NFPA 90B

Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

1999 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

IMPORTANT NOTICE ABOUT THIS DOCUMENT

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

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

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

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

NOTICES

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

Users of this document should be aware that this document may be amended from time to time through the issuance of Tentative Interim Amendments, and that an official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments then in effect. In order to determine whether this document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments, consult appropriate NFPA publications such as the *National Fire Codes*® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed above.

A statement, written or oral, that is not processed in accordance with Section 16 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

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

Users of this document should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action that is not in compliance with applicable laws, and this document may not be construed as doing so.

Licensing Policy

NFPA 90B

Standard for the

Installation of Warm Air Heating and Air-Conditioning Systems

1999 Edition

This edition of NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems,* was prepared by the Technical Committee on Air Conditioning and acted on by the National Fire Protection Association, Inc., at its May Meeting held May 17–20, 1999, in Baltimore, MD. It was issued by the Standards Council on July 22, 1999, with an effective date of August 13, 1999, 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 90B was approved as an American National Standard on August 13, 1999.

Origin and Development of NFPA 90B

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 standards on blower systems. In 1937, it was decided to prepare a separate standard on air-conditioning, warm air heating, and ventilating systems. This standard was initially adopted in 1937 with subsequent amendments in 1938, 1939, 1940, 1942, 1950, 1952, 1955, 1956, 1960, 1961, 1963, 1964, 1965, 1968, 1971, 1973, 1976, 1980, 1984, and 1989.

The 1993 and 1996 editions were reconfirmations of the 1989 edition.

The 1999 edition contains changes that are mainly editorial in nature, and references are updated to current editions.

Technical Committee on Air Conditioning

William A. Webb, *Chair*
Performance Technology Consulting, Ltd, IL [SE]

Charles E. Altizer, DHCD-Jackson Center, VA [E]
Rep. Int'l Fire Marshals Assn.
Jack B. Buckley, Houston, TX [SE]
Frederic B. Clarke, Benjamin/Clarke Assoc., Inc., VA [SE]
Michael Earl Dillon, Dillon Consulting Engr, Inc., CA [SE]
Mike K. Doerr, Federal Aviation Administration, TX [U]
Thomas M. Dusza, Schirmer Engr Corp., CA [SE]
S. E. Egesdal, Honeywell Inc., MN [M]
Rep. Nat'l Electrical Mfrs. Assn.
Victor Ferrante, U.S. Housing and Urban Development, DC [U]
Richard G. Gewain, Hughes Assoc., Inc., MD [SE]
James R. Hoover, The DuPont Co., DE [M]
Winfield T. Irwin, Irwin Services, PA [M]
Rep. North American Insulation Mfrs. Assn.
Philip R. Jose, U.S. Dept. of Veterans Affairs, NY [U]
Rep. American Society for Healthcare Engr
Daniel J. Kaiser, Underwriters Laboratories Inc., IL [RT]
Marvin A. Koerber, Atco Rubber Products Inc., TX [M]
Rep. Air Diffusion Council
James W. Naylor, Westinghouse Savannah River Co., SC [U]
Dale Rammien, Air Movement & Control Assn., Inc., IL [M]
Rep. Air Movement & Control Assn., Inc.
Sylvester A. Sampson, Jr., Raytheon Service Co., TX [IM]
William A. Schmidt, Bowie, MD [SE]
Randolph W. Tucker, Rolf Jensen & Assoc., Inc., TX [SE]
Robert Van Becelaere, Ruskin Mfg. Div., MO [M]
Rep. American Society of Mechanical Engr
Robert J. Wasilewski, Sheet Metal & Air-Conditioning Contractors Nat'l Assn., VA [IM]
Robert J. Wills, American Iron & Steel Inst., AL [M]

Alternates

Ken Adams, Society of the Plastics Industry, DC [M]
(Alt. to J. R. Hoover)
Lee Applegate, Hochiki America, CA [M]
(Alt. to S. E. Egesdal)
Delbert F. Boring, Jr., American Iron & Steel Inst., OH [M]
(Alt. to R. J. Wills)
Douglas S. Erickson, American Society for Healthcare Engr, IL [U]
(Alt. to P. R. Jose)
Timothy M. Goodman, Roche Carolina Inc., SC [IM]
(Vot. Alt. to ASHRAE Rep.)
Geraldine Massey, Dillon Consulting Engr, Inc., CA [SE]
(Alt. to M. E. Dillon)
Peter J. Mulvihill, Rolf Jensen & Assoc., Inc. NV [SE]
(Alt. to R. W. Tucker)
Jayendra S. Parikh, Underwriters Laboratories Inc., IL [RT]
(Alt. to D. J. Kaiser)
Thomas E. Ponder, CertainTeed Corp., PA [M]
(Alt. to W. T. Irwin)
J. Brooks Semple, Smoke/Fire Risk Mgmt., Inc., VA [SE]
(Alt. to W. A. Schmidt)
Robert A. Wessel, Gypsum Assn., DC [M]
(Vot. Alt. to GA Rep.)
Michael L. Wolf, Greenheck, WI [M]
(Alt. to D. Rammien)

Gregory E. Harrington, NFPA Staff Liaison

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. A key to classifications is found at the back of this document.

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

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

Contents

Chapter 1 General **90B–** 4
1-1 Scope **90B–** 4
1-2 Purpose **90B–** 4
1-3 Definitions **90B–** 4

Chapter 2 System Components **90B–** 4
2-1 Supply Systems **90B–** 4
2-2 Return Systems **90B–** 6
2-3 Common Requirements **90B–** 6

Chapter 3 Fire Integrity of Building Construction **90B–** 7
3-1 Clearances to Combustible Material **90B–** 7
3-2 Firestopping **90B–**10

Chapter 4 Equipment, Wiring, and Controls **90B–**12
4-1 Equipment **90B–**12
4-2 Electric Wiring and Equipment. **90B–**13
4-3 Controls **90B–**13

Chapter 5 Referenced Publications **90B–**13

Appendix A Explanatory Material **90B–**14

Appendix B Referenced Publications **90B–**14

Index **90B–**15

NFPA 90B

Standard for the

Installation of Warm Air Heating and Air-Conditioning Systems

1999 Edition

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

Information on referenced publications can be found in Chapter 5 and Appendix B.

Chapter 1 General

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

(1) One- or two-family dwellings
(2) Spaces not exceeding 25,000 ft^3 (708 m^3) in volume in any occupancy

Exception: Buildings of combustible construction over three stories in height shall be in accordance with NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

1-2 Purpose. This standard is intended to prescribe reasonable provisions based on minimum requirements for safety to life and property. Nothing in this standard is intended to prevent the use of alternative methods or devices, provided that sufficient technical data is submitted to the authority having jurisdiction to demonstrate that the proposed method or device is equivalent in quality, strength, fire endurance, effectiveness, durability, and safety to that prescribed by this standard.

1-3 Definitions.

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

Approved.* Acceptable to the authority having jurisdiction.

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

Central Warm Air Heating System. A heating system consisting of a heat exchanger with an outer casing or jacket, a solar collection system, or an electric heating unit that is connected to a supply system and a return system.

Combustible Material. Material made of or surfaced with wood, compressed paper, plant fibers, or other material that ignites and burns, whether flameproofed or not or whether plastered or unplastered.

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

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

Forced Air System. A central warm air heating system that is equipped with a fan or blower that provides the primary means for circulation of air.

Gravity System.* A central warm air heating system through which air is circulated by gravity.

Heat Exchanger. A chamber in which heat resulting directly from combustion of fuel, or heat from a medium such as air, water, or steam, is transferred through the walls of the chamber to the air entering the supply system or in which heat from electrical resistors is transferred to the air entering the supply system.

Heat Pump. A refrigeration system arranged to accomplish either heating or heating and cooling.

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

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

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

Return System. An assembly of connected ducts, air passages, or plenums and fittings through which air from the space or spaces to be conditioned is conducted back to the heat exchanger.

Rooms Large in Comparison with Size of Equipment. Rooms having a volume equal to at least 12 times the total volume of a furnace or air-conditioning appliance and at least 16 times the total volume of a boiler. The total volume of the appliance is determined from exterior dimensions and is to include fan compartments and burner vestibules, when used. When the actual ceiling height of a room is greater than 8 ft (2.44 m), the volume of a room is figured on the basis of a ceiling height of 8 ft (2.44 m).

Shall. Indicates a mandatory requirement.

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

Supply Systems. An assembly of connected ducts, air passages, or plenums and fittings through which air is conducted to the space or spaces to be conditioned.

Chapter 2 System Components

2-1 Supply Systems.

2-1.1 Duct Materials.

2-1.1.1* Supply ducts shall be made of either of the following materials:

(1) 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*
(2) Sheet metal having a nominal thickness as shown in Table 2-1.1.1

Table 2-1.1.1 Nominal Thickness of Sheet Metal Ducts

Diameter or Width		Nominal Thickness		Galvanized Sheet Minimum Thickness		Aluminum Thickness		Tin Plate Minimum Weight per Base Box	
in.	mm	in.	mm	in.	mm	in.	mm	lb	kg
Round Ducts and Enclosed Rectangular Ducts									
14 or less	356 or less	0.016	0.406	0.013	0.330	0.016	0.406	135	61
Over 14	Over 356	0.019	0.483	0.016	0.406	0.020	0.508	—	—
Exposed Rectangular Ducts									
14 or less	356 or less	0.019	0.483	0.016	0.406	0.020	0.508	—	—
Over 14	Over 356	0.022	0.559	0.019	0.483	0.023	0.584	—	—

Exception No. 1: Supply ducts that are completely encased in not less than 2 in. (51 mm) of concrete in a floor slab shall not be required to meet the requirements of 2-1.1.1, except within 2 ft (0.61 m) of the furnace supply plenum and within 2 ft (0.61 m) of a vertical connection to a riser or register.

Exception No. 2: Supply ducts for a separate air cooling system, not interconnected to any warm air heating system, serving a single-family dwelling shall not be required to meet the requirements of 2-1.1.1, provided that they are not closer than 2 ft (0.61 m) to any furnace or its supply plenum, boiler, or other heat-producing appliances and that they comply with 2-2.1.1, 2-2.1.3, 2-2.2, 2-2.3, and 2-2.4 as specified for return ducts.

Exception No. 3: Vibration isolation connectors in duct systems shall be made of approved flame-retardant fabric or shall consist of sleeve joints with packing of approved noncombustible material. The fabric shall not exceed 10 in. (254 mm) in length in the direction of airflow.

Exception No. 4: A 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. 5: A Class 0 or Class 1 rigid or flexible air duct shall not be used in an air duct containing air at a temperature in excess of 250°F (121°C).

2-1.1.2* Supply ducts shall be installed in conformance with the following:

(1) The conditions of their listing
(2) SMACNA *Fibrous Glass Duct Construction Standards*
(3) SMACNA *HVAC Duct Construction Standards — Metal and Flexible*
(4) SMACNA *Installation Standards for Residential Heating and Air Conditioning Systems*

2-1.2 Air Connectors. Air connectors are limited-use, flexible air ducts that shall not be required to conform to the requirements for air ducts, provided they conform with the provisions in 2-1.2.1 through 2-1.2.5.

2-1.2.1 Air connectors shall conform to the requirements for Class 0 or Class 1 connectors when tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors.*

2-1.2.2 Class 0 or Class 1 air connectors shall not be used in ducts containing air at temperatures in excess of 250°F (121°C).

2-1.2.3 An air connector run shall not exceed 14 ft (4.3 m) in length.

2-1.2.4 Air connectors shall not pass through any wall, partition, or enclosure of a vertical shaft that is required to have a fire resistance rating of 1 hour or more.

2-1.2.5 Air connectors shall not pass through floors.

2-1.3 Furnace Plenums. Furnace plenums shall be constructed of metal that is of the minimum thickness as shown in Table 2-1.1.1 and located a minimum of 36 in. (914 mm) from the heat exchanger measured along the centerline of airflow. Other plenums shall conform to the requirements for supply ducts.

2-1.4 Use of Underfloor Space as a Supply Plenum. Where heated air is discharged downward into an air chamber that forms a plenum of an underfloor space, the following shall apply:

(a) Use of such spaces shall be restricted to one-story portions of single-family dwellings.

(b) Such spaces shall be cleaned of all combustible material, shall be tightly and substantially enclosed, and shall not be used for storage or occupancy.

(c) The enclosing material of the underfloor space, including the sidewall insulation and ground cover, shall not be more flammable than 1-in. (25.4-mm) (nominal) wood boards. Ground cover not complying with this requirement shall be covered over with at least 2 in. (50.8 mm) of sand or other noncombustible material.

(d) Access, if provided to such spaces, shall be through an opening in the floor and shall not be greater than 24 in. × 24 in. (610 mm × 610 mm).

(e) Units supplying warm air to such a space shall be equipped with an automatic control that starts the air circulating fan when the air in the unit bonnet reaches a temperature not higher than 150°F (66°C). The automatic control shall not have the capability to be set higher than 150°F (66°C).

(f) Units supplying warm air to such a space shall be equipped with an approved temperature limit control that limits outlet air temperature to 200°F (93°C).

(g) A noncombustible receptacle shall be placed below each floor type, opening into the air chamber. Such receptacles shall conform to the following:

(1) The receptacle shall be suspended securely from the floor members and shall not be more than 18 in. (457 mm) below the floor opening.
(2) The size of the horizontal projected area of the receptacle shall extend 3 in. (76 mm) beyond the opening.

(3) The perimeter of the receptacle shall have a vertical lip at least 1 in. (25.4 mm) high at the open sides if it is at the level of the bottom of the joists or 3 in. (76 mm) high if the receptacle is suspended.

(h) Floor registers shall be designed for easy removal in order to provide access for cleaning the receptacles.

(i) Exterior walls and interior stud partitions shall be firestopped at the floor.

(j) Each wall register shall be connected to the air chamber with a duct or boot complying with 2-1.1, 3-1.3.1, and 3-1.3.2.

(k) Supply ducts to the air chamber shall comply with the provisions of 2-1.1, 3-1.1, and 3-1.2 and shall terminate approximately under the center of a room above at a distance of not less than 6 ft (1.83 m) from the plenum chamber.

(l) *Furnaces, boilers, or other heat-producing appliances shall not be installed in such a supply plenum.

2-2 Return Systems.

2-2.1 Duct Materials.

2-2.1.1 Return ducts shall be permitted to be constructed of metal, of 1-in. (25.4-mm) nominal wood boards, or of other suitable material, provided that no material more flammable than 1-in. (25.4-mm) boards shall be used.

Exception: As required by 2-2.1.2.

2-2.1.2 Portions of return ducts directly above the heating surface or closer than 2 ft (0.61 m) from the outer jacket or casing of the heater shall be constructed in accordance with provisions of 2-1.1 for supply ducts.

2-2.1.3 The interior of combustible ducts shall be lined with noncombustible material at points where there might be danger from incandescent particles dropped through the register or heater, such as directly under floor registers and the bottom of vertical ducts or directly under heaters having a bottom return.

2-2.2 Duct Openings. In buildings where vertical openings are required to be enclosed by walls or partitions having a fire resistance rating, openings in the enclosures for connections to vertical ducts carrying return air from more than one story shall be protected by approved fire dampers in such openings.

2-2.3 Continuous Ducts.

2-2.3.1 Return air shall be conducted to the appliance through continuous ducts.

Exception: As permitted in 2-2.3.2 and 2-2.3.3.

2-2.3.2* Underfloor spaces shall be permitted to be used as plenums for return of air from rooms directly above, provided such spaces are cleaned of all combustible material, are tightly and substantially enclosed, and are not used for storage or occupancy. Furnaces, boilers, and other heat-producing appliances shall not be installed in such a return plenum.

2-2.3.3 In a single-story residence, the return air shall be permitted to travel through the first floor living space to the return air inlet on the furnace. *(See 4-3.3.)*

2-2.4 Public Corridors. Public corridors shall not be used as a portion of a supply, return, or exhaust air system serving adjoining areas other than toilet rooms, bathrooms, shower rooms, sink closets, and similar auxiliary spaces opening directly on the corridor.

Exception: This requirement shall not prohibit the use of a corridor as follows:

(a) A source of makeup air through normal leakage around doors for interior exhaust fans in kitchens, appliances, bathrooms, and toilets

(b) A portion of a smoke control system, subject to the approval of the authority having jurisdiction

2-2.5 Negative Pressure from Circulating Fan. The return system and circulating fan shall be arranged so that negative pressure from the circulating fan cannot affect the air supply for combustion or act to draw products of combustion from joints or openings in the furnace or flue.

2-3 Common Requirements.

2-3.1* Duct Coverings and Linings.

2-3.1.1 Duct coverings *(see definition in Section 1-3),* duct linings *(see definition in Section 1-3),* and tapes used in duct systems shall have a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50. If 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 maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state.

Exception: These requirements shall not apply to duct coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

2-3.1.2 Duct coverings and linings shall not flame, glow, smolder, or smoke when tested in accordance with ASTM C 411, *Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation,* at the temperature to which it is exposed in service. In no case shall the test temperature be below 250°F (121°C).

2-3.1.3 Appliances such as fan coil units, self-contained air-conditioning units, and furnaces shall be considered to meet the requirements of 2-3.1.1 if they are listed. Unlisted solar energy air distribution system components shall be accompanied by supportive information indicating that their flame spread and smoke developed characteristics are not in excess of those of the duct system to which they are connected.

2-3.1.4 Duct coverings shall not extend through walls or floors required to be firestopped or required to have a fire resistance rating.

2-3.1.5 Duct coverings and linings shall be interrupted at the immediate area of operation of heat sources in a duct system that involves electric resistance, fuel-burning heaters, or heat exchangers connected to solar energy collection systems and shall be in accordance with the manufacturer's instructions.

Exception: Solar energy heat exchangers incapable of creating sustained operating temperatures higher than 200°F (93°C).

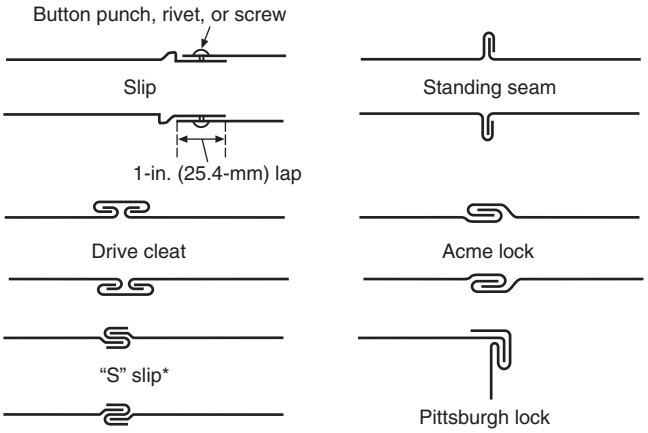
2-3.1.6 Duct coverings shall not conceal any service opening.

Exception: Where a label is permanently attached to the covering indicating the exact location of the opening.

2-3.2* Joints. Joints and seams shall be fastened securely and made substantially airtight. Slip joints shall have a lap of at least 1 in. (25.4 mm) and shall be fastened individually *(see Figure 2-3.2).* Tape shall be permitted to be used for sealing joints but, where exposed to the air in the system, it shall not be more combustible than fabric complying with NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.*

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

Figure 2-3.2 Types of duct joints.



*Used where the joint is otherwise fastened on two sides.

2-3.3 Duct Hangers. Ducts shall be supported securely by metal hangers, straps, lugs, or brackets. No nails shall be driven through the duct walls, and no unnecessary holes shall be cut therein.

2-3.4 Protection of Vertical Ducts. Where vertical ducts are installed within closets or rooms, they shall be enclosed with materials equivalent to those used in the closet or room construction. *(See 3-1.3.)*

2-3.5 Registers for Ducts and Plenums. Registers shall be constructed of metal or shall conform with the following:

2-3.5.1 Registers shall be made of a material classified as 94 HB when tested in accordance with UL 94, *Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances.*

2-3.5.2 Floor registers shall resist, without structural failure, a 200-lb (90.7-kg) concentrated load on a 2-in. (51-mm) diameter disc applied to the most critical area of the exposed face of the register. For this test, the register shall be at a temperature not less than 165°F (74°C) and shall be supported in accordance with the manufacturer's instructions.

2-3.5.3 Electric or fuel-fired furnace systems shall have at least one register or grille without a closable shutter, and the duct leading thereto shall be without a damper.

Exception: Where dampers and shutters cannot shut off more than 80 percent of the duct area.

2-3.5.4 Fittings connecting the registers to the duct system shall be constructed of metal or material that complies with the requirements of Class 0, Class 1, or Class 2 ducts in UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors.*

2-3.6 Pipeless Furnace Registers. Where registers are installed in the floor over the furnace, as in the case of a "pipeless" furnace, the register box shall be of double-walled construction with an air space not less than 4 in. (102 mm).

Exception: Where the warm air passage is surrounded by a cold air passage.

2-3.7 Use of Concealed Ceiling Spaces as Supply or Return Plenums. Where concealed ceiling spaces are to be used for air chambers or plenums, the following shall apply:

(1) Such installations shall be limited to detached single-family dwellings, and no concealed ceiling space plenum shall serve more than one story of such a residence. This shall not preclude separate installations on each floor.
(2) The concealed space plenum shall be separated from any other concealed spaces and shall be enclosed completely with construction not more flammable than 1-in. (25.4-mm) nominal wood boards.
(3) Such spaces shall not be used for storage or occupancy.
(4) No ventilating system shall discharge into such spaces.
(5) Units supplying such spaces shall be designed to limit the temperature of the air discharged into the supply plenum or chamber to 165°F (74°C).
(6) Where units incorporate heating elements, heated surfaces, or combustion chambers that develop temperatures higher than 165°F (74°C), such components shall be shielded to prevent direct radiation onto combustible material when the unit is installed.
(7) The installation of the unit supplying such spaces shall not produce negative pressure in the attic where the attic is the source of air for combustion for fuel-fired equipment.

Chapter 3 Fire Integrity of Building Construction

3-1 Clearances to Combustible Material.

3-1.1 General. Where ducts are adjacent to plaster on metal lath or to some other noncombustible finish attached to a combustible material, the clearance shall be measured to the combustible material.

Exception No. 1: The clearance shall be measured to the surface of the plaster or other noncombustible finish where a clearance of 2 in. (51 mm) or less is specified above a bonnet or plenum chamber or above supply ducts. This shall not be construed to prohibit the closure of openings with noncombustible material where ducts pass through walls and partitions, as provided in 3-1.2.

Exception No. 2: Where an appliance, ductwork, or chimney or vent connection is listed for different clearances, the listed clearances shall apply.

3-1.2 Clearances from Horizontal Supply Ducts. Minimum clearances from horizontal supply ducts to combustible materials shall be as follows:

(a) Within a distance of 3 ft (0.91 m) of the plenum of a system classified under A, C, or G of Table 3-1.3.1, the clearance shall be not less than that specified above the bonnet or plenum.

(b) Within a distance of 6 ft (1.83 m) of the plenum of a system classified under B or D of Table 3-1.3.1, the clearance shall be not less than 6 in. (152 mm). From ducts of furnaces classified under D, the clearance shall be not less than 1 in. (25.4 mm) beyond 6 ft (1.83 m) from the plenum to a point where there is a change in direction equivalent to 90 degrees or more.

(c) From ducts of furnaces classified under item F of Table 3-1.3.1, the clearance shall be not less than 18 in. (457 mm) up to 3 ft (0.91 m) from the bonnet or plenum, not less than 6 in. (152 mm) for 3 ft to 6 ft (0.91 m to 1.83 m), and not less than 1 in. (25.4 mm) beyond 6 ft (1.83 m).

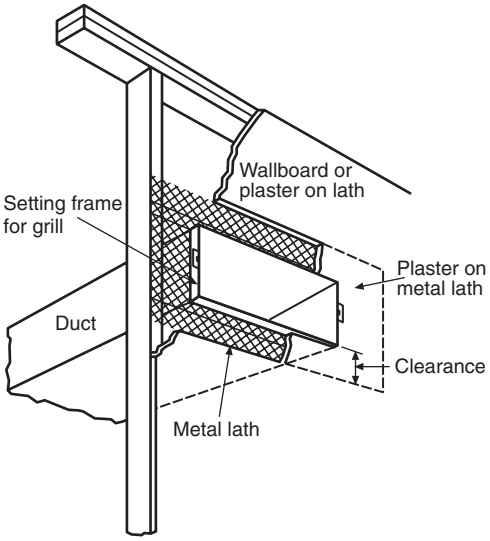
(d) Beyond the distances from the plenum or change in direction specified in 3-1.2(a) and (b), no clearance shall be required.

(e) Where a horizontal supply duct passes through or pierces a partition or enclosure constructed of combustible material, within the distances or point of change in direction specified in 3-1.2(a), (b), and (c), the clearance shall be not

less than that specified in those paragraphs. The ends of the space providing this clearance shall be permitted to be closed with a thimble and collar, or the wall surfaces shall be extended to the duct with noncombustible building material such as plaster on metal lath. *[See Figures 3-1.2(a) and (b).]*

(f) Separate air-cooling system ducts that are made of materials other than noncombustible material shall be installed with clearances to warm air ducts as required in 3-1.2(a), (b), and (c).

Figure 3-1.2(a) An arrangement for closing ends of clearance space around a supply duct. A similar arrangement can be used where a duct continues through the partition.



3-1.3 Clearances from Vertical Ducts, Risers, Boots, and Register Boxes.

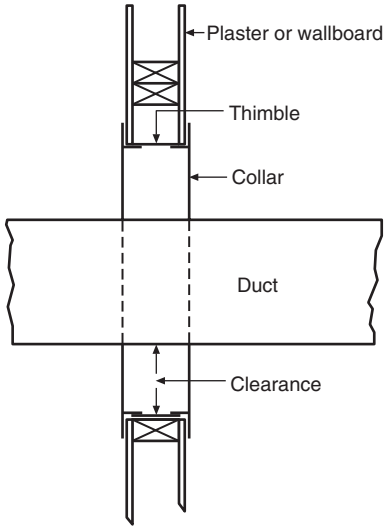
3-1.3.1 Where a duct, riser, boot, or box on a system that does not require 18-in. (457-mm) clearance above the supply plenum or bonnet enters a floor, partition, or enclosure constructed of combustible material within the distances from the plenum specified in 3-1.2(a) and (b), the clearance from such duct, riser, boot, or box shall be not less than the distance required above the furnace bonnet or plenum *(see Table 3-1.3.1),* or the duct shall change in a direction equivalent to at least two 90-degree turns before entering such floor, partition, or enclosure. These requirements shall not apply to pipeless furnaces as specified in 2-3.6.

3-1.3.2 Where a supply duct enters the floor of the first story above that story on which the furnace is located, the space around the duct at such points shall be sealed with noncombustible material.

3-1.3.3 Where a duct, riser, boot, or box on a system that requires 18 in. (457 mm) of clearance above the supply plenum or bonnet enters a floor, partition, or enclosure constructed of combustible material within a horizontal distance of 6 ft (1.83 m) of the furnace, the duct shall be arranged so that heated air travels at least 6 ft (1.83 m) from the closest primary heating surface and changes direction equivalent to at least one 90-degree turn before entering such a floor, partition, or enclosure.

3-1.3.4 Where a duct, riser, boot, or box on a system that requires 18 in. (457 mm) of clearance above the supply plenum or bonnet enters the floor of the first story above that story on which the furnace is situated, the clearance shall be at least $^{3}/_{16}$ in. (4.76 mm) from all combustible material in the floor construction.

Figure 3-1.2(b) An arrangement for passing ducts through combustible walls or partitions as specified in 3-1.2(e).



Exception: Where the duct is of double-wall construction with a continuous air space of not less than $^{3}/_{16}$ in. (4.76 mm) between the inner and outer walls.

3-1.3.5 Where a duct or riser on a system that requires 18 in. (457 mm) of clearance above the supply plenum or bonnet is enclosed in a partition, wall, or concealed space, constructed in whole or in part of combustible material, either of the following shall apply:

(1) The duct shall be installed with an air space of not less than $^{3}/_{16}$ in. (4.76 mm) between the duct and combustible material.

Exception: Where a noncombustible insulating covering of the cellular type that is at least $^{1}/_{8}$ in. (3.175 mm) thick is provided using metal lath and plaster partitions, no air space shall be required except from wood studs.

(2) The duct shall be double-walled with a continuous air space of not less than $^{3}/_{16}$ in. (4.76 mm) between the inner and outer walls.

3-1.3.6 Where a register on a system that requires 18 in. (457 mm) of clearance above the supply plenum or bonnet is placed in a floor or wall constructed of combustible material, the register box shall be installed with a clear space of not less than $^{3}/_{16}$ in. (4.76 mm) between the top and sides of the box and any combustible material.

3-1.4 Clearances from Furnaces, Boilers, Heat Exchangers, Heat Pumps, and Cooling Units.

3-1.4.1 Minimum clearances from furnaces, boilers, heat exchangers and their flue boxes, draft hoods, or chimney or vent connectors that are installed in rooms that are large in comparison with the size of the appliance shall be as specified in Table 3-1.3.1.

Exception: As provided in 3-1.1 and 3-1.4.2.

3-1.4.2 Heating furnaces and boilers used in residence-type central warm air heating systems shall be permitted to be installed in rooms that are large in comparison with the size of the appliance with clearances reduced as designated in Table 3-1.4.2 where combustible material is protected in the manner specified. *[See Figures 3-1.4.2(a), (b), and (c).]*

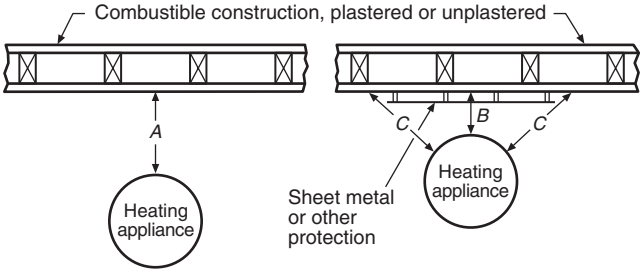
Exception: The reductions specified in Table 3-1.4.2 shall not apply to installations in alcoves or closets.

Table 3-1.3.1 Clearances to Combustible Material for Furnaces, Boilers, Solar Energy Heating Devices, and Heat Exchangers Installed in Rooms That Are Large in Comparison with Size of Appliance

System/Component	Minimum Clearance									
	Above and Sides of Bonnet or Plenum		Jacket Sides and Rear		Front[a]		Projecting Flue Box or Draft Hood		Chimney or Vent Connector	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
A. Listed automatically fired, forced air or gravity system with 250°F (121°C) temperature limit control:										
Burning liquid fuel	2[b]	51	6	152	24	610	18	457	18	457
Burning gas fuel	2[b]	51	6	152	18	457	6	152	6	152
Utilizing electricity	2[b]	51	6	152	18	457	—	—	—	—
B. Unlisted automatically fired, forced air or gravity system with temperature limit control that cannot be set higher than 250°F (121°C):										
Burning liquid fuel	6	152	6	152	24	610	18	457	18	457
Burning gas fuel	6	152	6	152	18	457	18[c]	457	18[c]	457
Utilizing electricity	6	152	6	152	18	457	—	—	—	—
C. Steam or hot water heat exchanger — steam not over 15 psi (103 kPa) pressure and hot water not more than 250°F (121°C).	2	51	2	51	2	51	—	—	—	—
D. Automatically stoker-fired, forced air system equipped with 250°F (121°C) temperature limit control with a barometric draft control:[d]										
Burning solid fuel	6	152	6	152	48	1219	18	457	18	457
E. Heating boilers used in central warm air heating systems — steam boiler operating at not over 15 psi (103 kPa) gauge pressure and hot water boilers operating at not in excess of 250°F (121°C) of the water wall–type or having a jacket or lining of masonry or other satisfactory material:										
Burning liquid fuel	6[e]	152	6	152	24	610	18	457	18	457
Burning gas fuel	6[e]	152	6	152	18	457	9[f]	229	9[f]	229
Burning solid fuel	6[e]	152	6	152	48	1219	18	457	18	457
Utilizing electricity	6[e]	152	6	152	18	457	—	—	—	—
F. Furnaces and heating boilers used in central warm air heating systems, other than above:										
Burning liquid fuel	18	457	18	457	48	1219	18	457	18	457
Burning gas fuel	18	457	18	457	18	457	18[c]	457	18[c]	457
Burning solid fuel	18	457	18	457	48	1219	18	457	18	457
G. Solar energy heat exchangers operating at a temperature not in excess of 250°F (121°C).	2[g]	51	2[g]	51	2[g]	51	—	—	—	—

[a]Front clearance shall be sufficient for servicing the burner and furnace or boiler.
[b]This clearance shall be permitted to be reduced to 1 in. (25.4 mm) for a listed forced air or gravity furnace equipped with a limit control that limits outlet air temperatures to 200°F (93°C).
[c]For unlisted gas appliances equipped with an approved draft hood, this clearance shall be permitted to be reduced to 9 in. (229 mm).
[d]The barometric draft control shall be operated by draft intensity and permanently set to limit the draft to a maximum intensity of 0.13 in. (32.4 Pa) of water gauge.
[e]This clearance is above top of boiler.
[f]This clearance shall be permitted to be reduced to 6 in. (152 mm) for listed gas burning furnaces and boilers.
[g]This clearance also shall apply to ducts from solar collectors to heat exchangers or thermal storage systems.

Figure 3-1.4.2(a) Sheet metal or other protection to reduce required clearance from heating appliance.



A equals the required clearance with no protection as specified in Table 3-1.3.1.

B equals the reduced clearance permitted in accordance with Table 3-1.4.2.

The protection applied to construction using combustible material shall be required to extend far enough in each direction so that *C* equals *A*.

3-1.4.3 Furnaces and boilers used in residence-type central warm air heating systems shall not be installed in a confined space such as an alcove or closet.

Exception: Furnaces and boilers specifically approved for such installations, where installed in compliance with the approval and with the clearances from the walls and ceiling of the alcove or closet not less than specified, regardless of the type of construction.

3-1.4.4 Cooling units, heat pumps, and equipment involving furnaces, boilers, or electric resistance heating shall not be installed in an attic or in any other space in the building construction that is used as a supply or return plenum.

Exception: Cooling units, heat pumps, and heating equipment shall be permitted to be installed in such a supply or return plenum where specifically approved for such use as a result of tests and listing by an approved testing laboratory. Such units or equipment shall be installed in accordance with the conditions of such approval.

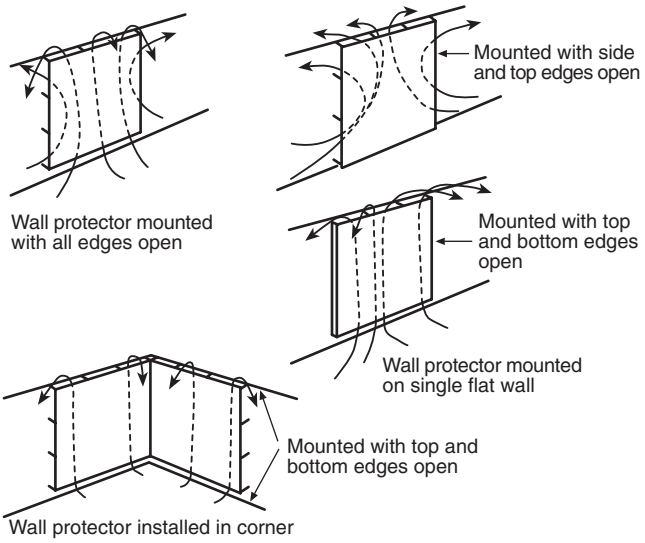
3-1.4.5 Furnaces, boilers, heat exchangers, heat pumps, solar energy system components, and air-conditioning and cooling units shall be installed to provide accessibility for cleaning heating surfaces; for removing and replacing burners, motors, compressors, controls, air filters, draft regulators, and other working parts; and for adjusting, cleaning, and lubricating parts requiring such attention.

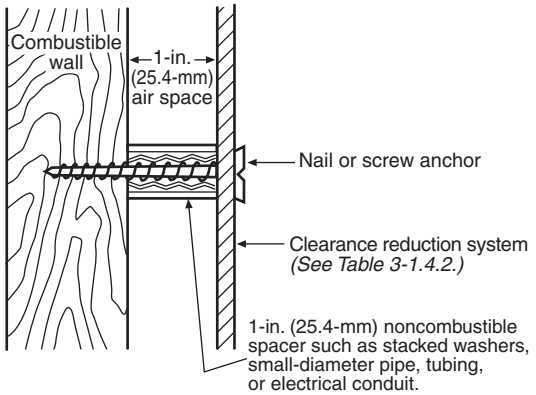
3-2 Firestopping.

3-2.1 Where the installation of ducts in walls, floors, or partitions necessitates the removal of any firestopping, the spaces around the duct at such points where firestopping was removed shall be sealed with noncombustible insulating material.

3-2.2 Where spaces between studs in walls or partitions are used as return ducts, the portions of such spaces so used shall be cut off from all remaining unused portions by tight-fitting stops made of sheet metal or wood that is not less than 2-in. (51-mm) (nominal) thickness. Such spaces shall not be used as a supply duct.

Figure 3-1.4.2(b) Wall protector clearance reduction system.





Masonry walls shall be permitted to be attached to combustible walls using wall ties.

Spacers shall not be used directly behind appliance or connector.

Figure 3-1.4.2(c) Masonry clearance reduction system.

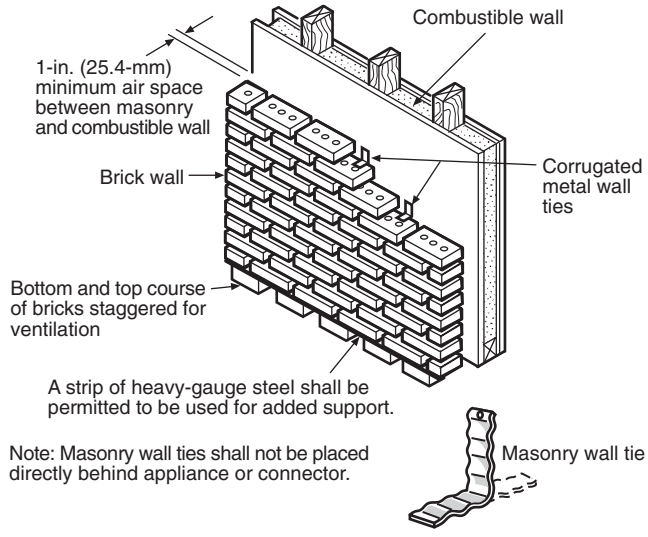


Table 3-1.4.2 Reduction of Clearances with Specified Forms of Protection

	Required Clearance with No Protection from Appliance and Vent Connector for Single Wall Metal Pipe																			
	36 in. (914 mm)				18 in. (457 mm)				12 in. (305 mm)				9 in. (229 mm)				6 in. (152 mm)			
	Allowable Clearance with Specified Protection																			
	Above		Sides and Rear		Above		Sides and Rear		Above		Sides and Rear		Above		Sides and Rear		Above		Sides and Rear	
Type of Protection*	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
3 1/2-in. (89-mm) thick masonry wall without ventilated air space	—	—	24	610	—	—	12	305	—	—	9	229	—	—	6	152	—	—	5	127
1/2-in. (12.7-mm insulation board over 1-in. (25.4-mm) glass fiber or mineral wool batts	24	610	18	457	12	305	9	229	9	229	6	152	6	152	5	127	4	102	3	76
0.024-in. (0.6-mm) (24-gauge) sheet metal over 1-in. (25.4-mm) glass fiber or mineral wool batts reinforced with wire on rear face with ventilated air space	18	457	12	305	9	229	6	152	6	152	4	102	5	127	3	76	3	76	3	76
3 1/2-in. (89-mm) thick masonry wall with ventilated air space	—	—	12	305	—	—	6	152	—	—	6	152	—	—	6	152	—	—	6	152
0.024-in. (0.6–mm) (24-gauge) sheet metal with ventilated air space	18	457	12	305	9	229	6	152	6	152	4	102	5	127	3	76	3	76	2	51
1/2-in. (12.7-mm) insulation board with ventilated air space	18	457	12	305	9	229	6	152	6	152	4	102	5	127	3	76	3	76	3	76
0.024-in. (0.6-mm) (24-gauge) sheet metal with ventilated air space over 0.024-in. (0.6-mm) (24-gauge) sheet metal with ventilated air space	18	457	12	305	9	229	6	152	6	152	4	102	5	127	3	76	3	76	3	76
1-in. (25.4-mm) glass fiber or mineral wool batts sandwiched between two sheets 0.024-in. (0.6-mm) (24-gauge) sheet metal with ventilated air space	18	457	12	305	9	229	6	152	6	152	4	102	5	127	3	76	3	76	3	76

*Applied to and covering all surfaces of combustible material within the distance specified as the required clearance with no protection.

Notes:

1. Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.
2. All clearances shall be measured from the outer surface of the combustible material to the nearest point on the surface of the appliance, disregarding any intervening protection applied to the combustible material.
3. Spacers and ties shall be of noncombustible material. No spacer or tie shall be used directly opposite an appliance or connector.
4. With all clearance reduction systems using a ventilated air space, means for air circulation shall be provided as described. *[See Figures 3-1.4.2(b) and (c).]*
5. There shall be at least 1 in. (25.4 mm) of clearance between the reduction system and combustible walls and ceilings for reduction systems using ventilated air space.
6. If a wall protector is mounted on a single flat wall away from corners, adequate air circulation shall be permitted to be provided by leaving only the bottom and top edges, or only the side and top edges, open with at least a 1-in. (25.4-mm) air gap.
7. Mineral wool batts (blanket or board) shall have a minimum density of 8 lb/ft^3 (128 kg/m^3) and a minimum melting point of 1500°F (816°C).
8. Insulation material used as part of the clearance reduction system shall have a thermal conductivity of 1.0 (Btu-in.)/(ft-hr-°F) or less.
9. There shall be at least 1 in. (25.4 mm) between the appliance and the protector. In no case shall the clearance between the appliance and the combustible surface be reduced below that permitted by the table.
10. All clearances and thicknesses are minimum; larger clearances and thicknesses shall be permitted.

Chapter 4 Equipment, Wiring, and Controls

4-1 Equipment.

4-1.1 Heating Panels.

4-1.1.1 Air chambers that have one or more external surfaces designed for use as heating panels shall be used only with the following:

(1) Automatically fired gas-burning or oil-burning forced warm air systems equipped with temperature limit controls that limit furnace outlet air temperature to 200°F (93°C)
(2) Forced warm air systems equipped with heat exchangers utilizing steam that cannot exceed 15 lb (103 kPa) gauge pressure or hot water that cannot exceed a temperature of 250°F (121°C)

4-1.1.2 Connection. Heating panels shall be connected to supply and return air ducts that conform to this standard.

4-1.1.3 Construction.

4-1.1.3.1 Where the warm air supply is from a warm air furnace, heating panels shall be enclosed on all sides with material that is wholly noncombustible or that possesses a flame spread classification of not over 25 as determined in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*. This enclosing material shall be attached securely to the building structure; joints and seams shall be substantially airtight. Braces and hangers inside the chamber shall be noncombustible.

4-1.1.3.2 Where the warm air supply is from a steam or hot water heat exchanger, heating panels either shall comply with 4-1.1.3.1 or shall be enclosed on all sides with material not more flammable than 1-in. (25.4-mm) (nominal) wood boards. This enclosing material shall be attached securely to the building structure; joints and seams shall be substantially airtight. No single vertical heating panel shall serve more than one story.

4-1.2 Down-Flow Systems.

4-1.2.1 Down-flow heating equipment shall be designed or equipped so that the outlet air temperature shall not exceed 200°F (93°C).

Exception: For systems installed under the provisions of 2-3.7, the outlet air temperature shall be limited to 165°F (74°C).

4-1.2.2 Equipment shall be designed so as to prevent unsafe temperature in the event of reverse flow or fan failure.

4-1.3 Air Filters.

4-1.3.1 Air filters shall have either a Class 1 or Class 2 rating in accordance with UL 900, *Standard for Safety Air Filter Units*.

4-1.3.2 An evaporative cooler containing a combustible filter and water evaporation medium, such as excelsior, shall not be used.

4-1.3.3 Liquid adhesive coatings used on filters shall have a flash point not less than 325°F (163°C) in accordance with ASTM D 93, *Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester*.

4-1.4 Air-Cooling Equipment.

4-1.4.1 Mechanical refrigeration used with air duct systems shall be installed in accordance with ANSI/ASHRAE 15, *Safety Code for Mechanical Refrigeration*.

4-1.4.2 Evaporative coolers containing a combustible evaporating medium, such as excelsior, shall not be used. This requirement does not preclude the use of evaporation media meeting the requirements of 4-1.3.1.

4-1.5 Furnaces Used with Cooling Units.

4-1.5.1 Furnaces that are combination units in which a refrigeration coil is provided shall have the refrigeration coil located downstream from the heating furnace, or the coil shall be located parallel to the heating furnace.

Exception: Where the heating furnace is specifically approved for installation downstream from the coil.

4-1.5.2 Where the heating furnace is located upstream from the coil, the coil shall be designed or equipped to prevent the development of excessive temperatures or pressures. In those cases where the coil is located parallel to the heating furnace, dampers or other means to control the flow of air shall be provided to prevent chilled air from entering the furnace section. Means shall be provided for the disposal of condensate and to prevent dripping of condensate on the heating element.

Exception: Manually operated dampers shall not be required to be provided with means to prevent operation of either unit, provided the damper is in the full heat or cool position.

4-1.5.3 Furnaces, including duct furnaces, shall be permitted to be installed downstream from evaporative coolers or air washers, provided that the condensate cannot fall into any portion of burners, pilots, or burner carryover arms and provided that the heating element is made of corrosion-resistant material, such as 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.

4-1.5.4 Air washers operating with chilled water that delivers air below the dew point of the ambient air at the appliance shall be considered as refrigeration systems.

4-1.5.5 The blower shall be of such capacity as 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.

4-1.6 Boilers Used with Cooling Units.

4-1.6.1 Where 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.

4-1.6.2 Where hot water heating boilers are connected to heating coils located in air-handling units and where they are 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.

4-1.7 Heat Pump Systems. Heat pump systems involving units or equipment installed in attics or in a space in the building construction used as a supply or return plenum shall conform to the appropriate provisions of 2-3.7 and 3-1.4.

4-1.8 Solar Systems.

4-1.8.1 Solar systems or solar assisted systems shall be designed, constructed, and controlled so that the air temperature in the supply system shall not exceed 250°F (121°C).

4-1.8.2 A flammable or combustible heat transfer fluid from a solar energy system shall not be used in a heat exchanger located in a duct system.

4-2 Electric Wiring and Equipment. Electric wiring and equipment shall be adequate for safe operation and shall be installed in accordance with NFPA 70, *National Electrical Code®*. In addition, a disconnecting means shall be installed within sight and reach in the ungrounded leads of each power circuit to electrically operated components that are in unprotected locations and in other locations not accessible for service.

4-3 Controls.

4-3.1 Temperature Limit Controls. Temperature limit controls shall be of a listed type and shall be such that they cannot be set higher than a specified temperature setting and shall be located no more than 2 ft (0.61 m) downstream from the heat exchanger.

4-3.2 Fan Control for Stoker-Fired Furnaces. Where a warm air furnace equipped with a fan to circulate the air is stoker-fired, it also shall be equipped with an automatic overrun control to start the fan when the air in the furnace bonnet or the air at the beginning of the main supply duct at a point not affected by radiated heat reaches a temperature not higher than 200°F (93°C) after the stoker and fan (in its normal operation) have been shut down as a result of a satisfied thermostat. If a manual disconnect is installed in the air circulating fan electrical circuit, it shall be installed to deenergize both the fan and the stoker simultaneously.

4-3.3* Air for Combustion and Ventilation. Heating appliances shall be installed in a location in which the facilities for ventilation provide for combustion and proper ventilation under normal conditions of operation and use.

4-3.4 Thermostatically Controlled, Hand-Fired, Solid Fuel–Burning Furnaces. Hand-fired, solid fuel–burning furnaces on which the furnace draft is controlled by a thermostat shall be equipped with the following:

(1) A fail-safe 250°F (121°C) limit control installed not more than 10 in. (254 mm) above the top surface of the heat exchanger in a supply plenum that extends at least 12 in. (305 mm) above the top surface of the heat exchanger

(2) *A barometric draft control operated by draft intensity and permanently set to limit the draft to a maximum intensity of 0.13 in. (32.4 Pa)

4-3.5 Air-Circulating Fan Controls. Where a hand-fired, solid fuel–burning furnace is equipped with a fan to circulate the air, it shall be equipped with fan controls as required for stoker-fired furnaces by 4-3.2.

4-3.6 Accessory Equipment. Material used in the construction of accessory equipment attached to or installed in a supply or return system shall comply with the requirements for the materials of that portion of the system to which it is attached. This shall not preclude the attachment to a plenum or duct of small devices, such as humidifiers, specifically listed for such use. Motors and electrical wiring and equipment shall comply with Section 4-2.

Chapter 5 Referenced Publications

5-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix B.

5-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 70, *National Electrical Code®,* 1999 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 1999 edition.

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

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films,* 1999 edition.

5-1.2 Other Publications.

5-1.2.1 ANSI/ASHRAE Publication. American National Standards Institute, 11 West 42nd Street, 13th floor, New York, NY 10036.

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

5-1.2.2 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

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

ASTM D 93, *Standard Test Methods for Flash Point 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.

5-1.2.3 SMACNA Publications. Sheet Metal and Air-Conditioning Contractors' National Association, Inc., 4201 Lafayette Center Drive, Chantilly, VA 22021-1209.

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

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

Installation Standards for Residential Heating and Air Conditioning Systems, 6th edition, 1988.

5-1.2.4 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 94, *Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances,* 1991.

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.

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

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