TABLE 1. AIR VELOCITIES AND REGISTER TEMPERATURES FOR FAN FURNACE SYSTEMS

TYPE OF BUILDING	VELOCITIES IN FEET PER MINUTE							REGISTER TEMPERATURE
	Thru Free Area of Heaters	In Horizontal Heat Ducts	In Heat Risers	Into Room	In Vent Outlets	In Vent Risers	In Horizontal Vent Ducts and Recirculating Ducts	
Schools	800 to 1000	800 to 1000	500 to 600	300 to 400	300 to 400	500 to 600	600 to 800	90° to 120°
Churches	800 to 1000	700 to 900	400 to 600	300 to 500	300 to 500	400 to 600	500 to 700	80° to 120°
Auditoriums and Convention Halls	800 to 1000	800 to 1000	500 to 600	300 to 500	300 to 500	500 to 600	600 to 800	80° to 120°
Garages and Industrial Buildings	1000 to 1400	1000 to 1400	600 to 1000	400 to 1000	400 to 600	600 to 1000	800 to 1200	80° to 140°

consumption. In practice, velocities through the free area of the heaters are used as follows:

1. Schools, Churches, Auditoriums, Theatres, etc., from 800 to 1000 ft. per minute.
2. Industrial Buildings, Factories and Garages, from 1000 to 1400 ft. per minute.

The importance of power costs effects the decision as to what free area and static resistance are allowable.

The thermal efficiency of the various makes of heaters is a consideration deserving some thought in case the fuel to be burned is relatively high in cost.

First cost and fuel economy are items that also bear on the type of casing to be employed.

One of the most important considerations is the durability or life of the apparatus. Investigation of the several makes of heaters contemplated submitted to him should include such data as the thickness of the metal in each heater, the provisions made for expansion and contractions, and the protection afforded the firebox at the point of most intense heat.

A heater made of thicker metal than others will naturally give greater length of service, all other things being equal.

Proper provisions for expansion and contraction are imperative. Without such provisions a cast-iron heater is likely to crack and a steel heater is likely to warp and buckle.

Most furnaces have linings around the periphery of the fuel bed to protect the firebox from the action of the hottest part of the fire. The linings are removable and are as easily installed as new grates.

SUGGESTED METHODS OF PROCEDURE IN DESIGN OF FAN FURNACE SYSTEMS

1. Calculate Heat Loss of each room in building.

   See Chapter I.

   Example.—Assume school room with cubic content 6550.
   Heat loss = 45,269 B.t.u.

2. Determine volume of air per minute.

   Based on number of occupants.

   Based on number of air changes.

   Example.—Assuming 33 occupants; 30 C.F.M. per occupant.
   33 × 30 = 990 C.F.M.
   6550 content = 6½ minutes air change or approximately 9 changes per hour.

3. Figure diffusion temperature of air for each room.[1]

   Example.—Diffusion Temperature = $\frac{56 \times h}{60 \times v} = \frac{56 \times 45.269}{60 \times 990} = 42.3$ deg.

4. Determine required register temperature.

   Register temperature equals room temperature plus diffusion temperature.

   Example.—Assume 70 deg. room temp.
   42.3 deg. plus 70 deg. = 112.3 deg.

5. Set final temperature of air leaving heater.

   Final temperature equals register temperature plus allowance for loss in ducts.

   Example.—
   112.3 deg. register + 10 deg.
   Loss in ducts = 122.3 deg.

6. Determine temperature rise through heater.

   Temperature rise equals final temperature minus initial temperature.

   Where part outside and part recirculation is used.

   Initial temperature approximately equals $P_o T_o + P_r T_r$.

   P_o = percentage outside air.
   T_o = temperature.
   P_r = percentage recirculated air.
   T_r = temperature recirculated air.

[1]The diffusion temperature may be defined as the number of degrees the volume of air as determined under Item 2 must be *in excess* of the room temperature, in order to offset the heat loss by cooling over that range. In other words it is the number of degrees representing the difference between the necessary supply register temperature and the room temperature for the conditions under which the heat losses are calculated in Item 1. It is readily calculated by using the following formula:

Diffusion temperature = $\frac{56\,h}{60\,v}$ where h is the heat loss in B.t.u. per hour, v is the volume of air in cubic feet per minute measured at 70 deg. fahr. for the room in question.