

of the height of the discharge grille above the heating element. Therefore the published ratings are generally given in terms of square feet of *Equivalent Direct Radiation*, EDR. For steam convectors, as for radiators, 240 Btu per hour may be taken as an equivalent square foot of radiation. When more than one heating unit is used, one mounted above the other in the same cabinet, the output of the upper unit or units will be materially less than that of the bottom unit.

RADIATOR AND CONVECTOR RATINGS

A standard method of testing radiators was adopted by the A.S.H.V.E. in 1927. This Code provides for a standard test room, the temperature of which is to be maintained at 70 F, measured in the center of the room at an elevation of 5 ft above the floor. The steam temperature in the radiator is to be 215 F, which corresponds to 15.6 lb per square inch absolute.

TABLE 3. CORRECTION FACTORS FOR DIRECT CAST-IRON RADIATORS AND CONVECTORS

STEAM PRESS. APPROX.		HEATING MEDIUM TEMP F OR WATER	FACTORS FOR DIRECT CAST-IRON RADIATORS							FACTORS FOR CONVECTORS						
Gage Vacuum In. Hg.	Abs. Lb. per Sq. In.		ROOM TEMPERATURE F							INLET AIR TEMPERATURE F						
			80	75	70	65	60	55	50	80	75	70	65	60	55	50
22.4	3.7	150	2.58	2.36	2.17	2.00	1.86	1.73	1.62	3.14	2.83	2.57	2.35	2.15	1.98	1.84
20.3	4.7	160	2.17	2.00	1.86	1.73	1.62	1.52	1.44	2.57	2.35	2.15	1.98	1.84	1.71	1.59
17.7	6.0	170	1.86	1.73	1.62	1.52	1.44	1.35	1.28	2.15	1.98	1.84	1.71	1.59	1.49	1.40
14.6	7.5	180	1.62	1.52	1.44	1.35	1.28	1.21	1.15	1.84	1.71	1.59	1.49	1.40	1.32	1.24
10.9	9.3	190	1.44	1.35	1.28	1.21	1.15	1.10	1.05	1.59	1.49	1.40	1.32	1.24	1.17	1.11
6.5	11.5	200	1.28	1.21	1.15	1.10	1.05	1.00	0.96	1.40	1.32	1.24	1.17	1.11	1.05	1.00
Lb.per Sq.in.																
1	15.6	215	1.10	1.05	1.00	0.96	0.92	0.88	0.85	1.17	1.11	1.05	1.00	0.95	0.91	0.87
6	21	230	0.96	0.92	0.88	0.85	0.81	0.78	0.76	1.00	0.95	0.91	0.87	0.83	0.79	0.76
15	30	250	0.81	0.78	0.76	0.73	0.70	0.68	0.66	0.83	0.79	0.76	0.73	0.70	0.68	0.65
27	42	270	0.70	0.68	0.66	0.64	0.62	0.60	0.58	0.70	0.68	0.65	0.63	0.60	0.58	0.56
52	67	300	0.58	0.57	0.55	0.53	0.52	0.51	0.49	0.56	0.54	0.53	0.51	0.49	0.48	0.47

* To determine the size of a radiator or a convector for a given space, divide the heat loss in Btu per hour by 240 and multiply the result by the proper factor from the above table.

To determine the heating capacity of a radiator or a convector under conditions other than the basic ones with the heating medium at a temperature of 215 F, and the room temperature at 70 F in the case of a radiator, and the inlet air temperature at 65 F in the case of a convector, divide the heating capacities at the basic conditions by the proper factor from the above table.

The weight of condensate per hour, under these standard conditions, multiplied by the difference in the enthalpy of the steam entering the radiator and that of the condensate leaving the radiator, gives the radiator output in Btu per hour. This output divided by 240 gives the steam rating of the radiator in equivalent square feet, EDR.

Similar test methods for convectors are the A.S.H.V.E. Codes for Testing and Rating Concealed Gravity Type Radiation², (Steam Code 1932 and Hot Water Code 1933). These Codes recognize a different type of test booth, and the air temperature used is that of the air entering the convector casing instead of the temperature in the center of the room. The entering air temperature for standard test conditions is 65 F. For hot water the standard test conditions call for a mean temperature of the water in the convector of 170 F.

The method of testing and rating both ferrous and non-ferrous convectors, which is now generally accepted, is given in Commercial Standard CS140-47, Testing and Rating Convectors, which has been developed cooperatively by the Convector Manufacturers Association, the Institute of

Boiler and Radiator Manufacturers, other members of the trade, and the National Bureau of Standards.

The rating of a top outlet convector is established at a value not in excess of the *condensation capacity* (which is the heat extracted from the steam or water in the convector, under standard test conditions). The rating of a front outlet convector includes the *condensation capacity* plus an allowance for heating effect in the occupied zone, based on convector enclosure height from bottom of the enclosure to top of the outlet. A table of heights and heating effect allowances is given in the Commercial Standard CS140-47, and lists allowances from zero per cent for a 38-in. height to 15 per cent for a 20-in. height.

For an inclined outlet convector the rating includes the *condensation capacity* plus a heating effect allowance obtained by multiplying the allowance for a front outlet convector by a factor (angle of outlet to horizontal ÷ 90).

Approval of convector ratings may be obtained by the manufacturer by submitting test data to a *Convector Rating Committee* composed of two members appointed by the *Convector Manufacturers Association* and the *Institute of Boiler and Radiator Manufacturers*, and one appointed by the Division of Trade Standards of the *National Bureau of Standards*. Requests should be addressed to the Division of Trade Standards.

Effect of Operating Conditions

The heat output of a radiator is proportional to the 1.3 power of the temperature difference between the air in the room at the 60 in. level and the heating medium in the radiator. The heat output of a convector is proportional to the 1.5 power of the temperature difference between the air entering the convector and the heating medium, steam or hot water, within the convector³. For hot water the arithmetical average between entering and leaving water temperatures is used. These laws may be expressed as correction factors to change from output under standard rating-test conditions to output under other operating conditions. Such factors are given in Table 3.

When it is desired to change the output under any test conditions to the corresponding output under standard Code test conditions, the reciprocal form of correction factor may be derived. The equations for steam units are:

For radiators:

$$C_r = \left(\frac{215 - 70}{t_s - t_r} \right)^{1.3} \quad (1)$$

For convectors:

$$C_c = \left(\frac{215 - 65}{t_s - t_i} \right)^{1.5} \quad (2)$$

The output under standard conditions will be:

$$H_s = C_r H_t \quad (3)$$

where

C_r = correction factor.

t_s = steam temperature during test, Fahrenheit degrees.

t_r = room temperature during test, Fahrenheit degrees.

t_i = inlet air temperature during test, Fahrenheit degrees.

H_s = heat emission rating under standard conditions, Btu per hour.

H_t = heat output under test conditions, Btu per hour.