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STANDARDS

for the Installation of

Residence Type
WARM AIR HEATING

and

Air Conditioning Systems

July
1956

Thirty-five cents*

NATIONAL FIRE PROTECTION ASSOCIATION
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National Fire Protection Association

International

Executive Office, 60 Batterymarch St., Boston 10, Mass.

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes nearly two hundred national and regional societies and associations (list on outside back cover) and more than sixteen thousand individuals, corporations, and organizations. Anyone interested may become a member; membership information is available on request.

This pamphlet is one of a large number of publications on fire safety issued by the Association including periodicals, books, posters and other publications; a complete list is available without charge on request. All NFPA standards adopted by the Association are published in six volumes of the **National Fire Codes** which are re-issued annually and which are available on an annual subscription basis. The standards, prepared by the technical committees of the National Fire Protection Association and adopted in the annual meetings of the Association, are intended to prescribe reasonable measures for minimizing losses of life and property by fire. All interests concerned have opportunity through the Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

NFPA standards are purely advisory as far as the Association is concerned, but are widely used by law enforcing authorities in addition to their general use as guides to fire safety.

Definitions

The official NFPA definitions of shall, should and approved are:

SHALL is intended to indicate requirements.

SHOULD is intended to indicate recommendations, or that which is advised but not required.

APPROVED refers to approval by the authority having jurisdiction.

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The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The standards are prepared, as far as practicable, in terms of required performance, avoiding specifications of materials, devices or methods so phrased as to preclude obtaining the desired results by other means. The suitability of devices and materials for installation under these standards is indicated by the listings of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada, Factory Mutual Laboratories and American Gas Association Laboratories test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

Residence Type Warm Air Heating and Air Conditioning Systems

NFPA No. 90B — 1956

This edition of NFPA No. 90B with revisions recommended by the Committee on Air Conditioning and adopted by the Association on June 5, 1956, with a supplementary change adopted by the NFPA Board of Directors July 16, 1956, supersedes the 1955 edition. Prior to 1955, the subject of the present standard was Part II of the Standards on Air Conditioning, No. 90.

Prior to 1936, the subject of air conditioning was covered in NFPA Standards on Blower Systems, No. 91. 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 and 1955. Successive editions of this standard have been adopted and also published by the National Board of Fire Underwriters in editions with identical text and the same designating number; also by the Dominion Board of Insurance Underwriters as DBIU No. 90B.

For Standards for the Installation of Air Conditioning and Ventilating Systems of Other Than Residence Type see NFPA No. 90A.

Contents

	Page
100. Application and Scope	90B-3
110. Definitions	90B-3
120. Supply Ducts	90B-4
130. Controls	90B-7
140. Clearances to Combustible Material	90B-8
150. Heating Panels	90B-15
160. Down-Flow Furnace Systems	90B-16
170. Return Ducts	90B-17
180. Air Filters	90B-19
190. Electric Wiring and Equipment	90B-19
200. Air Cooling Equipment	90B-19
210. Hand Fired Solid Fuel Burning Furnaces	90B-20
220. Heat Pump Systems	90B-20
Appendix, Reference to other standards	90B-21

COMMITTEE ON AIR CONDITIONING

F. H. Faust, *Chairman,*
General Electric Co., 5 Lawrence St., Bloomfield, N. J. (rep. National Electrical Manufacturers Assn.)

Martin M. Brown,† *Secretary,*
Associated Reciprocal Exchanges, 2 Park Ave., New York 16, N. Y.

Morris Bengal, New York State Building Code Commission.
A. C. Buensod, Heating, Piping and Air Conditioning Contractors National Association.
R. C. Corson, Factory Mutual Engineering Division.
Keith T. Davis, Air-Conditioning & Refrigeration Institute.
Lewis L. Dollinger, Jr., Air Filter Institute.
E. C. Epple, American Institute of Architects.
E. W. Fowler, National Board of Fire Underwriters.
L. B. Hansen, Factory Insurance Assn.
W. M. Horn, Kentucky Inspection Bureau.
L. G. Keeney, NFPA Committee on Farm Fire Protection.
Geo. W. McCormick, Jr., National Assn. of Fan Manufacturers.
Fred W. McGhan, Federal Housing Administration.
G. P. Nachman, American Society of Heating and Air-Conditioning Engineers.
C. A. Pfahl, Sheet Metal Contractors' National Assn.
Robert K. Raisler, National Automatic Sprinkler and Fire Control Assn.
Sterling S. Sanford, Edison Electric Institute.
C. L. Sapp, National Warm Air Heating and Air Conditioning Association.
C. George Segeler, American Gas Assn.
Raymond C. Seifert, Association of Casualty & Surety Cos.
George V. Stafford, Improved Risk Mutuals.
E. K. Stoehr, Underwriters' Laboratories, Inc.
J. Milton Wright, Associated Reciprocal Exchanges.

Alternate

George S. Jones, Jr., Air-Conditioning and Refrigeration Institute. (Alternate to Keith T. Davis.)

†Non-voting member.

1956 Revisions

The revisions incorporated in the present edition include the following, also incidental editorial changes:

Paragraph 101. Addition of a reference to heat pumps.

Section 110. Revision of definition of Heat Exchanger to include a reference to electrical resistors. Addition of a new definition on heat pumps.

Paragraph 121. Addition of new sub-paragraphs d and e pertaining to duct construction.

Paragraph 122. Change in provisions for tape used in sealing joints.

Note 4, Table 1. Revisions to clarify location of limit control.

Paragraph 142. Addition of a new sub-paragraph d referring to accessibility of appliances for maintenance.

Paragraph 143. Expanded sub-paragraph a to include more specific reference to duct clearances with respect to the location of limit controls. Addition of a new sub-paragraph g pertaining to proximity of air conditioning ducts to heating ducts.

New Paragraph 165. New provisions pertaining to the use of underfloor crawl spaces as plenum chambers.

New Section 220. A new section with recommendations on heat pump systems.

STANDARDS FOR THE INSTALLATION OF RESIDENCE TYPE WARM AIR HEATING AND AIR CONDITIONING SYSTEMS

(NFPA No. 90B, formerly Part II of NFPA No. 90)

100. Application and Scope.

101. This standard applies to residence type central warm air heating and cooling systems including separate air cooling systems, combination heating and air conditioning systems, and to heat pump systems.

NOTE: For other type systems, see Standards for the Installation of Air Conditioning and Ventilating Systems of other than Residence type, NFPA No. 90A*, (formerly Part I of NFPA No. 90). For installation of Blower and Exhaust systems including kitchen ventilating see NFPA No. 91*.

102. This standard is intended to prescribe reasonable provisions based on minimum requirements for safety to life and property. It does not attempt to establish a procedure or code for the design of warm air heating or air conditioning systems from the standpoint of performance.

110. Definitions.

a. CENTRAL WARM AIR HEATING SYSTEM. A heating system consisting of a heat exchanger with an outer casing or jacket, or an electric heating unit, connected to a supply system and a return system.

b. COMBUSTIBLE MATERIAL. Material made of or surfaced with wood, compressed paper, plant fibers or other material that will ignite and burn, whether flameproofed or not, or whether plastered or unplastered.

c. FORCED AIR SYSTEM. A central warm air heating system that is equipped with a fan or blower which provides the primary means for circulation of air.

*See Appendix for information on availability of standards.

d. GRAVITY SYSTEM. A central warm air heating system through which air is circulated by gravity. It may also use an integral fan or blower that is used only to overcome the internal furnace resistance to air flow.

e. 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.

f. HEAT PUMP. A refrigeration system arranged to accomplish either heating or cooling.

g. LISTED. Included in a list published by an approved nationally recognized testing agency*, that is qualified and equipped for experimental testing, and maintains an adequate periodic inspection of current production of listed models and whose listing states either that the device complies with nationally recognized safety requirements or has been tested and found safe for use in a specified manner.

h. PLENUM. An air compartment or chamber to which one or more ducts are connected and which forms part of either the supply or return systems.

i. RETURN SYSTEM. An assembly of connected ducts, air passages or plenums and fittings through which air from the space or spaces to be heated is conducted back to the heat exchanger.

j. SUPPLY SYSTEM. An assembly of connected ducts, air passages or plenums and fittings through which air, heated in a heat exchanger, is conducted from the heat exchanger to the space or spaces to be heated.

120. Supply Ducts. Minimum requirements for the construction of supply ducts.

121. Duct Material. Except as permitted by pars. 121 c, d, e and f, supply ducts shall be constructed entirely of noncombustible material equivalent in structural strength and durability to the following:

* The Underwriters' Laboratories, Inc. and the American Gas Association, Inc. Laboratories are such nationally recognized testing agencies.

a. Ducts Not Enclosed in Partitions:

ROUND DUCTS

Diameter, Inches	Minimum Thickness Galv. Iron U. S. Gage	Minimum Thickness Aluminum B & S Gage	Minimum Weight of Tin-Plate
Less than 12	30	26	IC (107 lb.)
12 or more.....	28	26	IX (135 lb.)

RECTANGULAR DUCTS

Width, Inches	Minimum Thickness Galv. Iron U. S. Gage	Minimum Thickness Aluminum B & S Gage
Less than 14	28	26
14 or more.....	26	24

b. Ducts Enclosed in Partitions:

RECTANGULAR DUCTS

Width, Inches	Minimum Thickness Galv. Iron U. S. Gage	Minimum Thickness Aluminum B & S Gage	Minimum Weight of Tin-Plate
14 or less.....	30	26	IC (107 lb.)
Over 14	28	26	IX (135 lb.)

c. Supply ducts that are completely encased in not less than 2 inches of concrete in a floor slab need not meet the requirements of par. 121 except within 2 feet of the furnace supply plenum, and within 2 feet of a vertical connection to a riser or register.

d. Supply ducts serving a single family dwelling having heating equipment classified as items I and III only, in Table No. 1, need not meet the requirements of pars. 121a and b, except for the first three feet from the bonnet or plenum, if they conform to the following provisions and are approved for such use:

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

(2) They shall be constructed to resist deformation or collapse during installation and in exposed locations.

(3) They shall possess a flame spread classification of not over 50 as determined by the Standard Test Method for Fire Hazard Classification of Building Materials of Underwriters' Laboratories, Inc., NFPA No. 255,* (ASTM E84).

* See Appendix for information on availability of standards.

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

(5) They shall not be used on systems which operate with an outlet air temperature higher than 250°F.

e. Supply ducts for a separate air cooling system, not interconnected to any warm air heating system, serving a single family dwelling need not meet the requirements of pars. 121 a and b provided that they are not closer than 2 feet to any furnace or its supply plenum, boiler or other heat producing appliance, and that they comply with pars. 171a and c and sections 172, 173, 174 and 175 as specified for return ducts.

f. Vibration isolation connectors in duct systems shall be made of woven asbestos or approved flameproofed fabric or shall consist of sleeve joints with packing of rope asbestos or other approved noncombustible material. Vibration isolation connectors of fabric shall not exceed 10 inches in length.

122. **Duct Joints.** Joints and seams of supply ducts shall be securely fastened and made substantially air tight. Slip joints shall have a lap of at least one inch and shall be individually fastened. (See Figure 1.) Tape may be used for sealing joints but where exposed to the air in the duct, it shall not be more combustible than flameproofed fabric complying with NFPA Standard No. 701, Flameproofed Textiles.*

123. **Duct Hangers.** Supply ducts shall be securely supported by metal hangers, straps, lugs or brackets. No nails shall be driven through the duct walls and no unnecessary holes shall be cut therein.

124. **Firestopping.** Where the installation of supply ducts in walls, floors, or partitions requires the removal of any firestopping, the spaces around the duct at such points where firestopping was removed shall be sealed with asbestos, mineral wool, or other noncombustible insulating material.

*See Flame Retarded Fabrics in Fire Protection Equipment List published by Underwriters' Laboratories, Inc. See Appendix for information on availability of standards.

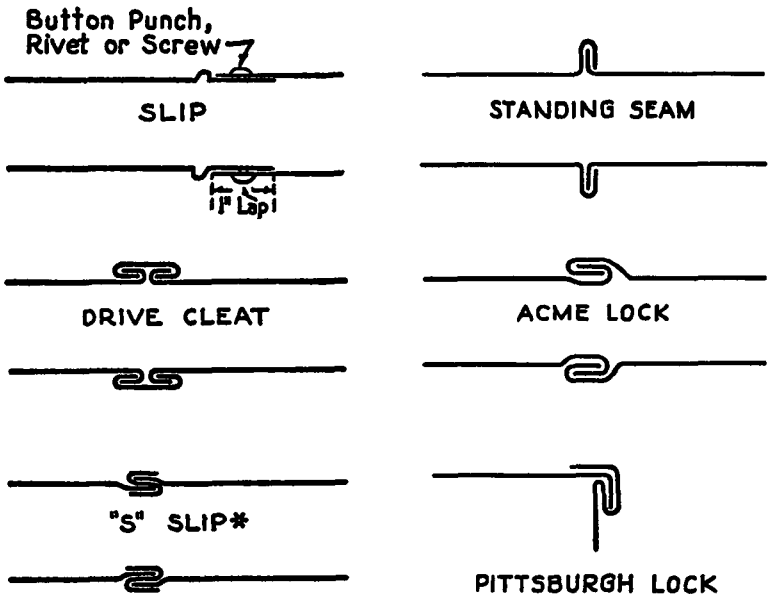

Fig. 1. Types of duct joints.

*Used where the joint is otherwise fastened on 2 sides.

125. Covering of Exposed Vertical Supply Ducts. Where vertical supply ducts are exposed in closets or rooms, they shall be covered with at least ¼-inch thick approved air cell asbestos or other equivalent fire resistant insulation.

126. Registers for Ducts. Warm air furnace systems, other than systems which are automatically fired with oil, gas or electricity and have listed temperature limit controls, shall have at least one register or grille without a closeable shutter and the duct leading thereto shall be without a damper, except where dampers and shutters cannot shut off more than 80 per cent of the duct area.

130. Controls.

131. Temperature Limit Controls. Temperature limit controls shall be of a listed type and shall be such that they cannot be set higher than the specified temperature setting.

132. Fan Control for Stoker-fired Furnaces. When a warm air furnace equipped with a fan to circulate the air is stoker-fired it shall also be equipped with an automatic over-run control to start the fan when the air in the furnace bonnet or at the beginning of the main supply duct at a point not affected by radiated heat reaches a temperature not higher than 200°F. 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 so installed as to de-energize simultaneously both the fan and the stoker.

140. Clearances to Combustible Material.

141. General.

a. The clearances specified below apply except where an appliance, duct work, or flue or vent pipe is listed for different clearances, in which case the listed clearances take precedence.

b. Where ducts are adjacent to plaster on metal lath or to other noncombustible finish attached to a combustible material, the clearance shall be measured to the combustible material, except that the clearance shall be measured to the surface of the plaster or other noncombustible finish where a clearance of 1 inch or 2 inches is specified above a bonnet or plenum chamber and above supply ducts within the distance from the plenum specified in pars. 143 a and b. This shall not be construed to prohibit closure of openings with noncombustible material where ducts pass through walls and partitions, as provided in par. 143 f.

142. Clearances From Furnaces, Boilers and Heat Exchangers.

a. Except as provided in pars. 141 a and 142 b, minimum clearances from furnaces, boilers, heat exchangers and their smoke, flue or vent pipes installed in rooms which are large in comparison with the size of the appliance shall be as given in Table 1.

b. Heating furnaces and boilers used in residence type central warm air heating systems may be installed in rooms which are large in comparison with the size of the appliance with clearances reduced as designated in Table 2 where combustible material is protected in the manner specified. Such reductions shall not apply to installations in alcoves or closets.

c. 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 unless specifically approved for such installation and then only when 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.

d. Furnaces, boilers, heat exchangers, heat pumps, and air conditioning and cooling units should be installed with sufficient clearances to provide reasonable accessibility for cleaning heating surfaces, 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.

143. Clearances From Horizontal Supply Ducts. Minimum clearances from horizontal supply ducts shall be as follows:

a. Within a distance of 3 feet of the plenum of a system classified under Item I of Table 1, the clearance shall be not less than one inch when Note 2 is complied with and not less than six inches when Note 4 is complied with. Within a distance of 3 feet of the plenum of a system classified under Item III of Table 1, the clearance shall be not less than one inch.

b. Within a distance of 6 feet of the plenum of a system classified under Items II, IV and VI of Table 1, the clearance shall be not less than specified above the bonnet or plenum.

c. Beyond the distance from the plenum specified in pars. 143 a and b no clearance is required except as provided in pars. 143 d and e.

d. From ducts of furnaces classified under Item IV of Table I the clearance shall be not less than 6 inches out to 6 feet and one inch beyond 6 feet to a point where there is a change in direction equivalent to 90 degrees or more.

e. From ducts of furnaces that require 18-inch clearance above the bonnet or plenum (See Table 1) the clearance shall be not less than 18 inches out to 3 feet, not less than 6 inches from 3 feet to 6 feet, and not less than one inch beyond 6 feet.

Table 1.

Clearances to Combustible Material for Furnaces, Boilers and Heat Exchangers Installed in Rooms which are Large in Comparison with Size of Appliance, Except as Provided in par. 141 a.

	Minimum Clearance, Inches				
	Above & Sides of Bonnet or Plenum	Jacket Sides & Rear	Front[1]	Projecting Flue Box or Draft Hood	Smoke, Flue or Vent Pipe
I. Listed or Unlisted automatically fired, forced air or gravity system, equipped with 250°F temperature limit control installed in accordance with Note 2.					
Burning Liquid Fuel	1[4]	6	24	18[8]	18[8]
Burning Gas Fuel	1[4]	6	18	9[7]	9[7]
Utilizing Electricity	1[4]	6	18	—	—
II. Listed automatically fired, forced air or gravity system, equipped with limit control not conforming to Note 2, but that will limit outlet air temperature to 250°F. See Note 5.					
Burning Liquid Fuel	2	6	24	18[8]	18[8]
Burning Gas Fuel	2	6	18	6	6
Utilizing Electricity	2	6	18	—	—
III. Steam or Hot Water Heat Exchanger — Steam not over 15 pounds gauge pressure and hot water not more than 250°F	1	1	1	—	—
IV. Automatically stoker fired, forced air system equipped with 250°F temperature limit control installed in accordance with Note 2 and with a barometric draft control. See Notes 3 and 5.					
Burning Solid Fuel	6	6	48	18	18
V. Heating Boilers Used in Residence Type Central Warm Air Heating Systems — Steam boilers operating at not over 15 gauge pressure and hot water boilers operating at not in excess of 250°F of the water-wall type or having a jacket or lining of masonry or other satisfactory material.					
Burning Liquid Fuel	6	6	24	18[8]	18[8]
Burning Gas Fuel	6	6	18	9[7]	9[7]
Burning Solid Fuel	6	6	48	18	18
VI. Furnaces and Heating Boilers Used in Residence Type Central Warm Air Heating Systems, other than above. See Note 6.					
Burning Liquid Fuel	18	18	48	18	18
Burning Gas Fuel	18	18	18	9[7]	9[7]
Burning Solid Fuel	18	18	48	18	18

Notes for Table 1.

1) Front clearance shall be sufficient for servicing the burner and furnace.
2) Listed limit control that cannot be set higher than 250° F installed not more than 10 inches above the top surface of heat exchanger in a supply plenum that extends at least 12 inches above the top surface of the heat exchanger.
3) Barometric draft control operated by draft intensity and permanently set to limit the draft to a maximum intensity of 0.13 inches of water gauge.
4) If the limit control cannot be set higher than 250° F but is installed more than 10 inches above the top surface of the heat exchanger or is in a supply plenum that extends less than 12 inches above the top surface of the heat exchanger, this clearance shall not be less than 6 inches.
5) Clearance above supply ducts within 6 feet of the plenum shall be not less than that specified above the bonnet or plenum. (Par. 143 b.)
6) Clearance above horizontal supply ducts within 3 feet of the plenum shall be not less than 18 inches, from 3 feet to 6 feet not less than 6 inches, and beyond 6 feet not less than 1 inch.
7) This clearance may be reduced to 6 inches for listed gas burning furnaces and boilers. The vent pipe clearance does not apply to listed Type B gas vents.
8) For listed liquid burning furnaces and boilers, this clearance may be reduced in accordance with the listing.

f. Where a horizontal supply duct passes through or pierces a partition or enclosure constructed of combustible material, the clearance shall be not less than specified in pars. 143 a, b, d, and e. The ends of the space providing this clearance may be closed with a thimble and collar or the wall surfaces extended to the duct with noncombustible building material such as plaster on metal lath. (See Figures 3 and 4.)

g. Separate air cooling system ducts that are made of other than noncombustible material shall be installed with clearances to warm air ducts as required in pars. 143a, b, d and e.

144. Clearances from Vertical Ducts, Risers, Boots and Register Boxes.

a. Where a duct, riser, boot or box on a system that does not require 18-inch clearance above the supply plenum

Table 2.
Clearances, Inches, with Specified Forms of Protection.*

Type of Protection Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection (see Fig. 2). Thicknesses are minimum	where the required clearance with no protection is: 18 inches			9 inches	6 inches		
	Above	Sides & Rear	Smoke or Vent Pipe	Smoke or Vent Pipe	Above	Sides & Rear	Vent Pipe
a) ¼ in. asbestos millboard spaced out 1 in.†	15	9	12	6	3	2	3
b) 28 gage sheet metal on ¼ in. asbestos millboard	12	9	12	4	3	2	2
c) 28 gage sheet metal spaced out 1 in.†	9	6	9	4	2	2	2
d) 28 gage sheet metal on ⅛ in. asbestos millboard spaced out 1 in.†	9	6	9	4	2	2	2
e) 1½ in. asbestos cement covering on heating appliance	9	6	18	9	2	1	6
f) ¼ in. asbestos millboard on 1 in. rockwool bats reinforced with wire mesh or equivalent	6	6	6	4	2	2	2
g) 22 gage sheet metal on 1 in. rockwool bats reinforced with wire mesh or equivalent	4	3	3	2	2	2	2
h) ¼ in. asbestos cement board or ¼ in. asbetos millboard	18	18	18	9	4	4	4
i) ¼ in. cellular asbestos	18	18	18	9	3	3	3

*Except for the protection indicated in (e), all clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material.
†Spacers shall be of noncombustible material.

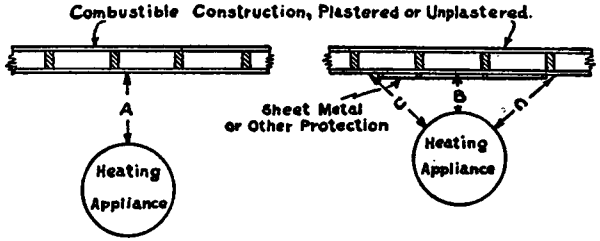

Figure 2. Sheet metal or other protection to reduce required clearance from heating appliance.

A equals the required clearance with no protection specified in Table 1.

B equals the reduced clearance permitted in accordance with Table 2. The protection applied to construction using combustible material is required to extend far enough in each direction to make "C" equal to "A".

or bonnet enters a floor, partition, or enclosure constructed of combustible material within the distance from the plenum specified in pars. 143 a and b, the clearance from such duct, riser or boot shall be not less than the distance required above the furnace bonnet or plenum (See Table 1) or the duct shall change direction equivalent to at least two 90 degree turns before entering such floor, partition, or enclosure. The above does not apply to pipeless furnaces covered in par. 145.

b. Where a supply duct enters the floor of the first story above that in which the furnace is located, the space around the duct at such points shall be sealed with asbestos cement or other noncombustible material.

c. Where a duct, riser, boot or box on a system that requires 18-inch clearance above the supply plenum or bonnet enters a floor, partition, or enclosure constructed of combustible material within a horizontal distance of 6 feet of the furnace, the duct shall be so arranged that heated air must travel at least 6 feet from the closest primary heating surface and change direction equivalent to at least one 90 degree turn before entering such floor, partition or enclosure.

d. Where a duct, riser, boot or box on a system that requires 18-inch clearance above the supply plenum or bonnet enters the floor of the first story above that in which the furnace is situated, the clearance shall be at least 3/16 of an inch from all combustible material in the floor construction, unless the duct is of double wall construction with a continuous air space of not less than 3/16 of an inch between the inner and outer walls.

e. Where a duct or riser on a system that requires 18-inch clearance above the supply plenum or bonnet is enclosed in a combustible partition, wall or concealed ceiling space,

(1) It shall be installed with an air space of not less than 3/16 of an inch provided between the duct and combustible material, unless a noncombustible insulating covering of cellular type at least 1/8 inch thick is provided (in metal lath and plaster partitions no air space is needed except from wood studs);

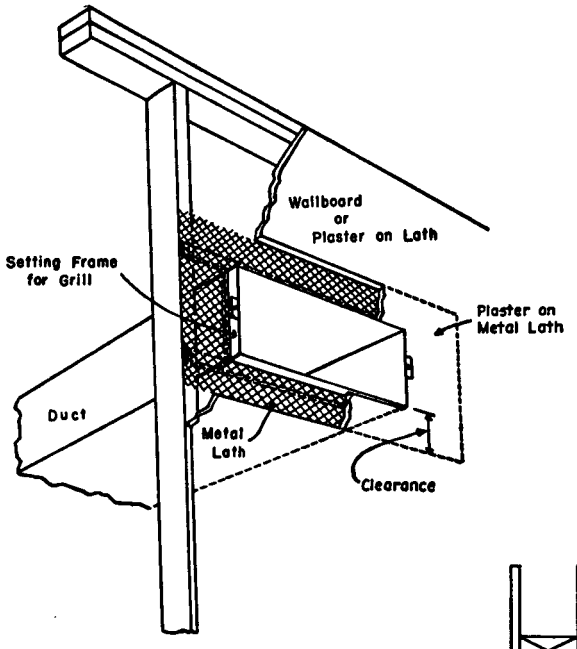

Figure 3. An arrangement for closing ends of clearance space around a supply duct. A similar arrangement can be used where a duct continues on through the partition.

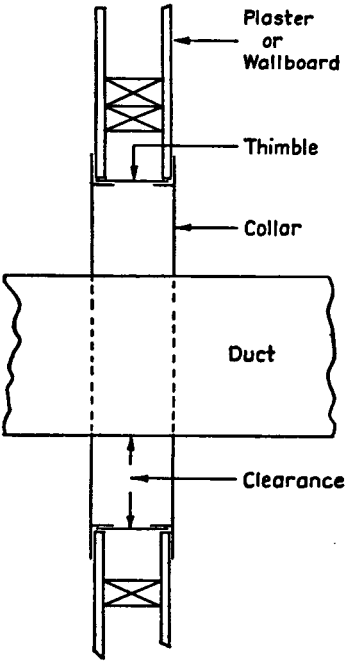

Figure 4. An arrangement for passing ducts through combustible walls or partitions as specified in par. 143 f.

(2) Or, such duct shall be made double with a continuous air space of not less than 3/16 of an inch between the inner and outer walls.

f. Where a register on a system that requires 18-inch 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 inch between the top and sides of the box and any combustible material.

145. Pipeless Furnace Registers. Where registers are installed in the floor over the furnace (as in the "pipeless" furnace) the register box shall be constructed double with an air space not less than 4 inches between, except where the warm air passage is surrounded by a cold air passage.

150. Heating Panels. Air chambers having one or more external surfaces designed for use as heating panels shall comply with the following:

151. Use. Heating panels shall be used only with

a. Automatically fired gas or oil burning forced warm air systems equipped with temperature limit controls that cannot be set above 200°F.;

b. Or, forced warm air systems equipped with heat exchangers utilizing steam which cannot exceed 15 pounds gauge pressure or hot water which cannot exceed a temperature of 250°F.

152. Connection. Heating panels shall be connected to supply and return air ducts conforming to these standards.

153. Construction.

a. Where warm air supply is from a warm air furnace, heating panels shall be enclosed on all sides with material which is wholly noncombustible or which possesses a flame spread classification of not over 20 as determined in accordance with the Method for Fire Hazard Classification of Building Materials, NFPA No. 255,* ASTM E84-50T, Under-

*See Appendix for information on availability of standards.

writers' Laboratories, Inc., Standard. This enclosing material shall be securely attached to the building structure; joints and seams shall be substantially air tight. Braces and hangers inside the chamber shall be noncombustible.

b. Where warm air supply is from a steam or hot water heat exchanger, heating panels shall either comply with par. 153 a or shall be enclosed on all sides with material not more flammable than 1-inch (nominal) wood boards (Flame spread classification of 200). This enclosing material shall be securely attached to the building structure; joints and seams shall be substantially air tight. No single vertical heating panel shall serve more than one story.

160. Down-Flow Furnace Systems.

161. Furnace. A down-flow furnace shall be an automatically operated oil, gas or electric furnace equipped with an approved temperature limit control that will limit outlet air temperature to 200°F, and the furnace shall be designed to prevent unsafe temperatures in the event of reverse flow. A listed oil, gas or electric down-flow furnace conforms to these requirements.

165. Use of Under Floor Space as Supply Plenum. When heated air is discharged downward into an air chamber which forms a plenum of an under floor space, the following shall apply:

a. Use of such spaces shall be restricted to one story portions of single family residences.

b. Such spaces shall be not more than 24 inches in height to the bottom of floor joists, shall be cleaned of all combustible material and shall be tightly and substantially enclosed.

c. The enclosing material of the under floor space including the side wall insulation shall be not more flammable than one-inch (nominal) wood boards (Flame spread classification of 200). Combustible ground cover shall be covered over with at least 2 inches 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 by 24 inches.

e. The furnace supplying warm air to such space shall be equipped with an automatic control that will start the air circulating fan when the air in the furnace bonnet reaches a temperature not higher than 150°F. Such control shall be one that cannot be set higher than 150°F.

f. The furnace supplying warm air to such space shall be equipped with an approved temperature limit control that will limit outlet air temperature to 200°F.

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 securely suspended from the floor members and shall not be more than 18 inches below the floor opening.

(2) The size of the horizontal projected area of the receptacle shall extend 3 inches beyond the opening.

(3) The perimeter of the receptacle shall have a vertical lip at least one inch high at the open sides if it is at the level of the bottom of the joists, or 3 inches high if the receptacle is suspended.

h. Floor registers shall be designed for easy removal in order to give 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 pars. 121, 144a and b.

k. Supply ducts to the air chamber shall comply with the provisions of pars. 121 and 143 (see also 141) and shall terminate approximately under the center of a room above, at a distance of not less than 6 feet from the plenum chamber.

170. Return Ducts.

171. Duct Material.

a. Return ducts, except as required by par. 171 b, may be constructed of metal, of one-inch (nominal) wood boards (Flame spread classification of 200), or other suitable mate-

rial, provided that no material more flammable than one-inch boards shall be used.

b. Portions of return ducts directly above the heating surface, or closer than 2 feet from the outer jacket or casing of the heater shall be constructed in accordance with provisions of par. 121 for supply ducts.

c. 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.

172. **Firestopping.**

a. Where return ducts are installed in walls, floors or partitions, their installation shall comply with the provisions of par. 124.

b. Where spaces between studs in walls or partitions are used as ducts, the portions of such spaces so used shall be cut off from all remaining unused portions by tight fitting stops of sheet metal or of wood not less than 2 inches (nominal) thick.

173. **Duct Openings.** No vertical stack shall have openings to receive return air on more than one floor.

174. **Continuous Ducts.**

a. Return air shall be conducted to the appliance through continuous ducts, except as indicated in pars. 174 b and c.

b. Under floor spaces may be used as ducts for return of air from rooms directly above, provided such spaces are not over 2 feet in height to bottom of floor joists and are cleaned of all combustible material and are tightly and substantially enclosed.

c. In a single story residence, the return air may travel through the first floor living space to furnace air inlet grilles located at or above the first floor level.

175. **Public Hall as Plenum.** Public halls or public stairways shall not be used as plenums.

176. Negative Pressure from Circulating Fan. The return system 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.

180. Air Filters.

181. Type Required. Air filters shall be of a type that will not burn freely or emit large volume of smoke or other objectionable products of combustion when attacked by flames.

182. Filter Coatings. Liquid adhesive coatings used on filters shall have a flash point of 325°F, Cleveland open cup tester, or higher.

190. Electric Wiring and Equipment.

191. Installation. Electric wiring and equipment shall be adequate for safe operation of all burners, motors, and control devices, and shall be installed in accordance with nationally recognized safe practices. Installations conforming to the National Electric Code* shall be considered as meeting these requirements.

200. Air Cooling Equipment.

201. Installation. Mechanical refrigeration used with air duct systems shall be installed in accordance with nationally recognized safe practices. Installations conforming to the American Safety Code for Mechanical Refrigeration, ASRE 15-53,* shall be considered as meeting these requirements.

202. Cooling and Heating Units in Series.

a. Heating furnaces of the combustion type shall not be located downstream from cooling units unless the furnace is listed for such use.

b. Heating furnaces shall not be located upstream from cooling units unless the cooling unit is designed or equipped so as not to develop excessive temperature or pressure.

*See Appendix for information on availability of standards.

c. Heating furnaces may be installed in parallel with cooling units by use of dampers located to direct the air to either the furnace only, or to the cooling unit only, as desired.

210. Hand Fired Solid Fuel Burning Furnaces.

211. Thermostatically Controlled Furnaces. Hand-fired solid fuel burning furnaces on which the furnace draft is controlled by a thermostat shall be equipped with (1) a fail safe 250°F limit control installed not more than 10 inches above the top surface of the heat exchanger in a supply plenum that extends at least 12 inches above the top surface of the heat exchanger, and (2) a barometric draft control operated by draft intensity and permanently set to limit the draft to a maximum intensity of 0.13 inches of water gage. By a fail safe limit control is meant one which will automatically check the furnace in the event of power failure or shut off, or which will automatically check the furnace when 250°F temperature is reached whether or not power is then available.

212. Air Circulating Fan Controls. When 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 par. 132.

220. Heat Pump Systems.

221. Heat pump systems that require supplemental heating units shall be equipped with an electrical interlock that will not allow the supplemental heating units to operate if the indoor air circulating fan is not operating.

222. Heat pump systems that are equipped with supplemental heating units shall be equipped with a temperature limit control located not more than 2 feet downstream from all heat input devices and of a type that will limit outlet air temperature to 200°F.