Chapter 25

RADIATORS, CONVECTORS, COILS

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, Coils, Coil Construction and Arrangement, Steam Coils, Water Coils, Direct-Expansion Coils, Flow Arrangement, Applications, Heat Transfer and Air Flow Resistance, Coil Selection

RADIATORS and convectors are primarily used for heating and, since their performance is affected by many of the same conditions, they will be considered together, while coils will be treated separately in the latter part of the chapter.

HEAT EMISSION OF RADIATORS AND CONVECTORS

Most heating units emit heat by *radiation* and *convection*. 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 occurs 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 and is generally expressed in units of: Btu per hr; *Mbh* (1000 Btu per hour); or in equivalent direct radiation (240 Btu per hour for steam or 150 for water radiation).

TYPES OF RADIATORS

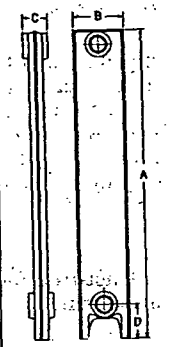
Present day radiators may be classified as tubular, wall, or window type and are generally made of cast-iron. Only the small-tube type of tubular radiators with a spacing of 1¾ in. per section are now available. Small-tube radiators occupy less space and are particularly suited for installation in recesses.

Baseboard radiation consists of long, low units which are made to resemble conventional baseboards and are installed along the outside walls of rooms in place of the usual wooden baseboard. Units are made either of hollow cast-iron panels (with, or without fins on the back) or of ferrous or non-ferrous finned tubing installed behind a metal enclosure. They are suited for use on hot water systems, but may also be used on two-pipe steam systems. Ratings are expressed in Btu per (hour) (linear foot) and must be obtained from the manufacturer as there is not yet a standardization of outputs for radiation of this type.

Among the advantages claimed for baseboard radiation are that it is inconspicuous; clean in operation; offers a minimum of interference with furniture placement; distributes the heat near the floor, thus preventing cold floors sometimes experienced—especially in basementless houses; and blankets exposed walls with a film of warmed air. This reduces floor to ceiling temperature gradient to about 2 F and tends to produce uniform temperatures throughout the room.

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	5 5/8	6 5/16	1¾	2½
	2.4	25	5 5/8	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.

After a 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 now being manufactured.

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

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