RADIATOR AND CONVECTOR RATINGS

A standard method of testing radiators was adopted by the A.S.H.V.E. in 1927.[3] 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 sq in. absolute. 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 Radiation,[4] (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 36-in. height to 13 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* 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 convector.[5] 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 7.

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:

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

For convectors:

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

TABLE 7. CORRECTION FACTORS FOR DIRECT CAST-IRON RADIATORS AND CONVECTORS

Steam Press. Approx.		Heating Medium Temp F	Factors for Direct Cast-Iron Radiators							Factors for Convectors						
			Room Temperature F							Inlet Air Temperature F						
Gage Vacuum In. Hg.	Abs. Lb per Sq In.	Steam or Water	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
LbperSqIn.																
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

[a] 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 output under standard conditions will be:

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

where

C_s = 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.

The relation between the size of the radiator or convector and the size of the test room will affect the results obtained in a capacity-rating test.[6] The height and location of the radiator and the insulation of the test room are other important factors that are not specifically regulated by the Code.

For a radiator, the finish coat of paint affects the heat output. Oil paints of any color will give about the same results as unpainted black or rusty surfaces, but an aluminum or a bronze paint will reduce the heat emitted