

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.

OUTPUT OF RADIATORS

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 per square foot and for hot water service 150 Btu per hour per square foot.

Wall radiators are now rated in terms of equivalent square feet, the same as large-tube and 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.

The heat emission of pipe coils placed vertically on a wall with the pipes horizontal is given in Table 3. This has been developed from available data and does not represent definite results of tests. For such coils the heat emission varies as the height of the coil. The heat emission of each pipe of ceiling coils, placed horizontally, is about 126 Btu, 156 Btu, and 175 Btu per linear foot of pipe, respectively, for 1-in., 1½-in., and 1½-in. coils.

Effect of Paint

The prime coat of paint on a radiator has no material effect on the heat output, but the finishing coat may influence the radiation emission and thus affect the heat output. Within the range of temperatures at which

TABLE 3. 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.	1½ 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

TABLE 4. EFFECT OF PAINTING 32-IN. THREE COLUMN, SIX-SECTION CAST-IRON RADIATOR^a

RADIATOR No.	FINISH	AREA Sq Ft	COEFFICIENT OF HEAT TRANS. BTU	RELATIVE HEATING VALUE PER CENT
1	Bare iron, foundry finish.....	27	1.77	100.5
2	One coat of aluminum bronze.....	27	1.60	90.8
3	Gray paint dipped.....	27	1.78	101.1
4	One coat dull black heat resistant paint....	27	1.76	100.0

^aComparative Tests of Radiator Finishes, by W. H. Severns (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 41).

radiators operate, color has no appreciable influence on the radiation emitted. Thus, finishing coats of oil paints of various colors will give the same results. However, a bronze paint, applied as the finish coat will change the character of the surface and reduce the amount of heat emitted by radiation. No paint has a noticeable effect on the portion of heat which is given off by convection. The larger the proportion of direct radiating surface, the greater will be the effect of any finish coat of paint which changes the character of the surface. Available tests are on old-style column type radiators which give results as shown in Table 4.

Effect of Superheated Steam

Available research data indicate that there is probably a decrease in heat transfer rate for a radiator or gravity convector with superheated steam in comparison with saturated steam at the same temperature. The decrease is probably small for low temperatures of superheats and additional tests are necessary with varying degrees of superheat to establish accurate comparisons for all types of radiators and convectors¹.

HEATING EFFECT

For several years the *heating effect* of radiators has been considered by engineers in order to use it for the rating of radiators and in the design of heating systems. Heating effect is the *useful output* of a radiator, in the comfort zone of a room, as related to the total input of the radiator².

No standard method for evaluating the heating effect of radiators and convectors and correlating it with comfort has yet been accepted. One method, with test data³ on radiators and convectors, and making use of the eupatheoscope for evaluating the environment produced has been suggested by the University of Illinois. The principle underlying the eupatheoscope involves the measurement of the heat loss from a sizable body by radiation and convection, when the surface is maintained at some constant temperature. Through the use of this instrument and its calibration curve, non-uniform environments may be referred to uniform environments in which the air and all surrounding surfaces are at the

¹Tests of Radiators with Superheated Steam, by R. C. Carpenter (A.S.H.V.E. TRANSACTIONS, Vol. 7, 1901, p. 206).

²The Heating Effect of Radiators, by Dr. Charles Brabbee (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 33).

³A.S.H.V.E. Research Report No. 962—The Application of the Eupatheoscope for Measuring the Performance of Direct Radiators and Convectors in Terms of Equivalent Temperature, by A. C. Willard, A. P. Kratz and M. K. Fahnestock (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 303).