor Air Systems.

4.3.12.1* Egress Corridors.

4.3.12.1.1 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 4.3.12.1.2.1 through 4.3.12.1.2.4.

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

4.3.12.1.2.1 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.

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

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

4.3.12.1.2.4 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).

4.3.12.2 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.

4.3.13* 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 equipment rooms used as plenums for supply or return air shall comply with 4.3.11.4.

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.)–thick approved insulating material.

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

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.

5.3.3* 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 Resistance 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 (GA) *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:

(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 occupancies where exempted by NFPA *101*, *Life Safety Code*, or *NFPA 5000*, *Building Construction and 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.

5.3.6 Other Construction Assumed to Inhibit the Passage of Smoke. Smoke dampers shall be installed in the air distribution system where it creates a passage for smoke movement between building spaces required to be separated by horizontal or vertical fire-resistive assemblies requiring opening protective devices, joint protective systems, or firestopping systems.

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 ANSI/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 ANSI/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 ANSI/UL 555S, *Standard for Safety Smoke Dampers.*

5.4.3.1 Smoke damper leakage ratings shall meet, as a minimum, Class II, and elevated temperature ratings shall be not less than 121°C (250°F).

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 ANSI/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.

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 ANSI/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 ANSI/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 ANSI/UL 555, *Standard for Safety Fire Dampers.*

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

5.4.6 Damper Location Information.

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 Dampers required to close in airflow shall have the calculated airflow at their location shown on the drawings of the air duct system.

5.4.7 Installation.

5.4.7.1* 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 and the requirements of NFPA 80, *Standard for Fire Doors and Other Opening Protectives.*

5.4.7.2 Smoke dampers shall be installed in accordance with the conditions of their listings, the manufacturer's installation instructions, and the requirements of NFPA 105, *Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.*

5.4.8 Maintenance.

5.4.8.1 Fire dampers and ceiling dampers shall be maintained in accordance with NFPA 80, *Standard for Fire Doors and Other Opening Protectives.*

5.4.8.2 Smoke dampers shall be maintained in accordance with NFPA 105, *Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.*

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 shall be permitted to remain open when their associated fan is off, provided their associated controlling damper actuators and automatic alarm-initiating devices 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 signal and an 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.

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 Chapter 6 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, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences.*

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 Information Technology 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 *Heating, Cooling, Ventilating and Cooking 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)."

A.3.3.13.3 Fire Damper. Some such devices are listed in UL *Heating, Cooling, Ventilating and Cooking Equipment Directory* under the category of "Fire Dampers for Fire Barrier and Smoke Applications (EMME)."

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 *Heating, Cooling, Ventilating and Cooking Equipment Directory* under the category "Dampers for Fire Barrier and Smoke Applications (EMME)."

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.3.3.20 Limited-Combustible (Material). Material subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition is considered combustible. See NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and NFPA 220, *Standard on Types of Building Construction.*

A.3.3.22 Plenum. A plenum can be one of the following five described types of unoccupied chambers through which air flows at low velocity and with little change in static pressure:

(1) Supply Air Plenum. Any plenum at any point on the discharge side of a fan through which air is intentionally conveyed to a space or spaces within a building.
(2) Return Air Plenum. Any plenum at any point on the intake side of a fan through which air is intentionally conveyed from a space or spaces within the building to the fan for eventual complete or partial return to the same space or spaces.
(3) Exhaust Air Plenum. Any plenum at any point on the intake side of a fan through which air is intentionally removed from a space or spaces within the building for discharge to the exterior of the building.
(4) Outside Air Plenum. Any plenum at any point on the intake side of a fan through which air from the exterior of the building is intentionally introduced into the building or its ventilation system(s).
(5) Mixed Air Plenum. Any plenum at any point on the intake side of a fan through which air is intentionally conveyed from a space or spaces within the building and from the exterior of the building to the fan for eventual complete or partial return to the same space or spaces.

A.3.3.24 Smoke Barrier. See also NFPA *101*, *Life Safety Code*, Chapter 8, for additional guidance.

A.3.3.26 Smoke Detector. See *NFPA 72, National Fire Alarm Code.*

A.3.3.27 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.4.2.1.2 The location of outside air intakes needs to be carefully selected and located to avoid drawing in objectionable materials including, but not limited to, combustible materials and toxic or hazardous vapors. The location should consider

proximity to emergency smoke exhaust, garage exhaust, discharge of kitchen hood vents, and other objectionable discharges from the building or adjacent structures.

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

A.4.3 Abandoned wires, cables, and other building service materials exposed to airflow result in an unnecessary increase in fuel load. Where practical, installation locations and methods that anticipate and facilitate the removal of such materials should be selected.

A.4.3.3.1 ASTM E 2231, *Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics*, is a practice that describes, in mandatory language, standard methods for specimen preparation and mounting of pipe and duct insulation systems using the Steiner tunnel test method (contained in NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, and in ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*). It requires that the entire system that is used in the field be tested, including the insulation itself, any adhesive, and/or any jacket used. The practice recognizes that pipe or duct insulation systems can be composed of a single product or of a combination of products, and that these have a variety of physical characteristics, including that they may or may not be self-supporting.

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

A.4.3.3.7 It is the intent of the committee that wall and ceiling finish in ceiling plenums comply with 4.3.3.7 and not 4.3.3.1.

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.4.3.4.4 Electrical wires and cables and optical fiber cables installed in metal raceways or metal sheathed cable are not considered to be exposed to the airflow, and need not meet the requirements of 4.3.4.4. Electrical wires and cables and optical fiber cables listed to UL Subject 2424, *Outline of Investigation for Cable Marked Limited Combustible*, are considered to be suitable for use wherever cables 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*, are required.

A.4.3.11.2.6.1 Electrical wires and cables and optical fiber cables listed to UL Subject 2424, *Outline of Investigation for Cable Marked Limited Combustible*, are considered to be suitable for use wherever cables 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*, are required.

A.4.3.11.2.6.5 Cable ties listed to ANSI/UL 1565, *Positioning Devices*, and marked for use in plenums are considered suitable for use whenever cable ties tested in accordance with UL 2043, *Standard for Fire Test for Heating Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces*, are required.

A.4.3.11.4.6 Electrical wires and cables and optical fiber cables installed in metal raceways, metal sheathed cable, or totally enclosed nonventilated busway are not considered to be exposed to the airflow, and need not meet the requirements of 4.3.11.4.6. Electrical wires and cables and optical fiber cables listed to UL Subject 2424, *Outline of Investigation for Cable Marked Limited Combustible*, are considered to be suitable for use wherever cables 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*, are required.

A.4.3.11.5.5.1 Electrical wires and cables and optical fiber cables listed to UL Subject 2424, *Outline of Investigation for Cable Marked Limited Combustible*, are considered to be suitable for use wherever cables 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*, are required.

A.4.3.12.1 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 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 restricted to leakage permitted through opening protectives.

A.4.3.13 For further information, see NFPA 92A, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences*, or NFPA 92B, *Standard for Smoke Management Systems in Malls, Atria, and Large Spaces.*

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.5.4.4.1 For information on other methods of protecting openings in rated floor- or roof-ceiling assemblies, see the UL *Fire Resistance Directory* design information section for duct outlet protection. System A can only be used when it is specified in

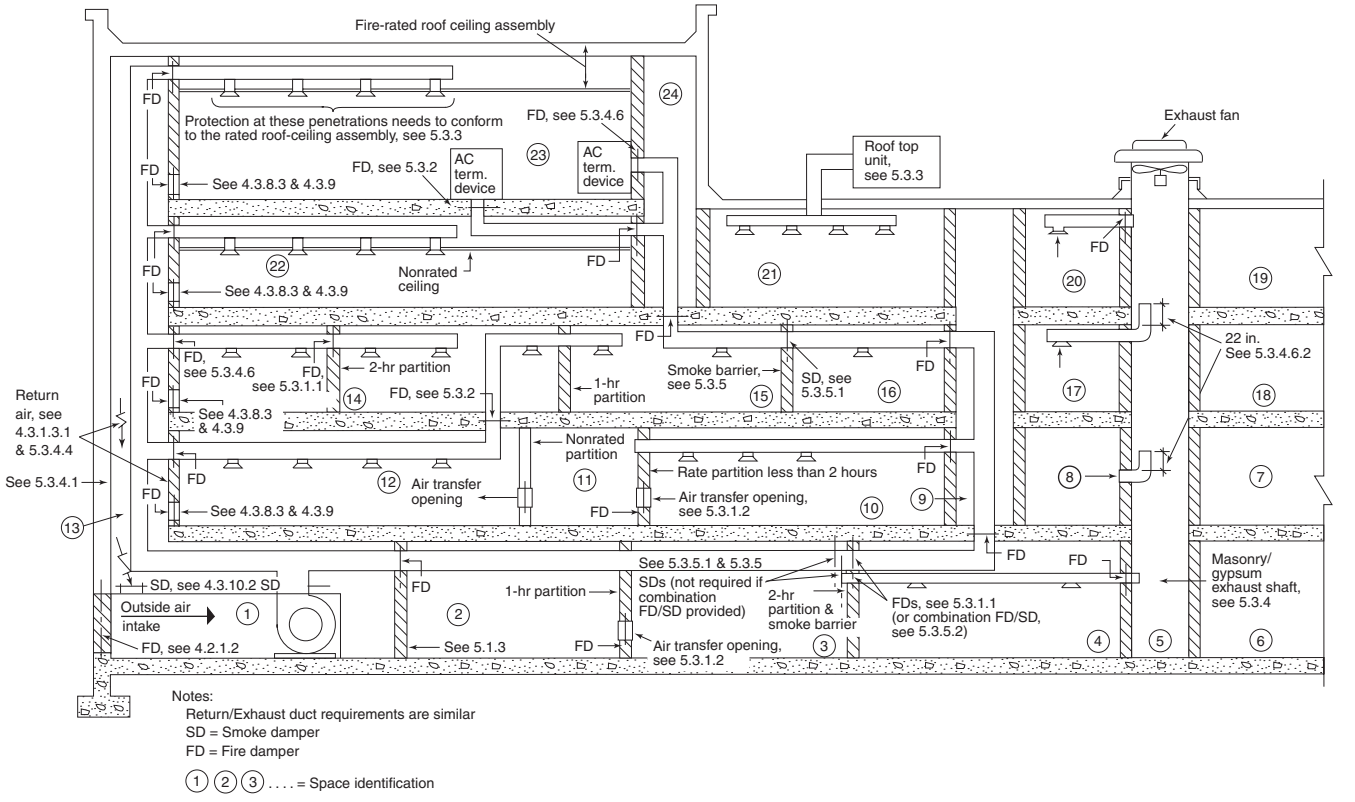


FIGURE A.5.3 Application of Penetration Requirements.

the individual design. System B can be used in any design that contains a steel duct with the duct outlet protected by a hinged door damper, for equal or smaller outlet size. The systems have been investigated for their effectiveness in retarding the transfer of heat into the ceiling space but their ability to retard smoke and other combustion products has not been investigated.

A.5.4.5.2.2.1 The exception to this paragraph in earlier editions applied to fire dampers, due to the fact that ANSI/UL 555S, *Standard for Safety Smoke Dampers*, which tested combination dampers, was not available. Fire dampers in accordance with ANSI/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 at 10 m/sec (2000 ft/min).

A.5.4.7.1 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 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, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences*.

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.

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, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences*, 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 4.3.7.)*

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, because 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 documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

C.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 2006 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 2007 edition.

NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*, 2007 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2004 edition.

NFPA 70®, *National Electrical Code®*, 2008 edition.

NFPA 72®, *National Fire Alarm Code®*, 2007 edition.

NFPA 75, *Standard for the Protection of Information Technology Equipment*, 2009 edition.

NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, 2009 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2004 edition.

NFPA 92A, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences*, 2009 edition.

NFPA 92B, *Standard for Smoke Management Systems in Malls, Atria, and Large Spaces*, 2009 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 2008 edition.

NFPA *101®*, *Life Safety Code®*, 2009 edition.

NFPA 220, *Standard on Types of Building Construction*, 2009 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 2006 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2008 edition.

NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces*, 2007 edition.

C.1.2 Other Publications.

C.1.2.1 ASHRAE Publications. 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 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2006a.

ASTM E 2231, *Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics*, 2002.

C.1.2.3 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.1.2.4 SMACNA Publications. 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, 2002.

C.1.2.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

ANSI/UL 555, *Standard for Safety Fire Dampers*, 2006.

ANSI/UL 555S, *Standard for Safety Smoke Dampers*, 2006.

ANSI/UL 1565, *Positioning Devices*, 2002.

Building Materials Directory, 2006.

Fire Resistance Directory, 2006.

Heating, Cooling, Ventilating and Cooking Equipment Directory, 2006.

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

UL Subject 2424, *Outline of Investigation for Cable Marked Limited Combustible*, 2006.

C.2 Informational References. (Reserved)

C.3 References for Extracts in Informational Sections. (Reserved)

Index

Formal Interpretation

NFPA 90A

Standard for the Installation of Air-Conditioning and Ventilating Systems

2009 Edition

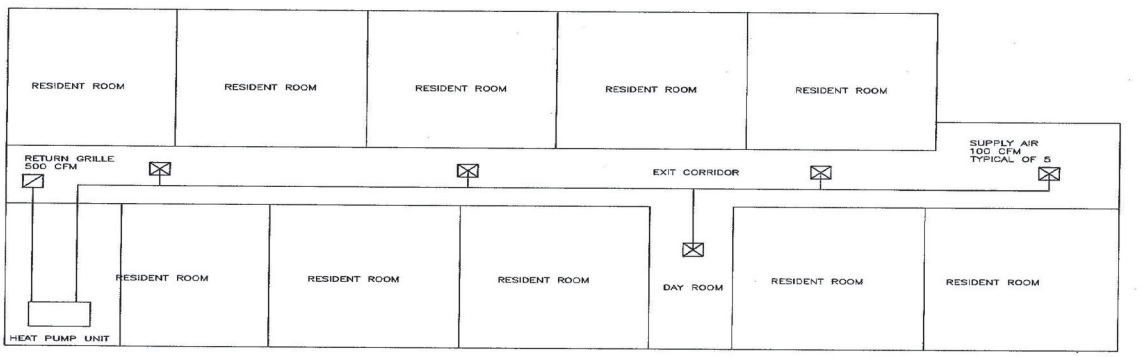
Reference: 4.3.11.1
F.I. No.: 90A-02-04

Question No. 1: Is the intent of the paragraph to require multiple locations for return air in a corridor?

Answer: No.

Question No. 2: Is one point of return air with multiple supply air locations as indicated on the attached sketch acceptable?

Answer: Yes.



Issue Edition: 2002
Reference: 4.3.11.1
Issue Date: 12/19/2007
Effective Date: 1/8/2008

Formal Interpretation

NFPA 90A

Standard for the Installation of Air-Conditioning and Ventilating Systems

2009 Edition

Reference: 4.3.11.1, 3.3.5 and 3.3.21
F.I. No. 90A-02-3

Question 1: When the resident's room windows are closed, can the 50cfr of air exhausted from the bathroom and drawn from the room in general be in whole or in part made up by infiltration through the NFPA 80 complying clearances around and under the corridor door due to the resultant pressure differences?

Answer: Yes.

Question 2: Does the corridor described constitute a plenum or air duct as these terms were intended to apply under 90A?

Answer: No.

Issue Edition: 2002
Reference: 4.3.11.1, 3.3.5 and 3.3.21
Issue Date: January 24, 2006
Effective Date: February 12, 2006

Formal Interpretation

NFPA 90A

Standard for the Installation of Air-Conditioning and Ventilating Systems

2009 Edition

Reference: 5.3.4.5
FI No. 90A-02-02

Question: Is it the intent of NFPA 90A: 5.3.4.5 to prohibit the installation of a Type B vent, which is connected to and exhausts a natural gas fire boiler within an environmental air shaft?

Answer: Yes.

Issue Edition: 2002
Reference: 5.3.4.5
Issue Date: January 10, 2006
Effective Date: January 30, 2006

Sequence of Events Leading to Issuance of an NFPA Committee Document

Step 1: Call for Proposals

- Proposed new Document or new edition of an existing Document is entered into one of two yearly revision cycles, and a Call for Proposals is published.

Step 2: Report on Proposals (ROP)

- Committee meets to act on Proposals, to develop its own Proposals, and to prepare its Report.
- Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Proposals (ROP) is published for public review and comment.

Step 3: Report on Comments (ROC)

- Committee meets to act on Public Comments to develop its own Comments, and to prepare its report.
- Committee votes by written ballot on Comments. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Comments (ROC) is published for public review.

Step 4: Technical Report Session

- "*Notices of intent to make a motion"* are filed, are reviewed, and valid motions are certified for presentation at the Technical Report Session. ("Consent Documents" that have no certified motions bypass the Technical Report Session and proceed to the Standards Council for issuance.)
- NFPA membership meets each June at the Annual Meeting Technical Report Session and acts on Technical Committee Reports (ROP and ROC) for Documents with "certified amending motions."
- Committee(s) vote on any amendments to Report approved at NFPA Annual Membership Meeting.

Step 5: Standards Council Issuance

- Notification of intent to file an appeal to the Standards Council on Association action must be filed within 20 days of the NFPA Annual Membership Meeting.
- Standards Council decides, based on all evidence, whether or not to issue Document or to take other action, including hearing any appeals.

Committee Membership Classifications

The following classifications apply to Technical Committee members and represent their principal interest in the activity of the committee.

M *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.

U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.

I/M *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.

L *Labor:* A labor representative or employee concerned with safety in the workplace.

R/T *Applied Research/Testing Laboratory:* A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.

E *Enforcing Authority:* A representative of an agency or an organization that promulgates and/or enforces standards.

I *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.

C *Consumer:* A person who is, or represents, the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in the *User* classification.

SE *Special Expert:* A person not representing any of the previous classifications, but who has a special expertise in the scope of the standard or portion thereof.

NOTES;
1. "Standard" connotes code, standard, recommended practice, or guide.
2. A representative includes an employee.
3. While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of members or unique interests need representation in order to foster the best possible committee deliberations on any project. In this connection, the Standards Council may make appointments as it deems appropriate in the public interest, such as the classification of "Utilities" in the National Electrical Code Committee.
4. Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.

NFPA Technical Committee Document Proposal Form

NOTE: All Proposals must be received by 5:00 pm EST/EDST on the published Proposal Closing Date.

For further information on the standards-making process, please contact the Codes and Standards Administration at 617-984-7249 or visit www.nfpa.org/codes.

For technical assistance, please call NFPA at 1-800-344-3555.

FOR OFFICE USE ONLY

Log #:

Date Rec'd:

Please indicate in which format you wish to receive your ROP/ROC ☐ **electronic** ☐ **paper** ☒ **download**
(Note: If choosing the download option, you must view the ROP/ROC from our website; no copy will be sent to you.)

Date April 1, 200X **Name** John J. Doe **Tel. No.** 716-555-1234

Company Air Canada Pilot's Association **Email**

Street Address 123 Summer Street Lane **City** Lewiston **State** NY **Zip** 14092

******If you wish to receive a hard copy, a street address MUST be provided. Deliveries cannot be made to PO boxes.***

Please indicate organization represented (if any)

1. (a) NFPA Document Title National Fuel Gas Code **NFPA No. & Year** 54, 200X Edition

(b) Section/Paragraph 3.3

2. Proposal Recommends (check one): ☐ new text ☒ revised text ☐ deleted text

3. Proposal (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~).]

Revise definition of effective ground-fault current path to read:

3.3.78 Effective Ground-Fault Current Path. An intentionally constructed, permanent, low impedance electrically conductive path designed and intended to carry ~~underground~~ electric fault current ~~conditions~~ from the point of a ground fault on a wiring system to the electrical supply source.

4. Statement of Problem and Substantiation for Proposal: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Proposal, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

Change uses proper electrical terms.

5. Copyright Assignment

(a) ☐ **I am the author of the text or other material (such as illustrations, graphs) proposed in this Proposal.**

(b) ☒ **Some or all of the text or other material proposed in this Proposal was not authored by me. Its source is as follows** (please identify which material and provide complete information on its source)**:**

ABC Co.

I agree that any material that I author, either individually or with others, in connection with work performed by an NFPA Technical Committee shall be considered to be works made for hire for the NFPA. To the extent that I retain any rights in copyright as to such material, or as to any other material authored by me that I submit for the use of an NFPA Technical Committee in the drafting of an NFPA code, standard, or other NFPA document, I hereby grant and assign all and full rights in copyright to the NFPA. I further agree and acknowledge that I acquire no rights in any publication of the NFPA and that copyright and all rights in materials produced by NFPA Technical Committees are owned by the NFPA and that the NFPA may register copyright in its own name.

Signature (Required)

PLEASE USE SEPARATE FORM FOR EACH PROPOSAL • email: proposals_comments@nfpa.org • NFPA Fax: (617) 770-3500
Mail to: Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471

6/11/2008

NFPA Technical Committee Document Proposal Form

NOTE: All Proposals must be received by 5:00 pm EST/EDST on the published Proposal Closing Date.

For further information on the standards-making process, please contact the Codes and Standards Administration at 617-984-7249 or visit www.nfpa.org/codes.

For technical assistance, please call NFPA at 1-800-344-3555.

FOR OFFICE USE ONLY

Log #: _____

Date Rec'd: _____

Please indicate in which format you wish to receive your ROP/ROC ☐ electronic ☐ paper ☐ download
(Note: If choosing the download option, you must view the ROP/ROC from our website; no copy will be sent to you.)

Date _____ **Name** _____ **Tel. No.** _____

Company _____ **Email** _____

Street Address _____ **City** _____ **State** _____ **Zip** _____

******If you wish to receive a hard copy, a street address MUST be provided. Deliveries cannot be made to PO boxes.***

Please indicate organization represented (if any) _____

1. (a) NFPA Document Title _____ **NFPA No. & Year** _____

(b) Section/Paragraph _____

2. Proposal Recommends (check one): ☐ new text ☐ revised text ☐ deleted text

3. Proposal (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~).]

4. Statement of Problem and Substantiation for Proposal: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Proposal, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

5. Copyright Assignment

(a) ☐ I am the author of the text or other material (such as illustrations, graphs) proposed in this Proposal.

(b) ☐ Some or all of the text or other material proposed in this Proposal was not authored by me. Its source is as follows (please identify which material and provide complete information on its source)**:**

_____

I agree that any material that I author, either individually or with others, in connection with work performed by an NFPA Technical Committee shall be considered to be works made for hire for the NFPA. To the extent that I retain any rights in copyright as to such material, or as to any other material authored by me that I submit for the use of an NFPA Technical Committee in the drafting of an NFPA code, standard, or other NFPA document, I hereby grant and assign all and full rights in copyright to the NFPA. I further agree and acknowledge that I acquire no rights in any publication of the NFPA and that copyright and all rights in materials produced by NFPA Technical Committees are owned by the NFPA and that the NFPA may register copyright in its own name.

Signature (Required) _____

PLEASE USE SEPARATE FORM FOR EACH PROPOSAL • email: proposals_comments@nfpa.org • NFPA Fax: (617) 770-3500
Mail to: Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471

6/11/2008