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INSTALLATION OF

AIR CONDITIONING AND VENTILATING SYSTEMS 1974

NATIONAL FIRE PROTECTION ASSOCIATION

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Air Conditioning and Ventilating Systems

NFPA 90A — 1974

This 1974 Edition of the Standard supersedes the Edition of 1973 and incorporates changes prepared by the Committee on Air Conditioning and adopted by the Annual Meeting on May 20–24, 1974.

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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
Reference herein to the 1974 National Electrical Code, NFPA No. 70, is to that code adopted by the National Fire Protection Association on May 22, 1974 at its Annual Meeting. This code is also known as the 1975 National Electrical Code.

Changes in this 1974 Edition from the 1973 Edition are indicated by vertical rules in the margins.

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 *Standard on Blower Systems*, NFPA 91. In 1937 it was decided to prepare a separate *Standard on Air Conditioning, Warm Air Heating, Air Cooling and Ventilating Systems.* This standard was initially adopted in 1937 with subsequent amendments in 1938, 1939, 1940, 1942, 1950, 1952, 1955, 1957, 1958, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1971, 1972, 1973, and now 1974.

Prior to 1955, the subject of the present standard was Part I of the *Standard on Air Conditioning*, NFPA 90. Since 1955 the two parts of NFPA 90 have been published separately as (this) NFPA 90A and as *Standard for the Installation of Warm Air Heating and Air Conditioning Systems* (NFPA 90B — 1973).

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Air Conditioning and Ventilating Systems

INTRODUCTION

General. Due to the ability of a duct system to convey smoke, hot gases and fire itself from area to area, and to accelerate a fire occurring within an air duct system, it is believed that a degree of fire protection commensurate with the characteristics of a duct system is essential to safety to life and the protection of property.

Materials. In the 1930's, during the early history of air conditioning systems, the combustion of materials used in the system itself contributed to substantial fire and smoke losses. It became apparent that materials possessing combustible and smoke-producing characteristics so slight as to be considered of little importance in an open room, could create a hazard under the draft conditions within a duct system. Therefore, greater attention was then given to prescribing the properties of materials used in ducts, interior linings and external coverings.

These properties are now subject to better identification, with general terms including "noncombustible" replaced in sections of this standard with specified flamespread and smoke-developed ratings based upon standard test procedures that compare fire hazard characteristics of materials.

Smoke. The movement of smoke through ducts creates a fire effect unique to buildings equipped with air duct systems. The smoke carried by relatively cool air precedes hot air that can actuate heat responsive devices, yet the cooler smoke can be distributed in sufficient quantity to cause injury or death, damage to property, or a tendency toward panic. Smoke-detecting devices were originally used but sparingly, when the state of the art of smoke detection was young. However, devices and systems for smoke detection have been improved and have found wide acceptance in protecting against these hazards.

Building Construction. The necessary installation of ducts and other elements of duct systems usually involves the piercing of walls, floors and ceilings. Where such walls, floors and ceilings have importance as fire barriers, the integrity of their fire resistance must be preserved.

Fire Prevention. The highest level of fire prevention is essential as a built-in aspect of an air conditioning installation because of the ability of a duct system to convey fire, hot gases and smoke quickly from area to area, and to accelerate a fire. Special attention is needed to the types of air filters and electrical equipment, and provision for their maintenance.

Maintenance Responsibility. Beyond the scope of this installation standard lies the responsibility for the maintenance of equipment including air filters, motors, fire dampers and controls, and cleanliness of ducts and plenums. There should be developed a greater awareness by owners, of the potential hazards of duct systems which do not receive periodic attention by qualified personnel.

Standard for the Installation of

Air Conditioning and Ventilating Systems

NFPA 90A — 1974

PURPOSE, SCOPE AND DEFINITIONS

1. Purpose and Scope

101. Purpose. It is the intent of this standard to provide general requirements to:

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

(b) Restrict the spread of heat and fire through duct systems from one fire area to another or into a building from the outside.

(c) Maintain the fire resistive integrity of building elements such as floors, walls and columns affected by duct system installation.

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

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

102. Scope. This standard applies to duct systems used for heating and ventilating, including warm air heating systems, plain ventilating systems, combination heating and ventilating systems, air cooling systems, air conditioning systems, and exhaust systems.[1]

103. This standard is intended to prescribe reasonable provisions based on minimum requirements for safety to life and property from fire.

2. Definitions

(a) AIR FILTERS. A Class 1 air filter is one which, when clean, does not contribute fuel when attacked by flame and emits only negligible amounts of smoke when tested by the *Standard for Air Filter Units* (UL900 — 1971).

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[1]For systems serving one or two family dwellings or serving spaces not exceeding 25,000 cu. ft. in volume in any occupancy, except in buildings of combustible construction over three stories in height, see NFPA 90B; for blower and exhaust systems for dust, stock and vapor removal or conveying, see NFPA 91; for systems in hospitals, in addition to this standard, see provisions for specific locations, as specified for use of inhalation anesthetics, see NFPA 56A; for ventilation of restaurant cooking equipment, see NFPA 96; for special protection of air systems in electronic computer/data processing rooms, see NFPA 75; for ventilation of transformer vaults, see Article 450 of NFPA 70; for systems in mobile homes, see NFPA 501B.

A Class 2 air filter is one which, when clean, burns moderately when attacked by flame or emits moderate amounts of smoke, or both when tested by the *Standard for Air Filter Units*, (UL 900 — 1971).

(b) BLOWER. A fan used to force air under pressure into an affected area.

(c) DUCT COVERING. The outside covering of a duct, fan casing, duct plenum. Includes materials such as adhesive, insulation, banding, coating(s), film, and jacket.

(d) DUCT LINING. The inside lining of a duct, fan casing, duct plenum. Includes materials such as adhesive, insulation, coating, and film.

(e) DUCT SYSTEM. A continuous passageway for the transmission of air which, in addition to ducts, may include duct fittings, dampers, plenums, fans and accessory air handling equipment.

(f) EXHAUSTER. A fan used to withdraw air from an affected area under suction.

(g) FAN. An assembly comprising blades or runners and housings or casings, and being either a blower or exhauster.

(h) FIRE DAMPER. A damper arranged to interrupt air flow automatically through part of an air duct system, so as to restrict the passage of heat. A fire damper may also be used as a smoke damper if location lends itself to the dual purpose. (*See 2(1).*)

(i) 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 *Standard Methods of Fire Tests of Building Construction and Materials* (NFPA 251 — 1972).

(j) FIRE WALL. A wall having adequate fire resistance and structural stability under fire conditions to accomplish the purpose of completely subdividing a building or completely separating adjoining buildings to restrict the spread of fire.

(k) FLAME SPREAD RATING. The flame spread rating of materials as determined by the *Method of Test of Surface Burning Characteristics of Building Materials*, (NFPA 255 — 1972). Such materials are listed in the Underwriters' Laboratories, Inc., *Building Materials List* under the heading "Hazard Classification (Fire)."

(l) HEAT DETECTOR. A device which detects abnormally high temperature or rate-of-temperature rise.

(m) PLENUM. An air compartment or chamber to which one or more ducts are connected and which forms part of an air distribution system.

(n) SMOKE DAMPER. A damper arranged to interrupt air flow automatically through a part of an air duct system, so as to restrict passage of smoke. A smoke damper may be a standard louvered damper serving other control functions if location lends itself to the dual purpose. A smoke damper does not need to meet all the requirements of a fire damper.

(o) SMOKE DETECTOR. A device which senses visible or invisible particles of combustion.

(p) SMOKE DEVELOPED RATING. The smoke developed rating of materials as determined by the *Method of Test of Surface Burning Characteristics of Building Materials* (NFPA 255 — 1972). Such materials are listed in *Fire Resistance Index* (UL — 1974) under the heading "Hazard Classification (Fire)".

SYSTEM COMPONENTS

3. Construction of Ducts

301. Ducts shall be constructed of iron, steel, aluminum or other approved metal or materials such as clay or asbestos cement (*See also 317(b)*).

Exception: Ducts need not conform to the above provisions if they are not used for vertical risers in air duct systems serving more than two stories and comply with the following:

(a) They shall be constructed of Class 1 duct materials as tested in accordance with Sections 3 through 21 of Standard for Air Ducts (UL 181 — 1972).

(b) Such ducts shall be installed in accordance with the conditions of their approval.

(c) They shall not be used in air duct systems which operate with an air temperature higher than 250° F entering the ducts.

302. Ducts may be of independent construction or a part of the building structure, provided they are in accordance with the requirements of this Standard. Where a duct passes through floors of a building, it shall also comply with 315.

303. (a) Flexible connectors (duct) for use between ducts and air outlets or air outlet units, and which do not pass through floors of buildings, need not conform to the requirements for ducts if they conform to the following provisions:

(1) Connectors not exceeding 8 in. in diameter shall conform to the requirements for Class 2 connectors when tested in accordance with Sections 3 through 21 of *Standard for Air Ducts* (UL 181 — 1972).

(2) Connectors exceeding 8 in. in diameter shall conform to the requirements for Class 1 connectors when tested in accordance with Sections 3 through 21 of *Standard for Air Ducts* (UL 181 — 1972).

(3) They shall not exceed 14 ft. in length.

(4) They shall not pass through any fire wall or partition which serves to restrict the spread of fire and is required to have a standard fire resistance rating of not less than two hours.

(5) Connectors used in concealed spaces consisting in part of combustible materials shall also pass the 15 minute flame penetration test for Class 2 air ducts as described in Section 7 of *Standard for Air Ducts* (UL 181 — 1972).

(b) Flexible connectors (duct) which are for use between ducts and air outlet units and which pass through one floor only shall conform for their full length to the following provisions:

(1) Connectors shall be of material having a melting point of not less than 1700°F, classed as noncombustible as defined in *Test for Noncombustibility of Elementary Materials*, (ASTM E136 — 1965), and conform with requirements for Class 1 air duct materials of *Standard for Air Ducts* (UL 181 — 1972).

(2) Connectors shall not exceed 20 square inches in cross-sectional area.

(3) Connectors shall not exceed 14 feet in length.

(4) Connectors shall not pass through any fire wall or partition which serves to restrict the spread of fire and is required to have a standard fire resistance rating of not less than two hours.

(5) Connector openings shall be firestopped in accordance with 313.

304. Vibration isolation connectors in duct systems shall be made of an approved flame retarded fabric or shall consist of sleeve joints with packing of approved material having a flame spread rating of not over 25 and a smoke development rating of not over 50. Vibration isolation connectors of fabric shall not exceed 10 inches in length.

305. (a) Duct coverings, linings (*see Section 2. Definitions*), and core materials in panels used in duct systems shall have a flame-spread rating not over 25 without evidence of continued progressive combustion and with a smoke developed rating not higher than 50. If the coverings and linings are to be applied with adhesives, they shall be tested as applied with such adhesives, or the adhesives used shall have a flame-spread rating not over 25 and a smoke developed rating not higher than 50.

Exception: Coverings need not meet these requirements where they are entirely located outside of a building and do not penetrate a wall or roof, and do not create an exposure hazard.

(b) Evidence shall also be offered that the duct coverings and linings will not flame, glow, smolder, or smoke when tested in accordance with *Test for Hot-Surface Performance of High-Temperature Thermal Insulation* (ASTM C411 — 1961) at a temperature to which it is exposed in service. In no case shall the test temperature be below 250° F.

(c) Appliances, such as fan coil units, self-contained air conditioning units, furnaces, etc., shall be considered to meet the requirements of 305(a) if they are listed.

306. Duct coverings shall not extend through walls or floors required to be firestopped or required to have a fire resistance rating. Duct linings shall be interrupted at fire dampers and fire doors so as not to interfere with their operation. Duct coverings and linings shall also be interrupted at the immediate area of operation of heat sources in a duct system involving electric resistance or fuel burning heaters.

307. Work involving the use of torches shall not be undertaken on ducts until the system has been shut down, the duct cleaned and all lining and covering material has been removed from the portion of the duct being repaired.

308. The materials, thickness, and construction of ducts shall provide structural strength and durability in conformance with recognized good practice. Ducts shall be deemed as meeting the intent of this paragraph if constructed, braced, and reinforced in accordance with:

(*a*) the *Duct Manual, Fibrous Glass Construction for Ventilating and Air Conditioning Systems*, Third Edition, 1972; the *Low Velocity Duct Construction Standard*, Fourth Edition, 1969; or the *High Velocity Duct Construction Standard*, Second Edition, 1969, (all published by Sheet Metal and Air Conditioning Contractors' National Association), whichever is applicable; or

(b) the *Guide and Data Book*, 1972 — "Equipment Volume," American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.

309. Ducts shall be made reasonably tight throughout and shall have no openings other than those required for proper operation and maintenance of the system. Wired glass may be used for inspection windows in ducts. Tape may be used for sealing joints but where exposed to the air in the duct, it shall be not more combustible than approved flameproofed fabric.

310. Return plenums and ducts, other than vertical ducts, shall be so constructed that the interior is accessible to facilitate the cleaning of possible accumulations of dust and combustible material in them (*See Appendix A, A-2 and A-3*). Clean-out openings at approximately 20-foot intervals shall be provided where accessibility to facilitate cleaning is required and where the ducts are smaller than 18 by 24 inches. Removable grilles of adequate size and accessibility may be accepted as clean-out openings.

Exception: Accessibility is not required when all of the following conditions prevail:

(a) The occupancy is not productive of combustible material such as dust, lint, greasy vapors, etc. Such occupancies are banks, office buildings, churches, hotels and institutions (but not kitchens, service rooms and manufacturing portions).

(b) The return openings are at least 7 feet above the floor or are protected by corrosion-resistant metal screens of at least 14 mesh, installed back of the grilles so that they will not draw in papers, refuse, cigarettes and other combustible solids.

(c) The minimum design velocity in the return from the particular occupancy is 1,000 feet per minute.

311. Supply ducts, other than vertical, shall conform to the above requirement for return ducts.

Exception: Where all of the supply air passes through either water spray or filters.

312. The clearance from metal ducts to stored combustible material shall not be less than 6 inches, and to combustible construction including plaster on wood lath not less than ½ inch.

Exception: These clearances may be disregarded for systems solely for ventilation, air cooling, or air conditioning without heating in small buildings, subject to approval by the authority having jurisdiction.

313. Where ducts pass through walls, floors or partitions the opening in the construction around the duct shall not exceed ½-inch average clearance on all sides and shall be firestopped by packing with mineral fiber or other approved material to prevent the passage of flame and smoke. (*See 306, which describes interruption of the duct covering.*)

Exception No. 1: This requirement may be disregarded where ducts are installed and enclosed as required under 315.

Exception No. 2: Where fire dampers are installed their proper clearance to building construction shall be maintained. (*See 905 (e).*)

314. Where ducts pass through concealed spaces within a floor/ceiling assembly or a roof/ceiling assembly constructed of combustible materials or through partitions or walls constructed of combustible materials, either the ducts or the interior surfaces of such concealed ceiling space, partition, or walls shall be protected with ¼-inch asbestos or other approved insulating material, or a clearance of ½-inch (as specified in 312) shall be maintained between ducts and all combustible materials. The integrity of fire-stopping shall be maintained. The spaces between the ducts and the fire-stopping shall be filled solidly with brick, mineral fiber, or other approved noncombustible material.

315. Ducts which pass through floors of buildings requiring the protection of vertical openings shall be enclosed with partitions or walls constructed of noncombustible materials having fire resistance rating (based on possible fire exposure from either side of the partition or wall) of not less than 1 hour when such ducts are located in a building less than 4 stories in height, and not less than 2 hours when such ducts are located in a building 4 stories or more in height. A fire resistive shaft used as a duct which conforms both with the above and with the requirements for ducts need not be additionally enclosed.

(a) The enclosure of ducts shall not be required for branches which are cut off from the main portion of the duct by approved fire dampers.

(b) Ducts which are located in one story and have all duct openings extending through a floor to the story next above or below may in lieu of such fire resistive enclosure be provided with approved fire dampers at each such point where the floor is pierced.

(c) Two or more ducts serving separate floors shall not be located within the same fire resistive enclosure unless approved fire dampers are installed where each branch is taken from such enclosure.

(d) The portion of a duct system below a floor which has a branch serving connectors which pierce the floor at more than one point is not required to be enclosed when all of the following are complied with:

(1) Each connector has a cross sectional area less than 20 square inches.

(2) The connectors pierce only one floor.

(3) Each connector serves an air handling terminal enclosed with material having a melting point of not less than 1700° F, classed as noncombustible as defined in *Test for Noncombustibility of Elementary Materials* (ASTM E136 — 1965) located on the floor above, and protected by the above mentioned enclosure.

(4) The above mentioned duct system is of material having a melting point of not less than 1700° F, classed as noncombustible as defined in *Test for Noncombustibility of Elementary Materials* (ASTM E136 — 1965) and conforms with requirements for Class 1 air duct materials of *Standard for Air Ducts* (UL181 — 1972).

(e) Where a branch serves connectors which pierce the floor at more than one point, that portion of the duct system below the floor shall be enclosed with construction having a fire resistance rating (based on possible fire exposure from either inside or outside the enclosure) of not less than 1 hour.

316. (a) No attic, basement, room, or concealed space in a building shall be used as an integral part of a duct system, unless it conforms to all the requirements for ducts. Plenums which conform to all the requirements for ducts may be located in any such portion of the building; such plenums shall not be used for storage or occupational purposes. Such arrangements shall be subject to the approval of the authority having jurisdiction.

Exception No. 1: The space between the ceiling and floor (or roof) of a floor and ceiling assembly or roof and ceiling assembly which has been tested in accordance with Standard Methods of Fire Tests of Building Construction and Materials (NFPA 251 — 1972) and obtained not less than a one-hour fire resistance rating may be used in accordance with 316(a) provided:

(a) No combustible materials shall be incorporated in the floor and ceiling construction.

(b) Openings in such ceilings shall be permitted only when the area of such openings does not exceed the proportionate areas of such openings in the assembly tested.

(c) The integrity of fire-stopping shall be maintained.

(d) Such spaces shall be used for a supply air plenum. (They may also be used for a return air plenum if tested for that purpose.)

(e) Electrical wiring in concealed spaces used as part of the air distribution system shall conform with Sections 300–21 and 300–22 of the National Electrical Code (NFPA 70-1974).

Exception No. 2: The space between the ceiling and floor (or roof) of other than the fire resistive assemblies covered by Exception No. 1 may be used in accordance with 316(a) provided there are no combustible materials in the concealed space, electrical wiring in such space complies with Sections 300–21 and 300–22 of the National Electrical Code (NFPA 70-1974), the ceiling material is constructed to resist deformation or collapse during installation and use, and complies with the following:

(a) They shall be made from a base material of metal or mineral.

(b) All surfaces of ceiling material shall possess a flamespread rating of not over 25 without evidence of continued progressive combustion and with a smoke developed rating of not higher than 50.

(c) The ceiling material shall be supported by noncombustible material which if of metal shall have a melting point above 1400° F.

(d) They shall not be subject to deterioration or deformation on long exposure to temperatures of 250° F or under conditions of high humidity, excessive moisture or mildew.

(e) They shall not be used on systems which operate with an air temperature higher than 250° F entering the air ducts.

(b) Public corridors in institutional and residential occupancies shall not be used as a portion of a supply or return air system serving adjoining areas other than toilet rooms, bathrooms, shower rooms, sink closets and similar auxiliary spaces opening directly on the corridor. This requirement shall not prohibit the use of mechanical ventilation for the corridors or incidental exfiltration because of pressure differential in special institutional occupancies. In apartment houses, this requirement shall not prohibit the use of a corridor

as a source of make-up air through normal leakage around doors for interior exhaust fans in kitchens, appliances, bathrooms, and toilets.[1]

Exception: One- and two-family dwellings.

(c) Exit passageways, stairways, ramps and other exits shall not be used as part of a supply, return, or exhaust esystm serving other areas of the building.[2]

317. (a) Ducts shall not be built into a building in such a way as to impair the effectiveness of the fireproofing around steel or iron structural members, such as placing ducts between the fireproofing and the members protected, except in the case of beams or joists protected by a ceiling of a fire resistive floor and ceiling or roof and ceiling assembly.

(b) Where ducts and openings are employed in a fire resistive floor and ceiling assembly or roof and ceiling assembly, the duct materials tested shall be used and such openings shall be limited in size and adequately protected to preserve the required fire resistance.[3]

(c) Where access doors or panels are necessary in the ceiling of a floor and ceiling assembly or roof and ceiling assembly, which has been tested in accordance with the *Standard Methods of Fire Tests of Building Construction and Materials* (NFPA 251 — 1972), the door or panel shall be designed and installed to not reduce the fire resistance rating of the assembly.

(d) Where the installation of the hangars for the components of an air duct system penetrates an existing ceiling of a fire resistive floor and ceiling assembly or roof and ceiling assembly and requires removal of a portion of that ceiling, materials used to repair the ceiling shall provide a construction equivalent to the existing ceiling.

Exception: In lieu of repair of the existing ceiling, another ceiling of the same construction may be installed below the duct system.

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[1]In accordance with Chapter 4 of the *Code for Safety to Life from Fire in Buildings and Structures* (NFPA 101 — 1973) institutional and residential occupancies are defined as follows:

Institutional — Hospitals, nursing homes, nurseries, homes for the aged, mentally retarded care institutions, penal institutions, reformatories, jails, and other similar occupancies.

Residential — Hotels, motels, apartment buildings, dormitories, orphanages, lodging or rooming houses.

[2]For a definition of exits see *Code for Safety to Life from Fire in Buildings and Structures.* (NFPA 101-1973.)

[3]For information on designs of fire resistive assemblies incorporating air handling components, see *Fire Resistance Index* (UL — 1974) under the heading, "Resistance Classification (Fire) — Floor or Roof and Ceiling Construction and Beam Protection."

318. Ducts shall not be located where they will be subject to damage or rupture. Where so located they shall be suitably protected.

319. Ducts shall be substantially supported. Hangers and brackets for supporting ducts shall be of metal.

4. Air Intakes and Outlets

401. Air shall not be recirculated from any space in which flammable vapors, flyings, or dust are present in quantities resulting in threshold limit values exceeding those recommended in the *Threshold Limit Values for Toxic Dusts, Fumes and Mists,* (American Conference of Governmental Industrial Hygienists), as determined with the fans off.

402. Discharge and exhaust air openings and recirculating air intakes shall be located at least 3 inches above the floor, except that protected floor inlets may be permitted under seats in theatres. When located less than 7 feet above the floor, inlet and outlet openings shall be protected by a substantial grille or screen, through the openings in which a half-inch sphere will not pass.

403. Fresh air intakes shall be protected by screens of corrosion-resistant material not larger than one-half inch mesh.

404. Care shall be exercised in choosing the location of fresh air intakes to avoid drawing in combustible material and to minimize the hazard from fires in other structures.

405. Air inlet and outlet ceiling openings with combustible grilles may be permitted provided the installation of such grilles conforms to the following provisions:

(a) They shall be of such materials and installed in such a manner as will assure their falling from position before they ignite.

(b) They shall be installed not less than 7 feet above the floor.

(c) They shall be installed so as not to permit propagation of flame from one grille or unit to another.

(d) They shall not be installed in ceilings of fire resistive floor and ceiling or roof and ceiling assemblies unless paragraph 317(b) is complied with.[1]

5. Air Filters

501. Air filters shall be of approved types that will not burn freely or emit large volumes of smoke or other objectionable products

[1]Where applicable, provisions on interior finish found in *Code for Safety to Life from Fire in Buildings and Structures* (NFPA 101 — 1973) and on obstructions to sprinklers, *Standard for the Installation of Sprinkler Systems* (NFPA 13 — 1974), also apply.

of combustion attacked by flames. Filters qualifying as Class 1 and Cla shall be accepted as meeting these requirements. (*See Sectio 2, Definitions.*) An evaporative cooler containing a combustible filter and water evaporation medium, such as excelsior, shall not be used.[1]

502. Liquid adhesive coatings used on air filters shall have a flash point not lower than 325° F, Cleveland open cup tester.

503. Liquid adhesive tanks into which removable filters are dipped should preferably be located outside the building or in a separate fire resistive room. Such tanks shall be of metal, equipped with tight-fitting covers and shall be kept tightly covered when not in actual use.

504. Where filters are flushed with liquid adhesives flowing through the air stream the system shall be arranged so that the filters cannot be flushed while the fan is in operation.

505. All air filters shall be kept free of excess dust and combustible material. Unit filters shall be renewed or cleaned when the resistance to air flow has increased to two times the original resistance or when the resistance has reached a value of recommended replacement by the manufacturer.[2] If the filters are of the automatic liquid adhesive type, sludge shall be regularly removed from the liquid adhesive reservoir.

6. Fans

601. When installed, fans shall be so located and arranged as to afford ready access for repairing, cleaning, inspection and lubricating.

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[1]The installation of approved automatic extinguishing equipment employing water, inert gas or other approved means in the enclosure of the air conditioning system to protect against combustion of material that may accumulate is recommended for systems other than those of the unit or cabinet type with blower capacity not exceeding 20,000 cubic feet per minute and which supply only one floor area or a portion thereof. Where sprinklers are installed, suitable provision should be made for drainage including adequate provision for overflow drains from any oil reservoirs installed at filters. In buildings not equipped with automatic sprinklers, the water supply may be taken from the house piping, if the supply is adequate for the purpose.

[2]A suitable draft gage should be provided for the purpose of monitoring resistance. Draft gages of a type, which will operate a warning light or produce an audible signal when excessive dust loads have accumulated, are recommended.

2. Exposed openings into fan housings shall be protected with antial metal screens or gratings to prevent accidents or the entry of foreign material.

603. Fans and air handling equipment connected thereto such as washers, filters, and heating and cooling units, shall be located in a room cut off from other portions of the building used for storage or occupational purposes by construction having a fire resistance rating equivalent to that required for the enclosure of the main supply or return ducts but not less than one hour, where either of the following conditions prevail (*See also 315*):

(a) The main portion of the duct system served by the fan passes through floors of fire-resistive, protected noncombustible, or heavy timber construction, in which vertical openings are generally protected, or

(b) The system serves more than a single room of a public or institutional building.[1]

7. Electric Wiring and Equipment

701. Electric wiring and equipment shall be installed in accordance with the *National Electrical Code* (NFPA 70 — 1974). Lamps within the working spaces of the conditioning system shall be enclosed in fixtures of the marine (vaportight) type, except that germicidal lamps of a type which operate at relatively low exposed surface temperatures need not be so enclosed. A disconnecting means shall be installed within sight and easy reach, in the ungrounded leads of each power circuit to electrically operated components which are in unprotected locations and in other locations not readily accessible for service. In particular, see Section 300–22 of the *National Electrical Code* (NFPA 70 — 1974).

702. Motors shall be located so that maintenance, such as oiling of bearings and replacing of brushes, can readily be accomplished. Open motors having commutators or collector rings shall be located or protected so that sparks cannot reach adjacent combustible material. Motors installed inside air ducts or plenums or inside unit type air conditioning equipment shall be provided with protection devices designed to cut off current before temperatures reach a point where smoke may be generated. These may be inherent over-temperature protective devices or over-current protective devices of the thermal overload relay type.

[1]Examples of public buildings are schools, libraries, exhibition buildings, assembly halls, dance halls and theatres; and of institutional buildings, hospitals, asylums, sanitariums and jails. If the fan room is used as a plenum chamber, see 316 (a).

8. Air Cooling and Heating Equipment

801. Mechanical refrigeration used with air duct systems shall be installed in accordance with nationally recognized safety practices. Installations conforming to the *American Standard Safety Code for Mechanical Refrigeration* (ANSI B9.1 — 1971) shall be considered as meeting these requirements.

802. Heating equipment shall be installed in an approved manner with due regard to clearance between hot surfaces and woodwork or other combustible materials.[1]

803. Heating furnaces and cooling units using the same duct system and blower shall have the refrigeration coil located downstream from the heating furnace, unless the heating furnace is specifically approved for installation downstream from the coil, or the coil is located parallel to the heating furnace. When the heating furnace is located upstream from the coil, the coil shall be so designed or equipped as to not develop excessive temperatures or pressures. In those cases where the coil is located parallel to the heating furnace, dampers or other means used to control flow of air shall be adequate to prevent chilled air from entering the furnace section. If the dampers are manually operated means shall be provided to prevent operation of either unit unless the damper is in the full heat or cool position. Adequate means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element.

The capacity of the blower shall be adequate to overcome the external static resistance imposed by the combined heating and cooling units at the air throughput required for heating or cooling, whichever is greater.

Furnaces (including duct furnaces) may be installed downstream from evaporative coolers or air washers if the heating element is made of corrosion-resistant material. Stainless steel, ceramic-coated steel, or an aluminum-coated steel in which the bond between the steel and the aluminum is an iron-aluminum alloy, are considered to be corrosion-resistant. Air washers operating with chilled water which delivers air below the dew point of the ambient air at the appliance are considered as refrigeration systems.

804. When the same coil is used for both heating and cooling, valves shall be provided to prevent chilling of the boiler during the operation of the cooling system.

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[1]The authority having jurisdiction should be consulted regarding standard requirements for installation of heating equipment. (For guidance, see *Manual on Clearances for Heat Producing Appliances*, NFPA 89M.)

When hot water heating boilers are connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

805. Where heat sources are introduced in a duct system involving electric resistance or fuel burning heaters, the adjacent duct covering and lining shall comply with 305(b).[1]

FIRE CONTROL

9. Automatic Fire Doors and Fire Dampers

901. Where Fire Doors Are Required. Duct systems should be designed so it will not be necessary to have ducts pass through fire walls. Where ducts, or outlets from or inlets to ducts pass through a fire wall, each opening in the fire wall shall be provided with

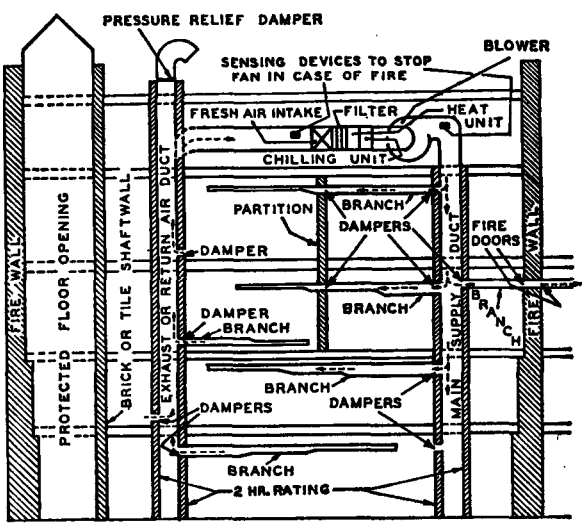

Fig. 1. Typical installation of air conditioning system in building

[1]Article 424 — Part F in particular, of the *National Electrical Code* (NFPA 70 — 1974) should also be consulted, as well as appropriate fuel burning heater control standards.

approved automatic closing fire doors, satisfactory for Class A openings, on both sides of the fire wall.

902. Where Fire Dampers Are Required. Approved fire dampers shall be provided as follows, subject to the exceptions in 903:

(a) Where a duct passes through a partition which serves to restrict the spread of fire and is required to have a standard fire resistance rating of not less than 2 hours.

(b) At each opening in a required enclosure of a vertical shaft.

(c) Where duct systems serve two or more floors, (1) at each direct air outlet or air inlet in the enclosure for a main vertical duct, or at each point where such vertical duct pierces a floor it serves, (2) and at the point where each branch duct pierces the enclosure for a main vertical duct (*See Fig. 2, 315 and 905(e)*).

(d) Where an aluminum duct or Class 1 duct regardless of size passes through a fire resistive floor.
Exception: Where encased as specified in 315.

(e) At fresh air intakes.
Exception: Where permission to omit them, because of light exposure, is granted by the authority having jurisdiction.

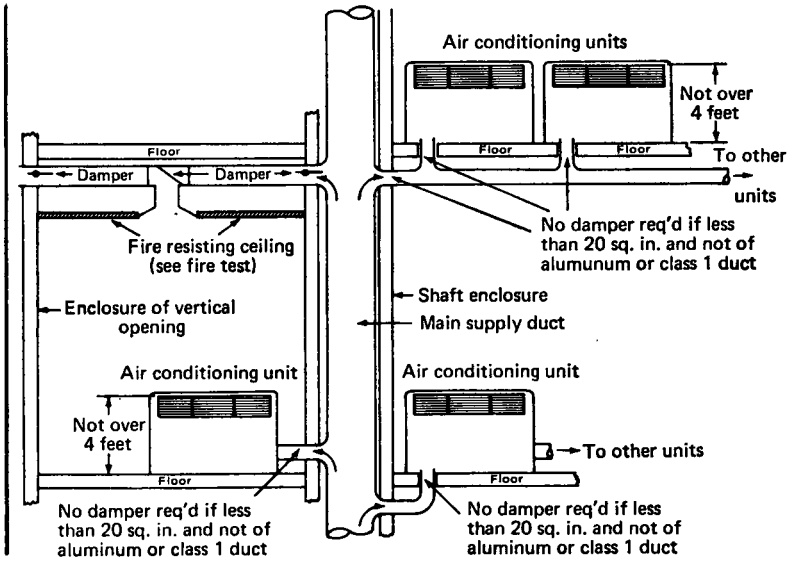

Fig. 2. Typical fire damper requirements and examples of locations where dampers are not required.

(f) As an alternate to enclosure of vertical ducts which extend through only one floor, dampers to be located at each point where the floor is pierced (*See 315(b)*).

(g) Where ducts installed above a ceiling of a fire resistive floor and ceiling assembly or roof and ceiling assembly are provided with openings in the ceiling, and such openings require ceiling fire dampers (*see footnote to 905(g)*) for protection to conform with the design of the fire resistive assembly, as tested in accordance with *Standard Methods of Fire Tests of Building Construction and Materials* (NFPA 251 — 1972). (*See also 315(b)*).[1]

903. *Exception: Fire dampers required under 902 may be omitted where any of the following conditions prevail:*

(a) In branch ducts, not of aluminum or Class 1 duct, having a cross-sectional area of less than 20 square inches which supply only air conditioning units discharging air at not over 4 feet above the floor.

(b) Where a branch duct serves air conditioning units discharging air not over four feet above the floor in one story only, supplied through the floor by individual connectors, each duct being less than 20 square inches in cross-sectional area, when installed in accordance with 315(d) and 315(e). (See Figure 2.)

(c) In buildings where floor openings are not required to be protected.

(d) In duct systems serving only one story and used only for exhaust of air to the outside and not penetrating a fire wall or partition which serves to restrict the spread of fire and is required to have a standard fire resistance rating of not less than two hours, or passing entirely through the enclosure for a vertical shaft.

(e) Where branch ducts connect to exhaust risers in which the air flow is upward and subducts are carried upward at least 22 inches inside the riser from each inlet (See Fig. 3).

904. Installation of Fire Doors.

(a) Fire doors shall be approved for the protection of Class A openings in fire walls. See *Standard for Fire Doors and Windows*, (NFPA 80—1974).

(b) Suitable hand hole openings shall be provided to make all fire doors in ducts accessible for inspection and servicing.

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[1]For information on designs of fire resistive assemblies incorporating openings in the ceiling, see *Fire Resistance Index* (UL — 1974) under the heading, "Resistance Classification (Fire) — Floor or Roof and Ceiling Construction and Beam Protection."

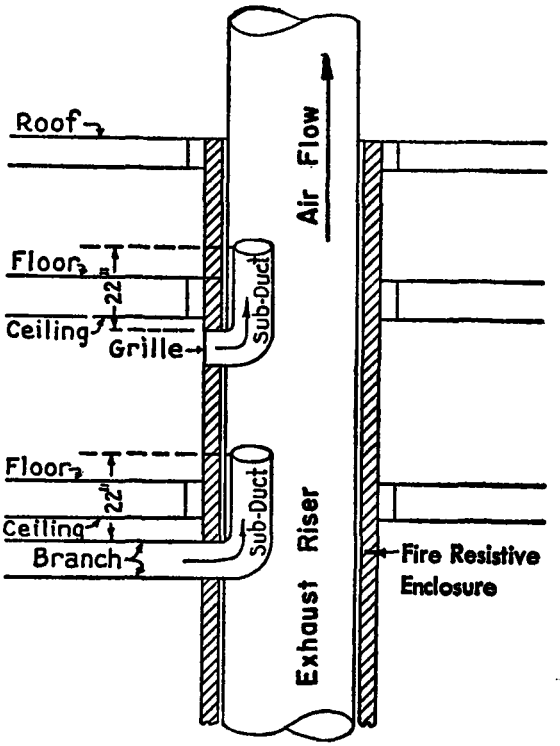

Fig. 3. Typical arrangement of sub-ducts [paragraph 903(e)].

(c) Fire doors shall be arranged to close automatically and remain tightly closed, upon the operation of an approved fusible link or other approved heat actuated device located where readily affected by an abnormal rise of temperature in the duct. Fusible links shall have a temperature rating approximately 50° F above the maximum temperature that would normally be encountered with the system in operation or shut down but not less than 165° F.

(d) Fire doors shall be so arranged that the disruption of the duct will not cause failure to protect the fire wall opening.[1]

905. Construction of Fire Dampers. Approved fire dampers shall have the following performance characteristics:

[1]This may be accomplished by locating the fire door in a substantial sleeve securely fastened to the wall.

(a) Fire dampers shall be arranged to close automatically in event of abnormal high temperature.

(b) Fire dampers shall provide the maximum practical barrier to passage of air when in the closed position.

(c) Fire dampers shall remain in the closed position under fire conditions.

(d) Fire dampers shall have resistance to corrosion.

(e) Fire dampers shall be so installed as to stay in place at the protected opening, even though the duct is disrupted during a fire, such as by the use of a substantial sleeve or frame secured by perimeter angles on both sides of the opening. Fire dampers shall be installed in accordance with the conditions of their approval and the manufacturer's instructions.

(f) Suitable hand hole openings with tightly fitted covers shall be provided to make fire dampers accessible for inspection and maintenance.

(g) Fire dampers shall possess a 1½-hour standard fire protection rating in accordance with *Standard for Fire Dampers* (UL 555 — 1970), except for dampers protecting openings in fire-resisting ceilings.[2]

(h) Fire dampers provided in ducts used solely for exhaust of air to the outside shall be installed in such a way that they will not interfere with the flow of air in the main duct.

906. The designer of an air duct system shall show on the plans the location of all automatic fire doors and fire dampers as required by this *Standard*.

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[1]Automatic closure is usually effected upon operation of an approved fusible link or other approved heat actuated device located where readily affected by an abnormal rise of temperature in the duct. Fusible links should have a temperature rating approximately 50° F above the maximum temperature that would normally be encountered with the system in operation or shut down.

[2]Fire dampers have been tested to determine that they possess a 1½-hour fire protection rating, including dampers constructed in accordance with Drawings MB-12H, MB-14H, SB-10H, and SB-14H SMACCNA. Other designs which have also been tested may be found in *Fire Resistance Index* (UL — 1974).

For the construction of dampers in fire-rated floor or roof-and-ceiling assemblies, tested in accordance with *Standard Method of Fire Tests of Building Construction and Materials* (NFPA 251), see the test result of the testing laboratory. The *Fire Resistance Index* (UL — 1974), illustrates many fire-rated floor and roof-and-ceiling assemblies tested with air conditioning ducts that pierce the ceiling of the assembly and with fire dampers installed. Means other than fire dampers have also been used for ceiling opening protection.

10. Controls

1001. Each system shall be equipped with a manual emergency stop, located at a conveniently accessible point, for quick shutting down of the fan(s) in case of fire. This location shall be submitted to the authority having jurisdiction for approval.

1002. A building having two or more stories or zones required to be separated by construction that will restrict the spread of smoke or fire and

(a) in which it is determined that evacuation time is excessive, or

(b) in which evacuation is not practical because occupants are incapable of self-preservation because of age, physical or mental disability, or because of security measures not under occupant control,

shall have the duct systems arranged so that in the event of a fire, flow of smoke from the fire zone will be inhibited from spreading to required interior ways of exit access, interior enclosed stairs and ramps, interior exit passageways, and designated refuge areas. Such an arrangement may involve air conditioning systems alone or in combination with other systems such as emergency venting, pressurizing system and fire suppression system, taking into account possible stack and wind effect of multistory buildings. Smoke control systems are required to be engineered for the specific occupancy and building design. This shall not preclude the use of other engineered approaches to provide equivalent protection to life and property when acceptable to the authority having jurisdiction. Appendix B includes considerations and guidelines for smoke control systems.

1003. Except as required by provisions of 1002, in systems between 2,000 cfm and 15,000 cfm capacity, fans shall be arranged to shut down automatically when the temperature of the air in the system becomes excessive, as from a fire. For this purpose, approved fixed temperature thermostatic devices shall be provided as follows:

(a) With a setting not in excess of 136° F, at a suitable location in the return air stream prior to exhausting from the building or being diluted by outside air, and

(b) With a setting not in excess of 50° F above the maximum operating temperature, at a suitable location in the main supply duct on the downstream side of the filters. Either the thermostatic device shall be of a type that is manually reset or the control system shall be so arranged that some manual operation is required to restart the fan after the thermostatic device has operated. Smoke

detectors approved for duct installation may be used in lieu of thermostatic devices.[1]

Exception: In lieu of the automatic fan shutdown, systems may incorporate automatic exhaust when acceptable to the authority having jurisdiction.

1004. Except as required by provisions of 1002, in systems of over 15,000 cfm cubic feet per minute capacity, smoke detectors approved for duct installation shall be installed and arranged to automatically shut down fans. For this purpose, smoke detectors approved for duct installation shall be provided as follows: (a) at a suitable location in the return air stream prior to exhausting from the building or being diluted by outside air, and (b) at a suitable location in the main supply duct on the downstream side of the filters. Smoke dampers shall be installed in such a manner as to restrict circulation of smoke, and arranged to close automatically when the system is not in operation, and also by operation of the smoke detecting apparatus and by the manual emergency fan stop.[2]

Exception: In lieu of the automatic fan shutdown, systems may incorporate automatic exhaust when acceptable to the authority having jurisdiction.

1005. Heat and smoke detectors required by the provisions of this Standard shall not be construed as a substitute for complete area protection afforded by an approved detection system, as prescribed in NFPA Standards 71 — 1974, 72A — 1974, 72B — 1972, 72C — 1974, and 72D — 1974. When such an approved detection system is installed in the building, the heat or smoke detectors required by provisions of 1003 and 1004 shall be connected thereto in accordance with approved practice, so that actuation of any heat or smoke detector will sound the fire alarm as well as provide the function of controlling the ventilation systems.

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[1]In systems of 15,000 cfm capacity and under, effective means of detecting and controlling the spread of smoke in air conditioning systems is recommended in premises where the panic hazard is pronounced or where there are valuable contents particularly subject to smoke damage.

[2]Usually, circulation of smoke can be restricted by installation of smoke dampers in the main supply and return ducts.

APPENDIX A. MAINTENANCE

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 which have involved air conditioning systems.

The following recommendations apply, in general, to the period of operation of the system; systems operated only part of the year should be given a thorough general check-up before starting operation and again after shutting down.

1. Fresh Air Intakes.

(a) Conditions outside the fresh air intake should be examined at the time of inspection of the ducts. Items to be noted are, (1) Accumulations of combustible material near the intake, (2) Presence of buildings or structures which may present an exposure to the intake allowing smoke and fire to be drawn in, (3) Operating condition of any automatic damper designed to protect the opening against exposure fire.

(b) If accumulations of combustible material are noted, they should be immediately removed, 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 see that it is adequate. (*See 902(e).*)

2. Inspection and Cleaning of Ducts.

(a) Inspections to determine the amount of dust and waste material in the ducts (both discharge and return) should be made quarterly, except that if after several inspections such frequent inspection is found unnecessary, the interval between inspections may be adjusted to suit the conditions.

(b) Cleaning should be undertaken whenever inspection indicates the need.

(c) Cooling and heating coils should be cleaned, if necessary, at the time of cleaning the ducts.

NOTE. — 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 will depend greatly on the occupancy and the arrangement of duct system.

3. Inspection and Cleaning of Plenum Chambers.

(a) Plenum chambers should be inspected monthly, except that if after several inspections such frequent inspection is found unnecessary, the interval between inspections may be adjusted to suit the conditions.

(b) Cleaning should be undertaken whenever inspection indicates the need. Where plenum chambers are found used for storage, arrangements should be made to prevent this, such as keeping the doors locked. (*See 316(a).*)

4. Filters.

(a) All air filters shall be kept free of excess dust and combustible material. Unit filters shall be renewed or cleaned when the resistance to air flow has increased to two times the original resistance or when the resistance has reached