

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 *Convactor Manufacturers Association* has adopted the A.S.H.V.E. standard in the formulation of its ratings and has compiled a tentative standard of heating effect allowances for various enclosure heights to be included in the ratings by its members.

All published ratings bearing the title *C.M.C. Ratings (Convactor Manufacturers Certified Ratings)* indicate that the convectors have been tested in accordance with the A.S.H.V.E. Code by an impartial and disinterested

TABLE 4. CORRECTION FACTORS FOR DIRECT CAST-IRON RADIATORS AND CONVECTORS*

STEAM PRESS. APPROX.		HEATING MEDIUM TEMP. F STEAM 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	1.52	1.44	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	1.35	1.28	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	1.21	1.15	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	1.10	1.05	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	1.00	0.96	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 convactor 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 convactor 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 convactor, divide the heating capacities at the basic conditions by the proper factor from the above table.

laboratory and that the ratings have been approved by the Standardization Committee of the *Convactor Manufacturers Association*.

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 convactor is proportional to the 1.5 power of the temperature difference between the air entering the convactor 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 4.

When it is desired to change the output under any test conditions to the corresponding output under standard Code test conditions, the

*A.S.H.V.E. RESEARCH REPORT No. 998—Factors Affecting the Heat Output of Convectors, by A. P. Kratz, M. K. Fahnestock, and E. L. Broderick (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 443).

reciprocal form of correction factor may be derived. The equations for steam units are:

For radiators:

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

For convectors:

$$C_s = \left(\frac{215 - 65}{t_s - t_i} \right)^{1.5} \quad (3)$$

The output under standard conditions will be:

$$H_s = C_s H_t \quad (4)$$

where

C_s = correction factor.

t_s = steam temperature during test, degrees Fahrenheit.

t_r = room temperature during test, degrees Fahrenheit.

t_i = inlet air temperature during test, degrees Fahrenheit.

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 test⁴. 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 by radiation. The net effect may be a reduction of ten per cent or more in the total heat output of the radiator^{5,6,7}.

Radiator enclosures and convector casings affect the heat distribution within the room as well as the total amount of heat supplied by the steam or hot water⁸.

Heating Effect

For several years the term *heating effect* has been used to designate the relation between the *useful output* of a radiator, in the comfort zone of a room, and the total input as measured by steam condensation or water temperatures⁹. The application of such a heating effect factor is a recognition that some radiators and convectors use less steam than others for producing equal comfort heating results in the room.

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 data¹⁰ on radiators and convectors, and making use of the eupatheoscope for evaluating the environment produced has been

⁴Factors Influencing the Heat Output of Radiators, by A. C. Davis, W. M. Sawdon and David Dropkin (A.S.H.V.E. JOURNAL SECTION, Heating, Piping and Air Conditioning, March, 1942, p. 180) and Cornell University, Engineering Experiment Station Bulletin No. 29, April, 1942.

⁵Heat Emission from Radiators, by K. F. Rubert (Cornell University, Engineering Experiment Station Bulletin No. 24, 1937).

⁶Comparative Tests of Radiator Finishes, by W. H. Severns (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 41).

⁷Heat Loss from Direct Radiation, by J. R. Allen (A.S.H.V.E. TRANSACTIONS, Vol. 26, 1920, p. 11).

⁸Heat Output of Concealed Radiators, by E. A. Allcutt (University of Toronto, School of Engineering Research, Bulletin No. 140, 1933).

⁹The Heating Effect of Radiators, by Dr. Charles Brabbee (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 33).

¹⁰A.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).