90A

NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems 1996 Edition

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An International Codes and Standards Organization

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

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NFPA 90A

Standard for the Installation of

Air Conditioning and Ventilating Systems

1996 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 the National Fire Protection Association, Inc., at its Annual Meeting held May 20–23, 1996, in Boston, MA. It was issued by the Standards Council on July 18, 1996, with an effective date of August 9, 1996, and supersedes all previous editions.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

This edition of NFPA 90A was approved as an American National Standard on July 26, 1996.

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, *Standard on Air Conditioning, Warm Air Heating, Air Cooling and Ventilating System*, was developed. This standard was initially adopted in 1937, with many subsequent amendments through the 1978 edition. 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 contains revisions that are minor in nature. Some of these revisions were for consistency with NFPA *101®, Life Safety Code®*, to update reference documents and provide editorial clarification.

Prior to 1955, the subject of the current standard was Part I of NFPA 90, *Standard on Air Conditioning*. Since 1955, the two parts of NFPA 90 have been published separately as NFPA 90A and as NFPA 90B, *Standard for the Installation of Warm Air Heating and Air Conditioning Systems*.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

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

1996 Edition

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

Information on referenced publications can be found in Chapter 6 and Appendix C.

Chapter 1 General

1-1 Introduction. 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. (*See Section 1-4.*)

1-2 Scope. This standard shall apply to all systems for the movement of environmental air in structures that:

(a)* Serve spaces of over 25,000 ft^3 (707.9 m^3) in volume; or

(b)* Serve buildings of Types III, IV, and V construction over three stories in height, regardless of volume; or

(c)* Serve buildings and spaces not covered by other applicable NFPA standards; or

(d)* Serve occupants or processes not covered by other applicable NFPA standards.

1-3 Purpose.

1-3.1 This standard prescribes minimum requirements for safety to life and property from fire. These requirements are intended to:

(a) Restrict the spread of smoke through air duct systems within a building or into a building from the outside.

(b) Restrict the spread of fire through air duct systems from the area of fire origin whether located within the building or outside.

(c) Maintain the fire-resistive integrity of building components and elements such as floors, partitions, roofs, walls, and floor/roof-ceiling assemblies affected by the installation of air duct systems.

(d) Minimize the ignition sources and combustibility of the elements of the air duct systems.

(e) Permit the air duct systems in a building to be used for the additional purpose of emergency smoke control.

1-3.2 Nothing in this standard is 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.

1-3.3 The provisions of this standard are not 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.

1-4* Smoke Control. See A-1-4.

1-5 Maintenance. Pertinent information on maintenance is provided in Appendix B.

1-6 Definitions.

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

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. (*For limitations on the use of air connectors, see 2-3.2.1.*)

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

Air Duct. A conduit for conveying air.

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.

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.

Air Filter. A device used to reduce or remove airborne solids from heating, ventilating, and air conditioning systems by mechanical means.

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

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

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

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

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Blower. A fan used to force air under pressure through an air duct system.

Ceiling Damper.* A device installed to limit radiant heat transfer through an air outlet or air inlet opening in the ceiling of a floor/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/roof-ceiling assemblies.

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

Fan. An assembly comprising blades or runners and a housing or casing that is either a blower or an exhaust fan.

Fire Damper.* A device, installed in an air distribution system, that is designed to close automatically upon detection of heat, to interrupt migratory airflow, and to restrict the passage of flame. A combination fire and smoke damper meets the requirements of both.

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

Fire Wall. A wall subdividing a building to restrict the spread of fire and having fire resistance and structural stability.

Flame Spread Index.* A number or classification of a material determined in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

Limited Combustible Material.* A building construction material not complying with the definition of noncombustible material, which, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) and complies with one of the following paragraphs, (a) or (b). Materials subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition shall be considered combustible.

(a) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 in. (0.32 cm), that has a flame spread index not greater than 50.

(b) Materials, in the form and thickness used, other than as described in (a), having neither a flame spread index greater than 25 nor evidence of continued 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.

Listed.* Equipment, materials, or services included in a list published by an organization 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 either that the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

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 when tested in accordance with ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*.

Plenum. A compartment or chamber to which one or more air ducts are connected that forms part of the air distribution system and that is not used for occupancy or storage. (*See 2-3.10 for specific types.*)

Shall. Indicates a mandatory requirement.

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

Smoke. The airborne solid and liquid particulates and gases that evolve when a material undergoes pyrolysis or combustion.

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.

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

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

A smoke damper also shall be permitted to serve as a fire damper where its location lends itself to the multiple functions and where it meets the requirements of both functions.

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

Smoke Developed Index.* A number or classification of a material determined in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, that measures visible smoke.

Chapter 2 HVAC Systems

2-1 General Requirements for Equipment.

2-1.1 Equipment shall be arranged to afford access for inspection, maintenance, and repair.

2-1.2 Equipment shall be selected and installed based on its proper application with respect to the manufacturer's installation instructions and listing as applicable.

2-1.3 Equipment shall be guarded for personnel protection and against the intake of foreign matter into the system.

2-1.4 Electrical wiring and equipment shall be installed in accordance with NFPA 70, *National Electrical Code®*.

2-1.5 Equipment Location. See Section 3-1.

2-2 System Components.

2-2.1 Outside Air Intakes.

2-2.1.1 Outside air intakes shall be located to avoid drawing in combustible material or flammable vapor and to minimize the hazard from fires in other structures.

2-2.1.2 Outside air intakes shall be protected by screens of corrosion-resistant material not larger than 1/2-in. (1.27-cm) mesh.

2-2.1.3 Outside air intakes shall be located so as to minimize the introduction of fire into the building from combustible buildings and hazardous facilities, or the intakes shall be equipped with an approved fire damper.

2-2.1.4 Outside air intakes shall be located so as to minimize the introduction of smoke into the building, or the intakes shall be equipped with an approved smoke damper. (*See Section 4-3 for smoke damper operation to restrict the intake of smoke.*)

2-2.2 Air Cleaners and Air Filters.

2-2.2.1 Electrostatic air cleaners shall be listed in accordance with UL 867, *Standard for Safety Electrostatic Air Cleaners*, and shall be installed in conformance with the conditions of their listings.

2-2.2.2 Air filters shall be rated either as Class 1 or Class 2 in accordance with UL 900, *Standard for Safety Air Filter Units. (For care and maintenance, see Appendix B.)*

2-2.2.3 Liquid adhesive coatings used on air filters shall have a minimum flash point of 325°F (163°C) as determined by ASTM D 93, *Standard Test Methods for Flashpoint by Pensky–Martens Closed Cup Tester.*

2-2.2.4 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.

2-2.2.5 Combustible adhesive coatings shall be stored in accordance with NFPA 30, *Flammable and Combustible Liquids Code.*

2-2.3 Fans.

2-2.3.1 Installation. Fans shall be installed in accordance with the applicable NFPA standards and the manufacturer's instructions. Fans shall be approved for the specific installation.

2-2.3.2 Access. Fans shall be located, arranged, and installed to afford access for inspection and maintenance.

2-2.3.3 Exposed Inlets. Exposed fan inlets shall be protected with metal screens to prevent the entry of paper, trash, and similar foreign materials.

2-2.4 Air-Cooling and Heating Equipment.

2-2.4.1 Installation. Heating and cooling equipment shall be installed in accordance with the applicable NFPA standards and the manufacturer's instructions. The equipment shall be approved for the specific installation. *(See 2-3.3.1.)*

2-2.4.2 Appliances. Materials used in the manufacturing of fan coil units, self-contained air conditioning units, furnaces, heat pumps, humidifiers, and all similar appliances shall meet the requirements of 2-3.3.1 and 2-3.3.2. Listing by a testing laboratory shall be considered to be evidence of compliance with this requirement. Unlisted solar energy air distribution system components shall be accompanied by supportive information demonstrating that the components have flame spread and smoke developed indices that are not in excess of those of the air duct system permitted by this standard.

2-2.4.3 Mechanical Cooling. Mechanical refrigeration used with air duct systems shall be installed in accordance with recognized safety practices. Installations conforming to ANSI/ASHRAE 15, *Safety Code for Mechanical Refrigeration*, shall be considered to be in compliance with these requirements.

2-2.4.4 Furnaces. Heating furnaces combined with cooling units in the same air duct system shall be installed in accordance with NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, where oil fired, and NFPA 54 (ANSI Z223.1), *National Fuel Gas Code*, where gas fired.

2-2.4.5 Duct Heaters. 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 2-3.5.3. The installation of electrical duct heaters shall comply with the provisions of NFPA 70, *National Electrical Code*, Article 424, Part F, "Duct Heaters."

2-2.4.6 Evaporative Coolers. Combustible evaporation media shall not be used.

Exception: Evaporation media meeting the requirements of 2-2.2.2 shall be permitted.

2-2.4.7 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 2-2.

2-3 Air Distribution.

2-3.1 Air Ducts.

2-3.1.1 Air ducts shall be permitted to be rigid or flexible and shall be constructed of materials that are reinforced and sealed to satisfy the requirements for the use of the air duct system, such as the supply air system, the return or exhaust air system, and the variable volume/pressure air system.

2-3.1.2 Air ducts shall be constructed of the following materials:

(a) Iron, steel, aluminum, copper, concrete, masonry, or clay tile.

(b) Class 0 or Class 1 rigid or flexible air ducts tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*, and installed in conformance with the conditions of listing.

Exception No. 1: Class 0 or Class 1 rigid or flexible air duct shall not be used as a vertical air duct that is more than two stories in height.

Exception No. 2: Class 0 or Class 1 rigid or flexible air ducts shall not be used for air ducts containing air at temperatures in excess of 250°F (121°C).

(c) Where the temperature of the conveyed air does not exceed 125°F (52°C) in normal service, negative pressure exhaust or return air ducts shall be permitted to be constructed of gypsum board having a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50.

Exception: The maximum conveyed air temperature of 125°F (52°C) shall not apply to gypsum board material used for emergency smoke exhaust air ducts.

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

2-3.1.3 The materials, thickness, construction, and installation of ducts shall provide structural strength and durability in conformance with recognized good practice. Air ducts shall be considered to be in compliance with this requirement where constructed and installed in accordance with:

(a)* SMACNA *Fibrous Glass Duct Construction Standard;* SMACNA *HVAC Duct Construction Standards — Metal and*

Flexible; or SMACNA *HVAC Air Duct Leakage Test Manual,* whichever is applicable; or

(b) The 1992 *ASHRAE Handbook — HVAC Systems and Equipment.*

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

2-3.2 Air Connectors.

2-3.2.1 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 following requirements:

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

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

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

(d) 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.

(e) Air connectors shall not pass through floors.

2-3.2.2 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. The fabric shall have a maximum length of 10 in. (25.4 cm) in the direction of airflow.

2-3.3 Supplementary Materials for Air Distribution Systems.

2-3.3.1 Supplementary materials such as duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and core materials added to air ducts, plenums, panels, and duct silencers used in duct systems 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. Where air duct coverings and linings are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (*See 2-2.4.2.*)

Closure systems for use with rigid air ducts tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors,* shall have been tested and listed in accordance with UL 181A, *Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors,* and used in accordance with the conditions of their listings.

Exception No. 1: This requirement 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.

Exception No. 2: Smoke detectors required by 4-4.2.

2-3.3.2 Air duct, panel, and plenum coverings and linings shall not flame, glow, smolder, or smoke when tested in accordance with similar test for pipe covering, ASTM C 411, *Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation,* at the temperature to which they are exposed in service. In no case shall the test temperature be below 250°F (121°C).

2-3.3.3 Air duct coverings shall not extend through walls or floors that are required to be firestopped or required to have a fire resistance rating.

Exception: Where such coverings meet the requirements of 3-4.6.4.

2-3.3.4* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

2-3.3.5 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

2-3.3.6 Pipe insulation and coverings shall meet the requirements of 2-3.3.1 and 2-3.3.2 where installed in ducts, plenums, or concealed spaces used as part of the air distribution system.

2-3.4 Air Duct Access and Inspection.

2-3.4.1* A service opening shall be provided in air ducts adjacent to each fire damper, smoke damper, and smoke detector. The opening shall be large enough to permit maintenance and resetting of the device.

2-3.4.2 Service openings shall be identified with letters having a minimum height of ½ in. (1.27 cm) to indicate the location of the fire protection device(s) within.

2-3.4.3 Horizontal air ducts and plenums shall be provided with service openings (*see 2-3.4.1*) to facilitate the removal of accumulations of dust and combustible materials. Service openings shall be located at approximately 20-ft (6.1-m) intervals along the air duct and at the base of each vertical riser.

Exception No. 1: Removable air outlet or air inlet devices of adequate size shall be permitted in lieu of service openings.

Exception No. 2: 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.

Exception No. 3: Service openings shall not be required where all the following conditions exist:

(a) The occupancy has no process producing 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).

(b) The air inlets are at least 7 ft (2.13 m) above the floor or are protected by corrosion-resistant metal screens of at least 14 mesh (0.07 in.) that are installed at the inlets so that they cannot draw papers, refuse, or other combustible solids into the return air duct.

(c) The minimum design velocity in the return duct for the particular occupancy is 1000 ft/min (508 m/s).

2-3.4.4 Inspection windows shall be permitted in air ducts provided they are glazed with wired glass. However, service openings shall be provided as required in 2-3.4.1.

2-3.4.5 Openings in walls or ceilings shall be provided so that service openings in air ducts are accessible for maintenance and inspection needs.

2-3.4.6 Where a service opening is necessary in an air duct located above the ceiling of a floor/roof-ceiling assembly that has been tested and assigned a fire resistance rating in accordance with NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*, access shall be provided in the ceiling and shall be designed and installed so that it does not reduce the fire resistance rating of the assembly.

2-3.5 Air Duct Integrity.

2-3.5.1 Air ducts shall be located where they are not subject to damage or rupture, or they shall be protected to maintain their integrity.

2-3.5.2 Where an air duct is located outdoors, the air duct, together with its covering or lining, shall be protected from harmful elements.

2-3.5.3 Air Duct at Heat Sources. 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. Air ducts rated as Class 1 in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*, air duct coverings, and linings shall be interrupted at the immediate area of operation of such heat sources in order to meet the clearances specified as a condition of the equipment listing.

Exception No. 1: Appliances listed for zero clearance from combustibles where installed in accordance with the conditions of their listings.

Exception No. 2: Insulation specifically suitable 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.

2-3.6 Air Outlets.

2-3.6.1 General. Air supplied to any space shall not contain flammable vapors, flyings, or dust in quantities and concentrations that would introduce a hazardous condition.

2-3.6.2 Construction of Air Outlets. Air outlets shall be constructed of noncombustible material or a material that has a maximum smoke developed index of 50 and a maximum flame spread index of 25.

2-3.6.3 Location of Air Outlets.

(a) Air outlets shall be located at least 3 in. (7.6 cm) above the floor.

Exception: Where provisions have been made to prevent dirt and dust accumulations from entering the system.

(b) Where located less than 7 ft (2.13 m) above the floor, outlet openings shall be protected by a grille or screen having openings through which a 1/2-in. (1.27-cm) sphere cannot pass.

2-3.7 Air Inlets (Return or Exhaust or Return and Exhaust).

2-3.7.1 General. Air shall not be recirculated from any space in which flammable vapors, flyings, or dust is present in quantities and concentrations that would introduce a hazardous condition into the return air system.

2-3.7.2 Construction of Air Inlets. Air inlets shall be constructed of noncombustible material or a material that has a maximum flame spread index of 25 and a maximum smoke developed index of 50.

2-3.7.3 Location of Air Inlets.

(a) Air inlets shall be located at least 3 in. (7.6 cm) above the floor.

Exception: Where provisions have been made to prevent dirt and dust accumulations from entering the system.

(b) Where located less than 7 ft (2.13 m) above the floor, inlet openings shall be protected by a grille or screens having openings through which a 1/2-in. (1.27-cm) sphere cannot pass.

2-3.8 Fire Dampers. Approved fire dampers shall be provided as required in Chapter 3 and installed in conformance with the conditions of their listings.

2-3.9 Smoke Dampers.

2-3.9.1 Approved smoke dampers shall be provided as required in Chapter 3 and installed in conformance with the conditions of their listings.

2-3.9.2 Smoke dampers shall be installed in systems with a capacity greater than 15,000 cfm (7080 L/s) to isolate the air-handling equipment, including filters, from the remainder of the system in order to restrict the circulation of smoke.

Exception No. 1: Where the air-handling unit is located on the floor that it serves and serves only that floor.

Exception No. 2: Where the air-handling unit is located on the roof and serves only the floor immediately below the roof.

2-3.10 Plenums.

2-3.10.1 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, or return or exhaust air from, or return and exhaust air from, the occupied area, provided that the following conditions are met:

(a) All materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50.

Exception No. 1: The following materials 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 maximum flame spread distance of 5 ft (1.5 m) or less when tested in accordance with the specified test method:

(a) Electrical wires and cables — NFPA 262, Standard Method of Test for Fire and Smoke Characteristics of Wires and Cables

(b) Pneumatic tubing for control systems — UL 1820, Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only

(c) Optical-fiber cables — NFPA 262, Standard Method of Test for Fire and Smoke Characteristics of Wires and Cables

(d) Fire sprinkler piping — UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Flame and Smoke Characteristics

(e) Optical-fiber raceway — NFPA 262, Standard Method of Test for Fire and Smoke Characteristics of Wires and Cables.

Exception No. 2: Smoke detectors.

Exception No. 3: Loudspeakers, loudspeaker assemblies, and their accessories shall be permitted in the ceiling cavity plenum where listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a peak heat release rate of 100 kW or less when tested in accordance with UL 2043, Standard for Safety Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

(b) The integrity of the firestopping for penetrations shall be maintained.

(c) 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."

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

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

(f) 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 3-3.3.

2-3.10.2 Duct Distribution Plenum. A duct enclosure used for the multiple distribution or gathering of ducts or connectors shall be constructed of materials and methods specified in 2-3.1.

2-3.10.3 Apparatus Casing Plenum. A fabricated plenum and apparatus casing shall be permitted to be used for supply, return, or exhaust air service and shall be constructed of materials and methods specified in 2-3.1, and in accordance with the following:

(a) The casing and plenum construction standards in SMACNA *HVAC Duct Construction Standards — Metal and Flexible*;

(b) The 1992 *ASHRAE Handbook — HVAC Systems and Equipment*;

(c) Paragraph 2-3.3 for all air duct coverings, duct lining acoustical liner/cells, and miscellaneous materials.

2-3.10.4 Air-Handling Unit Room Plenum.

(a) Individual rooms containing an air-handling unit(s) gather return air from various sources and combine the return air within the room for returning to the air-handling unit. Duct covering, duct lining, acoustical liner/cells, and miscellaneous materials shall comply with 2-3.3.

(b) Air-handling unit room plenums shall not be used for storage or occupied other than during equipment servicing.

2-3.10.5 Raised Floor Plenum. 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, or return exhaust air from, or return and exhaust air from, the occupied area, provided that the following conditions are met:

(a) All materials exposed to the airflow shall be noncombustible or limited combustible and shall have a maximum smoke developed index of 50.

Exception No. 1: The following materials 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 maximum flame spread distance of 5 ft (1.5 m) or less when tested in accordance with the specified test method:

(a) Electrical wires and cables — NFPA 262, Standard Method of Test for Fire and Smoke Characteristics of Wires and Cables

(b) Pneumatic tubing for control systems — UL 1820, Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only

(c) Optical-fiber cables — NFPA 262, Standard Method of Test for Fire and Smoke Characteristics of Wires and Cables

(d) Fire sprinkler piping — UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Flame and Smoke Characteristics

(e) Optical-fiber cable raceway — NFPA 262, Standard Method of Test for Fire and Smoke Characteristics of Wires and Cables.

Exception No. 2: Raised floors, intermachine cables, electrical wires, listed plenum optical-fiber cable raceways, and optical-fiber cables in computer/data processing rooms where these rooms are designed and installed in accordance with NFPA 75, Standard for the Protection of Electronic Computer/Data Processing Equipment.

Exception No. 3: Smoke detectors.

(b) The integrity of the firestopping for penetrations shall be maintained.

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

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

2-3.11 Corridor Air Systems.

2-3.11.1 Egress Corridors. 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. An air transfer opening(s) shall not be permitted in walls or in doors separating egress corridors from adjoining areas.

Exception No. 1: Toilet rooms, bathrooms, shower rooms, sink closets, and similar auxiliary spaces opening directly onto the egress corridor.

Exception No. 2: Where door clearances do not exceed those specified for fire doors in NFPA 80, Standard for Fire Doors and Fire Windows, air transfer caused by pressure differentials shall be permitted.

Exception No. 3: Use of egress corridors as part of an engineered smoke-control system.

Exception No. 4: In detention and correctional occupancies with corridor separations of open construction (e.g., grating doors or grating partitions).

2-3.11.2 Exits. Exit passageways, stairs, ramps, and other exits shall not be used as a part of a supply, return, or exhaust air system serving other areas of the building.

2-3.12* Smoke Control. Where a smoke-control or exhaust system is required, it shall conform to the requirements of the building code of the authority having jurisdiction.

Chapter 3 Integration of a Ventilation and Air Conditioning System(s) with Building Construction

3-1 Air-Handling Equipment Rooms.

3-1.1 General. Air-handling equipment rooms generally fall into three categories:

(a) Those used as air plenums (usually return air);
(b) Those with air ducts that open directly into a shaft; and
(c) Other air-handling unit rooms.

3-1.2 Air-Handling Equipment Rooms Used as Plenum Space. Air-handling unit rooms used as plenums for supply or return air shall comply with 2-3.10.4.

3-1.3 Air-Handling Equipment Rooms that Have Air Ducts that Open Directly into a Shaft. 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 3-3.4.

Exception: 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.

3-1.4 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.

3-2 Building Construction.

3-2.1 Air Duct Clearance. The clearance from metal air ducts to assemblies constructed of combustible materials, including plaster on wood lath, shall be not less than 1/2 in. (1.27 cm), or the combustible material shall be protected with minimum 1/4-in. (0.635-cm) approved insulating material. The integrity of the firestopping and smokestopping shall be maintained.

Exception: This clearance shall not apply to systems used solely for ventilation, air cooling, or air conditioning without heating.

3-2.2 Structural Members. The installation of air ducts, including the hangers, shall not reduce the fire resistance rating of structural members.

3-2.3 Where the installation of the hangers for the components of an air duct system penetrates an existing ceiling of a fire-resistive floor/roof-ceiling assembly and necessitates removal of a portion of that ceiling, the replacement material shall be identical to or approved as equivalent to that which was removed.

Exception: 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/roof-ceiling design is not reduced.

3-3 Penetrations — Protection of Openings. For examples of the application of the penetration protection requirements, see Figure 3-3.

3-3.1 Fire-Rated Walls and Partitions.

3-3.1.1* 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. (*See Figure 3-3.*)

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

3-3.1.2 Approved fire dampers shall be provided in all air transfer openings in partitions required to have a fire resistance rating and in which other openings are required to be protected.

3-3.2 Floors Required to Have a Fire Resistance Rating. Where air ducts extend through only one floor and serve only two adjacent stories, the air ducts shall be enclosed (*see 3-3.4.1*) or fire dampers shall be installed at each point where the floor is penetrated.

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

3-3.3* Floor/Roof-Ceiling Assemblies Having a Fire Resistance Rating. Where air ducts and openings for air ducts are used in a floor/roof-ceiling assembly required to have a fire resistance rating, all the materials and the construction of the assembly, including the air duct materials and the size and protection of the openings, shall conform with the design of the fire-resistive assembly, as tested in accordance with NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials.* (*Where dampers are required, see 3-4.4.*)

3-3.4 Shafts.

3-3.4.1 Air ducts that pass through the floors of buildings requiring 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. The 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, and a minimum rating of 2 hours where such air ducts are located in a building four stories or more in height.

Exception: Where an air duct penetrates only one floor and the air duct contains a fire damper located where the duct penetrates the floor, an air duct enclosure shall not be required.

3-3.4.2 A fire-resistive enclosure used as an air duct shall conform with 3-3.4.1 and 2-3.1. Gypsum board systems shall be constructed in accordance with the Gypsum Association *Fire Resistance Design Manual.*

3-3.4.3 Shafts that constitute air ducts or that enclose air ducts used for the movement of environmental air shall not enclose:

(a) Exhaust ducts used for the removal of smoke- and grease-laden vapors from cooking equipment;
(b) Ducts used for the removal of flammable vapors;
(c) Ducts used for moving, conveying, or transporting stock, vapor, or dust;
(d) Ducts used for the removal of nonflammable corrosive fumes and vapors;
(e) Refuse and linen chutes; or
(f) Piping.

Exception: Noncombustible piping conveying water or other nonhazardous or nontoxic materials.

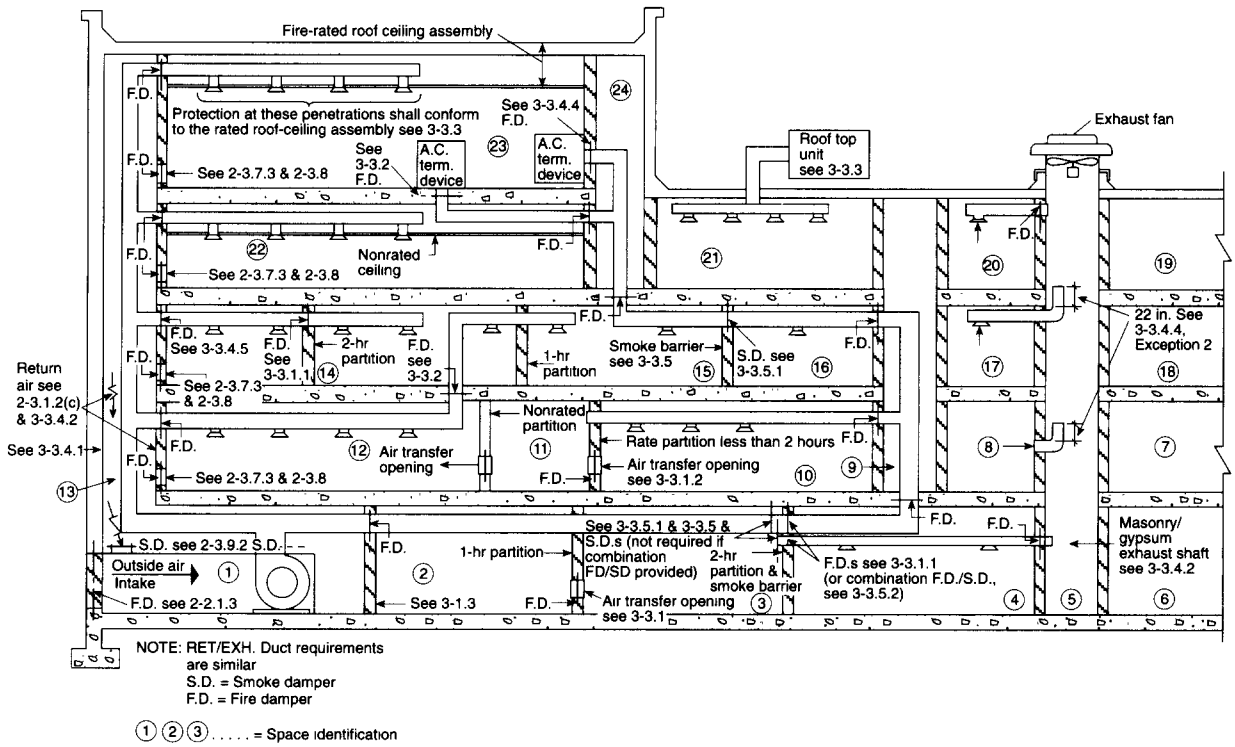

Figure 3-3 Application of penetration requirements.

3-3.4.4 Fire dampers shall be installed at each direct or ducted opening into or out of enclosures required by 3-3.4.1.

Exception No. 1: 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.

Exception No. 2: Where branch ducts connect to enclosed exhaust risers meeting the requirements of 3-3.4.1 or 3-3.4.2 in which the airflow moves upward and steel subducts at least 22 in. (56 cm) in length are carried up inside the riser from each inlet and the riser is appropriately sized to accommodate the flow restriction created by the subduct. (See Figure 3-3.)

3-3.5 Smoke Barriers.

3-3.5.1 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 2 ft (0.6 m) from the barrier or after the first air duct inlet or outlet, whichever is closer to the smoke barrier.

Exception No. 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:

(a) Function as an engineered smoke-control system, including the provision of continuous air movement with the air-handling system; or

(b) Provide air to other areas of the building during a fire emergency; or

(c) Provide pressure differentials during a fire emergency.

Exception No. 2: Smoke dampers shall not be required to be located within a prescribed distance of a smoke barrier where isolation smoke dampers are used in air-handling equipment. (See 2-3.9.2.)

Exception No. 3: Smoke dampers shall not be required where the air inlet or outlet openings in ducts are limited to a single smoke compartment.

Exception No. 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.

Exception No. 5: Smoke dampers shall not be required in health care occupancies where exempted by NFPA 101®, Life Safety Code®.*

3-3.5.2 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.

3-4 Fire Dampers, Smoke Dampers, and Ceiling Dampers.

3-4.1 Fire dampers used for the protection of openings in walls, partitions, or floors with fire resistance ratings of less than 3 hours shall have a 1½-hour fire protection rating in accordance with UL 555, *Standard for Safety Fire Dampers.*

3-4.2 Fire dampers used for the protection of openings in walls, partitions, or floors having a fire resistance rating of 3 hours or more shall have a 3-hour fire protection rating in accordance with UL 555, *Standard for Safety Fire Dampers.*

3-4.3* Smoke dampers used for the protection of openings in smoke barriers or in engineered smoke-control systems shall be classified in accordance with UL 555S, *Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.*

3-4.4 Ceiling dampers or other methods of protecting openings in rated floor/roof-ceiling assemblies shall comply

with the construction details of the tested floor/roof-ceiling assembly or with listed ceiling air diffusers, or with both listed ceiling dampers. Ceiling dampers shall be tested in accordance with UL 555C, *Standard for Safety Ceiling Dampers.*

3-4.5 Damper Closure.

3-4.5.1 All fire dampers and ceiling dampers shall close automatically, and they shall remain closed upon the operation of a listed fusible link or other approved heat-actuated device located where readily affected by an abnormal rise of temperature in the air duct.

3-4.5.2 Fusible links shall have a temperature rating approximately 50°F (28°C) above the maximum temperature that normally is encountered when the system is in operation or shut down, but not less than 160°F (71°C).

Exception: Where combination fire/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 50°F (28°C) above the maximum smoke-control system designed operating temperature, but shall not exceed the UL 555S, Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems degradation test temperature rating of the combination fire/smoke damper or a maximum of 350°F (177°C).*

3-4.5.3 A provision for remote opening of combination fire and smoke dampers, where necessary for smoke removal, shall be permitted. Such dampers shall have provisions that allow them to reclose automatically upon reaching the damper's maximum degradation test temperature in accordance with UL 555S, *Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.*

3-4.5.4 Dampers shall close against the maximum calculated airflow of that portion of the air duct system in which they are installed. Fire dampers shall be tested in accordance with UL 555, *Standard for Safety Fire Dampers.* Smoke dampers shall be tested in accordance with UL 555S, *Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.*

Exception: Where provisions for fan or airflow shutdown are provided.

3-4.6 Installation. See 2-3.4 for access.

3-4.6.1 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 air duct systems.

3-4.6.2* Fire dampers (including their sleeves), smoke dampers, and ceiling dampers shall be installed in accordance with the conditions of their listings and the manufacturer's installation instructions.

3-4.6.3 The thickness of sleeves for fire dampers shall not be less than that associated with the conditions of rating required by Section 3-4.

Exception: Where UL 555, Standard for Safety Fire Dampers, permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in Table 3-4.6.3.

3-4.6.4 Patching, Filling, and Repairing. Where air ducts pass through walls, floors, or partitions required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall not exceed a 1-in. (2.54-cm) average clearance on all sides and shall be filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials.*

Exception: Where fire dampers are installed, proper clearance for expansion shall be maintained. (See 3-4.6.)

Table 3-4.6.3 Minimum Sleeve Thickness Permitted in Accordance with UL 555
(See 3-4.6.3, Exception.)

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

3-4.7 Maintenance. At least every 4 years fusible links (where applicable) shall be removed, all dampers shall be operated to verify that they fully close, the latch, if provided, shall be checked, and moving parts shall be lubricated as necessary.

Chapter 4* Controls

4-1 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.*

4-2 Manual Control. Each air distribution system shall be provided with not less than one manually operable means to stop the operation of the supply, return, and exhaust fan(s) in an emergency. The means of manual operation shall be located at an approved location.

4-3* Smoke Dampers.

4-3.1 Smoke dampers shall be controlled by an automatic alarm initiating device. Smoke dampers shall be permitted to be positioned manually from a command station.

4-3.2 Smoke dampers installed to isolate the air-handling system in accordance with 2-3.9.2 shall be arranged to close automatically when the system is not in operation.

4-3.3* Smoke dampers installed in smoke barriers shall be permitted to remain open during fan shutdown, provided their associated controlling damper actuators and smoke detectors remain operational.

4-4* Smoke Detection for Automatic Control.

4-4.1 All automatic shutdown devices shall be tested at least annually.

4-4.2 Location. Smoke detectors listed for use in air distribution systems shall be located:

(a) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 2000 cfm (944 L/s).

(b) 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 15,000 cfm (7080 L/s) and serving more than one story.

Exception No. 1: 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.

Exception No. 2: Fan units whose sole function is to remove air from the inside of the building to the outside of the building.

4-4.3* Function. Smoke detectors provided as required by 4-4.2 shall automatically stop their respective fan(s) upon detecting the presence of smoke.

Exception: Where the return air fan is functioning as part of an engineered smoke-control system and a different mode is required.

4-4.4 Installation.

4-4.4.1 Smoke detectors shall be installed, tested, and maintained in accordance with NFPA 72, *National Fire Alarm Code*.

4-4.4.2 In addition to the requirements of 4-4.3, where an approved protective signaling system is installed in a building, the smoke detectors required by the provisions of Section 4-4 shall be connected to the protective signaling system in accordance with the requirements of NFPA 72, *National Fire Alarm Code*, so that the activation of any air distribution system smoke detector causes a supervisory signal to be indicated at a constantly attended location or causes an alarm signal.

4-4.4.3 Where smoke detectors required by Section 4-4 are installed in a building not equipped with an approved protective signaling system as specified by 4-4.4.2:

(a) The smoke detector activation required by Section 4-4 shall cause a visual and an audible signal in a normally occupied area; and

(b) Smoke detector trouble conditions shall be indicated visually or audibly in a normally occupied area and shall be identified as air duct detector trouble.

4-4.4.4 Smoke detectors powered separately from the signaling system for the sole function of stopping fans shall not require standby power.

Chapter 5 Acceptance Testing

5-1 General.

5-1.1* An acceptance test shall be performed to determine that the protective measures required in this standard function when needed to restrict the spread of fire and smoke. Maintenance recommendations, including cleaning, repair, and periodic test, are provided in Appendix B.

5-1.2 Records shall be maintained on acceptance test results and shall be available for inspection.

5-2 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.

5-3 Controls and Operating Systems.

5-3.1 Controls relating to fan shutdown and automatic damper operation shall be tested for compliance with the requirements of this standard. Generally, tests can be included with acceptance testing of the air conditioning controls or fire alarm systems.

5-3.2 Acceptance tests of fire protection devices in air conditioning and ventilating systems shall, as far as practicable, be performed under normal operating conditions. Some portions of control or alarm systems are permitted to have standby power or other emergency modes of operation, and the tests shall be performed to determine that the system operates under these conditions as well as normal conditions.

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

6-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 30, *Flammable and Combustible Liquids Code*, 1996 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 1992 edition.

NFPA 54, *National Fuel Gas Code*, 1996 edition.

NFPA 70, *National Electrical Code*, 1996 edition.

NFPA 72, *National Fire Alarm Code*, 1996 edition.

NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment*, 1995 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1995 edition.

NFPA *101, Life Safety Code*, 1994 edition.

NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*, 1995 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 1996 edition.

NFPA 262, *Standard Method of Test for Fire and Smoke Characteristics of Wires and Cables*, 1994 edition.

6-1.2 Other Publications.

6-1.2.1 ASHRAE Publications. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle NE, Atlanta, GA 30329.

ANSI/ASHRAE 15, *Safety Code for Mechanical Refrigeration*, 1994.

ASHRAE Handbook — HVAC Systems and Equipment, 1992.

6-1.2.2 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM C 411, *Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation*, 1982.

ASTM D 93, *Standard Test Methods for Flashpoint by Pensky–Martens Closed Cup Tester*, 1994.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*, 1994.

6-1.2.3 GA Publication. Gypsum Association, 1603 Orrington Avenue, Evanston, IL 60201.

Fire Resistance Design Manual, 14th edition, 1994.

6-1.2.4 SMACNA Publications. Sheet Metal and Air Conditioning Contractors' National Assn., Inc., 4201 Lafayette Center Drive, Chantilly, VA 22021-1209.

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

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

HVAC Duct Construction Standards — Metal and Flexible, 1st edition, 1985.

6-1.2.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*, 1994.

UL 181A, *Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors*, 1994, 2nd edition (as revised through 12/14/94).

UL 555, *Standard for Safety Fire Dampers*, 1995.

UL 555C, *Standard for Safety Ceiling Dampers*, 1992.

UL 555S, *Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems*, 1993.

UL 867, *Standard for Safety Electrostatic Air Cleaners*, 1995.

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

UL 1820, *Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only*, 1994.

UL 1887, *Standard for Safety Fire Test of Plastic Sprinkler Pipe for Flame and Smoke Characteristics*, 1989.

UL 2043, *Standard for Safety Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces*, 1992.

Appendix A Explanatory Material

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

A-1-2 (a) 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 25,000 ft^3 (707.9 m^3) in volume, see NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.*)

A-1-2 (b) For construction types, see NFPA 220, *Standard on Types of Building Construction.*

A-1-2 (c) 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-1-2 (d) Such applicable standards include, but are not limited to, NFPA 31, *Standard for the Installation of Oil-Burning Equipment*; NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*; NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*; NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*; NFPA 70, *National Electrical Code* (*see "Ventilation" in index*); NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment*; NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*; and NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.*

A-1-4 Guidance for the design of smoke-control systems is provided in NFPA 92A, *Recommended Practice for Smoke-Control Systems.*

A-1-6 Air Connector. Some such devices are listed in the Underwriters Laboratories Inc. *Gas and Oil Equipment Directory* under the category "Connectors (ALNR)." These devices, since they do not meet all the requirements for air ducts, have limitations on their use, length, and location.

A-1-6 Air Inlet. For further discussion of various types of air inlet devices, see Chapter 32, "Space Air Diffusion," in the 1993 *ASHRAE Handbook — Fundamentals.*

A-1-6 Air Outlet. For further discussion of various types of air outlet devices, see Chapter 32, "Space Air Diffusion," in the 1993 *ASHRAE Handbook — Fundamentals.*

A-1-6 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 concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-6 Authority Having Jurisdiction. The phrase "authority having jurisdiction" 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-1-6 Ceiling Damper. Some such devices are listed in the Underwriters Laboratories Inc. *Fire Resistance Directory* under the category of "Ceiling Damper (CABS)."

A-1-6 Fire Damper. Some such devices are listed in the Underwriters Laboratories Inc. *Building Materials Directory* under the category of "Fire Dampers (ALBR)."

A-1-6 Fire Resistance Rating. Some such assemblies are listed in the Underwriters Laboratories Inc. *Fire Resistance Directory* under the categories of "Floors," "Roofs," and "Walls and Partitions."

A-1-6 Flame Spread Index. Flame spread indexes for some materials are listed in the Underwriters Laboratories Inc. *Building Materials Directory.*

A-1-6 Limited Combustible Material. For further information, see NFPA 259, *Standard Test Method for Potential Heat of Building Materials.*

A-1-6 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which 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-1-6 Smoke Barrier. See also NFPA *101, Life Safety Code,* Chapter 6, for additional guidance.

A-1-6 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 the Underwriters Laboratories Inc. *Building Materials Directory* under the category "Leakage Rated Dampers (OOYZ)."

A-1-6 Smoke Detector. See NFPA 72, *National Fire Alarm Code.*

A-1-6 Smoke Developed Index. Smoke developed indexes for some materials are listed in Underwriters Laboratories Inc. *Building Materials Directory.*

A-2-3.1.3(a) See NAIMA *Fibrous Glass Duct Construction Manual* for additional information.

A-2-3.3.4 See NAIMA *Fibrous Glass Duct Liner Standard* for additional information.

A-2-3.4.1 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 size access door should be 18 in. × 16 in. (45.7 cm × 40.6 cm). 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 24 in. × 16 in. (61 cm × 40.6 cm) 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-2-3.12 For further information, see NFPA 92A, *Recommended Practice for Smoke-Control Systems,* or NFPA 92B, *Guide for Smoke Management Systems in Malls, Atria, and Large Areas.*

A-3-3.1.1 Duct penetrations of fire walls should be avoided.

A-3-3.1.1 Exception. Fire dampers are recommended in order to isolate specific hazards.

A-3-3.3 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-3-3.5.1 Exception No. 5. For an example, see NFPA *101, Life Safety Code,* 12-3.7.3, Exception No. 2, and 13-3.7.3, Exception No. 2.

A-3-4.3 The designer should specify the leakage class, maximum pressure, maximum velocity, installation mode (horizontal or vertical), and degradation test temperature of the damper.

A-3-4.5.2 Exception. The exception to this paragraph in earlier editions applied to fire dampers due to the fact that UL 555S, *Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems,* which tested combination dampers, was not available. Fire dampers in accordance with UL 555, *Standard for Safety Fire Dampers,* are listed with maximum 286°F (141°C) 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-3-4.6.2 Fire dampers are of no fire protection value unless they remain in place in the protected opening, in the event that the ductwork collapses during a fire. To accomplish this, ductwork should not be continuous through a partition opening but instead should connect on each side of the partition to a damper installed in a sleeve or frame secured by perimeter-mounting angles on both sides of the opening, or be installed per the listing of the device. For specific details regarding sleeve thickness, perimeter angle dimensions, size and frequency of fasteners, clearance for expansion, duct-sleeve connections, and fire damper access doors, the manufacturer's installation instructions and SMACNA *Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems* should be referenced.

A-4 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 4 provisions that are dependent on system capacity).

A-4-3 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-4-3.3 Smoke dampers and combination fire/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-4-4 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 NFPA 72, *National Fire Alarm Code,* 5-3.6, 5-3.7.6, and Section 5-11.

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

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

A-4-4.3 Water Flow for Automatic Control. 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 4.

Sprinklers are often tested weekly. Where it is desirable to prevent the accompanying automatic shutdown of the fan system(s) referred to in 4-4.2, a means may be permitted to be used to avoid such shutdown temporarily, provided:

(a) A trouble signal is sustained in the sprinkler supervisory system until the automatic shutdown provision is restored; or

(b) 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-5-1.1 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 2-3.4 should be checked for proper location, function, and size while conducting acceptance tests.

Appendix B Maintenance

This Appendix 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 these 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 appendix 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 Inspection Form. 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. Each damper should be examined every two years to ensure that it is not rusted or blocked, giving attention to hinges and other moving parts. It is recommended to operate dampers 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-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 may 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 may require scraping, brushing, or other positive means. Vacuum cleaning may 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 depends greatly on the occupancy and the arrangement of the duct system. Additional access doors or panels might 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 may 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 2-3.10.*)

B-5.4 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-6 Outside Air Intakes.

B-6.1 Conditions outside the outside air intake should be examined at the time ducts are inspected. Items to be noted include:

(a) Accumulations of combustible material near the intake;

(b) The presence of buildings or structures that could present an exposure to the intake, allowing smoke and fire to be drawn in; and

(c) The operating condition of any automatic damper designed to protect the opening against exposure fire.

B-6.2 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 2-2.1.*)

B-7 Fans and Fan Motors.

B-7.1 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 to see that they are running freely.

B-7.2 The alignment of fan belt drives should be checked, since improper alignment can cause motor overheating as well as premature belt failure.

B-8 Controls. Fan controls should be examined and activated at least annually to ensure that they are in operable condition.

Appendix C Referenced Publications

C-1 The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

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

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 1992 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 1995 edition.

NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*, 1995 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 1996 edition.

NFPA 70, *National Electrical Code*, 1996 edition.

NFPA 72, *National Fire Alarm Code*, 1996 edition.

NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment*, 1995 edition.

NFPA 90B, *Standard for the Installation of Warm Air Heating and Air Conditioning Systems*, 1996 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*, 1995 edition.

NFPA 92A, *Recommended Practice for Smoke-Control Systems*, 1996 edition.

NFPA 92B, *Guide for Smoke Management Systems in Malls, Atria, and Large Areas*, 1995 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 1994 edition.

NFPA *101, Life Safety Code*, 1994 edition.

NFPA 220, *Standard on Types of Building Construction*, 1995 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 1993 edition.

C-1.2 Other Publications.

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

ASHRAE Handbook — Fundamentals, 1993.

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

Fibrous Glass Duct Construction Manual, 1st edition, 1989.

Fibrous Glass Duct Liner Standard, 1994.

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

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

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

UL 555, *Standard for Safety Fire Dampers*, 1995.

UL 555S, *Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems*, 1993.

Building Materials Directory, 1995.

Fire Resistance Directory, 1995.

Gas and Oil Equipment Directory, 1995.

Index

The NFPA Codes and Standards Development Process

Since 1896, one of the primary purposes of the NFPA has been to develop and update the standards covering all areas of fire safety.

Calls for Proposals
The code adoption process takes place twice each year and begins with a call for proposals from the public to amend existing codes and standards or to develop the content of new fire safety documents.

Report on Proposals
Upon receipt of public proposals, the technical committee members meet to review, consider, and act on the proposals. The public proposals – together with the committee action on each proposal and committee-generated proposals – are published in the NFPA's Report on Proposals (ROP). The ROP is then subject to public review and comment.

Report on Comments
These public comments are considered and acted upon by the appropriate technical committees. All public comments – together with the committee action on each comment – are published as the Committee's supplementary report in the NFPA's Report on Comments (ROC).

The committee's report and supplementary report are then presented for adoption and open debate at either of NFPA's semi-annual meetings held throughout the United States and Canada.

Association Action
The Association meeting may, subject to review and issuance by the NFPA Standards Council, (a) adopt a report as published, (b) adopt a report as amended, contingent upon subsequent approval by the committee, (c) return a report to committee for further study, and (d) return a portion of a report to committee.

Standards Council Action
The Standards Council will make a judgement on whether or not to issue an NFPA document based upon the entire record before the Council, including the vote taken at the Association meeting on the technical committee's report.

Voting Procedures
Voting at an NFPA Annual or Fall Meeting is restricted to members of record for 180 days prior to the opening of the first general session of the meeting, except that individuals who join the Association at an Annual or Fall Meeting are entitled to vote at the next Fall or Annual Meeting.

"Members" are defined by Article 3.2 of the Bylaws as individuals, firms, corporations, trade or professional associations, institutes, fire departments, fire brigades, and other public or private agencies desiring to advance the purposes of the Association. Each member shall have one vote in the affairs of the Association. Under Article 4.5 of the Bylaws, the vote of such a member shall be cast by that member individually or by an employee designated in writing by the member of record who has registered for the meeting. Such a designated person shall not be eligible to represent more than one voting privilege on each issue, nor cast more than one vote on each issue.

Any member who wishes to designate an employee to cast that member's vote at an Association meeting in place of that member must provide that employee with written authorization to represent the member at the meeting. The authorization must be on company letterhead signed by the member of record, with the membership number indicated, and the authorization must be recorded with the President of NFPA or his designee before the start of the opening general session of the Meeting. That employee, irrespective of his or her own personal membership status, shall be privileged to cast only one vote on each issue before the Association.

Sequence of Events Leading to Publication of an NFPA Committee Document

Call for proposals to amend existing document or for recommendations on new document.

▼

Committee meets to act on proposals, to develop its own proposals, and to prepare its report.

▼

Committee votes on proposals by letter ballot. If two-thirds approve, report goes forward. Lacking two-thirds approval, report returns to committee.

▼

Report is published for public review and comment. (Report on Proposals - ROP)

▼

Committee meets to act on each public comment received.

▼

Committee votes on comments by letter ballot. If two-thirds approve, supplementary report goes forward. Lacking two-thirds approval, supplementary report returns to committee.

▼

Supplementary report is published for public review. (Report on Comments - ROC).

▼

NFPA membership meets (Annual or Fall Meeting) and acts on committee report (ROP and ROC).

▼

Committee votes on any amendments to report approved at NFPA Annual or Fall Meeting.

▼

Complaints to Standards Council on Association action must be filed within 20 days of the NFPA Annual or Fall Meeting.

▼

Standards Council decides, based on all evidence, whether or not to issue standard or to take other action, including hearing any complaints.

▼

Appeals to Board of Directors on Standards Council action must be filed within 20 days of Council action.