

Note 7.—Use no warm-air pipe less than 8 in. in diameter. If a basement warm-air pipe figures greater area than any standard commercial size then the nearest commercial size shall be used, provided however, that the total pipe area shall in no case be less than the total requirements according to Sections 1, 2 and 3.

Note 8.—It is understood in using the above values for determining basement warm-air pipe areas, that these pipes should be run comparatively straight and that they should not be over 10 to 12 ft. in length. Sharp turns and long pipes should have extra capacity.

Note 9.—The value of 800 (used in cubic contents) is for an estimated air change of one room volume per hour. If it is desired to provide for $1\frac{1}{4}$ room volume use the figure 600. If for two room volumes use the figure 400.

Transition Fittings and Stacks

Section 7. a. Transition from warm air pipes to stacks shall be made with a well designed elbow or boot and no stack shall be less than 70 per cent of the area of the warm-air pipe leading to it.

b. All first floor fittings and connections, shall maintain a free area equal to the round basement pipes leading to them.

Method for Determining Size of Registers

Section 8. All registers shall have a free area at least equal to the area of the basement pipes leading to them.

Method for Determining Size of Furnace

Section 9. a. Add together the areas (expressed in square inches) necessary for heating the building, as determined by the foregoing calculated requirements, Art. 3, Sec. 1, 2 and 3, and install a furnace, rated by the following formula:

Furnace Rating Formula

$$L = 1.75 G [1 + 0.02 (R - 20)]$$

L = square inches of warm-air pipe connected to the furnace as calculated.

G = grate area in square inches; the area of the firepot at the grate level; its most restricted area.

R = ratio of heating surface area to grate area;

1.75 = a constant based upon the results obtained in the Association Research on a furnace having 20 sq. ft. of heating surface for each square foot of grate, and including factors for:

E = efficiency of heater;

C = combustion rate;

F = calorific value of fuel;

0.75 = percentage of heat available at registers;

136 = B.t.u. delivering value of 1 sq. in. of pipe, assuming half of the heat is sent to each floor. This value is based on an operating temperature of 175 deg. Fahr. at the register.

The formula allows 1.75 sq. in. of warm-air pipe are for each square inch of grate area, for the furnace having a ratio of heating surface to grate surface of 20 to 1. For furnaces having other ratios of heating surfaces to grate surface, it adds 2 per cent or deducts 2 per cent for each unit above or below a ratio of 20.

Application:

	No. 1 Positive Correction	No. 2 No Correction	No. 3 Negative Correction
Grate area, square inch.	= 346	346	346
Heating surface area, square inch.	= 7540	6920	5665
Ratio heating surface area to grate area	= 21.8 to 1	20.0 to 1	16.4 to 1
$R - 20$	= 1.8	0.0	-3.6
Correction per cent	= 3.6	0.0	-7.2
$1.75 G$	= 606	606	606
$L = 1.75 G + \text{correction}$	= 628	606	562

Certified Measurements

Certified measurements on warm-air furnaces together with the name and number of that furnace, will be issued by authority of the *National Warm Air Heating and Ventilating Association*, when, if and as, the grate areas and heating surfaces have been accurately measured and approved by the Research Advisory Committee.

b. In second floor duplex, flats or apartments where separate heating plants are used, add 50 per cent to the total net *calculated* areas as determined in Art. 3, Sec. 5. This represents the required warm-air pipe capacity in square inches of the furnace for the second floor.

ARTICLE No. 4.—Installation—Location of Furnace

Section 1. The location of the furnace shall equalize the length of warm-air runs as far as possible, yet give necessary preference to pipes supplying living rooms, dining rooms and main halls.

Foundation

Section 2. Furnace foundation of brick, cement, or other incombustible material must be provided. Said foundation to extend at least fifteen inches (15") at rear and sides of furnace casing and at least thirty-six inches (36") in front of furnace casing. Foundation to be level.

Setting or Assembling of Furnace

Section 3. a. The base ring of the furnace shall be cemented to the foundation, making an air-tight joint. The furnace parts shall be assembled plumb and level, and in a workmanlike manner.

b. All sections and joints shall be properly fitted. Joints requiring cement shall be well filled and all bolts shall be drawn up tightly.

Casings

Section 4. a. Warm air furnaces shall be enclosed in metal casings or walls of brick, tile or concrete.

b. Portable. Sheet metal casings including casing tops shall be made of galvanized sheets, not lighter than 26 U. S. standard gauge. They shall fit the casings and casing rings closely, so as to be dust tight, and shall be securely fastened to the front. The casing shall be lined from the upper casing ring down to a line on a level with the grate.

c. When side collars are used the casing top must be of sufficient height so that the largest warm-air pipe can be taken from side without ovaling. In no case shall a distance less than eight inches (8") be maintained between the top of any furnace and the top line of the bonnet.

d. Any furnace, the casing top of which shall come within twelve inches (12") of a combustible floor, ceiling or joist, shall be protected by a metal shield, extending not less than eighteen inches (18") beyond the casing of said furnace. This shield shall be suspended at least 2 in. below woodwork, allowing free air space between shield and woodwork. No furnace casing or top, coming nearer than six inches (6") of ceiling or joists shall be allowed in any case.

e. Openings for side casing collars shall be cut into the casing top, so that the tops of all openings are on a level. Casing collars shall be fitted into place with a proper flange, or bead on the outside and drawn up on the inside, making a dust-tight joint. All collars shall be of same size as the warm-air pipes to which they are to be connected.

f. Brick, cement or hollow tile casings shall be constructed as follows: Walls shall be not less than eight inches (8") in thickness, and shall be constructed air-tight. The least inside dimension of rectangular casings shall be the same as that of the portable casing of a corresponding size of furnace. Walls shall be carried to the same height as the portable walls, allowing not less than eight inches (8") between the top of the furnace and the bottom of the top cover. After placing the collars for the warm-air pipes, continue the masonry up two inches (2") above the top of the collars, lay single or tee irons across the furnace top, spaced eight inches (8"), cover these with sheet metal not less than 26 U. S. standard gauge, cover the sheet metal with masonry or sand and run the side walls four inches (4") above the roof of the furnace. A galvanized iron casing bonnet may be used on a brick set furnace.

Provision shall be made in the walls for a manhole to give ingres to heater.

Warm Air Pipes in Basement

Section 5. a. All warm-air pipes shall be made of bright tin not lighter than IC, or galvanized iron. Side seams shall be locked seams. All joints shall be either double-seamed or lapped not less than one and one-quarter inches ($1\frac{1}{4}$ ") and such joints shall