CHAPTER 25

Radiators and Convectors

Heat Emission of Radiators and Convectors, Types of Radiators, Convectors, Radiator and Convector Ratings, Effect of Operating Conditions, Heating Effect, Heating Up the Radiator and Convector, Enclosed Radiators

THE accepted terms for heating units are: (1) *radiators*, for direct surface heating units, either exposed, enclosed, or shielded, which emit a large percentage of their heat by radiation; and (2) *convectors*, for heating units having a large percentage of extended fin surface and which emit heat principally by convection. Convectors are dependent upon enclosures to provide the circulation by gravity of large volumes of air.

HEAT EMISSION OF RADIATORS AND CONVECTORS

Most heating units emit heat by *radiation* and *convection*. The resultant heat from these processes depends upon whether or not the heating unit is exposed or enclosed and upon the contour and surface characteristics of the material in the units.

An exposed radiator emits roughly half of its heat by radiation, the amount depending upon the size and number of sections. When the radiator is enclosed or shielded, the proportion of radiation is further reduced. The balance of the emission is by conduction to the air in contact with the heating surface, and the resulting circulation of the air warms by convection.

A convector emits practically all of its heat by conduction to the air surrounding it and this heated air is in turn transmitted by convection to the rooms or spaces to be warmed, the heat emitted by radiation being negligible.

The output of a radiator can be measured only by the heat it emits. The old standard of comparison used to be square feet of *actual surface*, but since the advance in radiator design and proportions, the surface area alone is not a true index of output. (The engineering unit of output is the *Mbh* or 1000 Btu per hour.) However, during the period of transition from the old to the new, radiators may be referred to in terms of *equivalent square feet*. For steam service this is based on an emission of 240 Btu per (hour) (square foot) and for hot water service 150 Btu.

TYPES OF RADIATORS

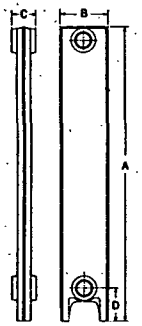
Present day radiators may be classified as tubular, wall, or window type and are generally made of cast-iron. Only the small-tube type of tubular radiators with a spacing of 1¾ in. per section are now available, the large-tube type which had a spacing of 2½ in. per section having been discontinued. Small-tube radiators occupy less space and are particularly suited for installation in recesses.

After a complete study of the demand for various sizes of radiators, the *Institute of Boiler and Radiator Manufacturers*, in cooperation with the Division of Simplified Practice, *National Bureau of Standards*, established Simplified Practice Recommendation R174-43 for small-tube cast-iron radiators. Table 1 shows the size and dimensions of small-tube cast-iron radiators which are being manufactured at the present time.

Wall radiators are now rated in terms of equivalent square feet, the same as small-tube radiators. Tests have shown that the heat emitted

TABLE 1. SMALL-TUBE CAST-IRON RADIATORS

Number of Tubes per Section	Catalog Rating per Section[a]	Section Dimensions					
		A Height[c]	*B* Width		*C* Spacing[b]	*D* Leg Height[c]	
			Minimum	Maximum			
	Sq Ft	In.	In.	In.	In.	In.	
3[d]	1.6	25	3¼	3½	1¾	2½	
4[d]	1.6	19	4 7/16	4 13/16	1¾	2½	
	1.8	22	4 7/16	4 13/16	1¾	2½	
	2.0	25	4 7/16	4 13/16	1¾	2½	
5[d]	2.1	22	5⅝	6 5/16	1¾	2½	
	2.4	25	5⅝	6 5/16	1¾	2½	
6[d]	1.6	14	6 13/16	8	1¾	2½	
	2.3	19	6 13/16	8	1¾	2½	
	3.0	25	6 13/16	8	1¾	2½	
	3.7	32	6 13/16	8	1¾	2½	



[a]The square foot of equivalent direct steam radiation is defined as the ability to emit 240 Btu per hour, with steam at 215 F, in air of 70 F. These ratings apply only to installed radiators exposed in a normal manner; not to radiators installed behind enclosures, grilles, etc. (See A.S.H.V.E. Code for Testing Radiators adopted January, 1927.)

[b]Length equals number of sections times 1¾ in.

[c]Over-all height and leg height, as produced by some manufacturers, are one inch (1 in.) greater than shown in Columns *A* and *D*. Radiators may be furnished without legs. Where greater than standard leg heights are required this dimension shall be 4½ in.

[d]Or equal.

from a wall-type radiator may be reduced from 5 to 10 per cent if the radiator is placed near the ceiling with the bars horizontal and in an air temperature exceeding 70 F. When radiators are placed near the ceiling, there is usually such a large difference in the temperature between the floor level and the ceiling that it becomes difficult to heat the living zone of the room satisfactorily.

Pipe coils are assemblies of standard pipe or tubing (1 in. to 2 in.) which are used as radiators. In older practice these coils were commonly used in factory buildings, but now wall-type radiators are most frequently used for this service. When coils are used, the miter type assembly is to be preferred as it best cares for expansion in the pipe. Cast manifolds or headers, known as branch tees, are available for this construction.

The heat emission of pipe coils placed vertically on a wall with the pipes horizontal is given in Table 2. This has been developed from avail-

TABLE 2. HEAT EMISSION OF PIPE COILS PLACED VERTICALLY ON A WALL (PIPES HORIZONTAL) CONTAINING STEAM AT 215 F AND SURROUNDED WITH AIR AT 70 F

Btu per linear foot of coil per hour (not linear feet of pipe)

Size of Pipe	1 In.	1¼ In.	1½ In.
Single row	132	162	185
Two	252	312	348
Four	440	545	616
Six	567	702	793
Eight	651	796	907
Ten	732	907	1020
Twelve	812	1005	1135