line level (approximately 5 ft-0 in. above floor), and temperatures taken at the breathing line may not be indicative of the actual heating effect of a radiator in the room. The comfort-indicating temperature should be taken below the breathing line level.

5. High column radiators placed at the sides of window openings do not produce as comfortable heating effects as long, low, direct radiators placed beneath windows.

The application of a heating-effect allowance implies that some radiators and convectors use less steam than others for producing equal comfort heating results in the room.

All authorities do not agree that the use of such an allowance is justified. No standard method for evaluating the heating effect of radiators and convectors and correlating it with comfort has yet been accepted.

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

Steam Press. (Approx.)		Heating Medium Temp F Steam or Water	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.		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

[a] To determine the size of a radiator or a convector for a given space, multiply the heat loss of the space in Btu per hour by the proper factor from the above table and select radiator or convector having an equivalent Btu per hour rating.

An alternate method is to divide the heat loss in Btu per hour by 240 and multiply the result by the proper factor from the above table and select radiator or convector having an equivalent square foot rating.

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 capacity at the basic rating conditions by the proper factor from the above table.

EFFECT OF OPERATING CONDITIONS

The heat output of a radiator, convector, baseboard or finned-tube unit is an exponential function of the temperature difference between the air in the room and the heating medium in the room-heating unit, or, expressed as an equation

$$H = c(t_s - t_r)^n \qquad (1)$$

where

H = heat output in Btu per hour.

c = a constant determined by test for each type.

t_s = average temperature of heating medium, Fahrenheit. For hot water the arithmetical average of the entering and leaving water temperatures is used.

t_r = room air temperature Fahrenheit. Air temperature 60 in. above the floor is generally used for radiators while the temperature 3 in. above the floor or at the inlet of the heating unit is used for all other types of heating units.

n = an exponent which equals 1.3 for radiators, 1.4 for baseboard radiation, and 1.5 for convectors. For finned-tube radiation n varies with both air and heating-medium temperatures.

Correction factors for converting outputs at standard rating conditions to outputs at other operating conditions are given in Tables 7 and 8.

Effect of Paint

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 10 percent or more in the total heat output of the radiator.[9, 10, 11]

TABLE 8. CORRECTION FACTORS FOR FINNED-TUBE AND BASEBOARD RADIATION[a]

Steam Pressure Approx		Heating Medium Temp. F Steam or Water	Factors for Finned-Tube							Factors for Baseboard						
			Inlet Air Temperature, F							Inlet Air Temperature, F						
Gage Vacuum In. Hg	Abs Lb per Sq In.		80	75	70	65	60	55	50	80	75	70	65	60	55	50
22.4	3.7	150	2.80	2.50	2.20	1.95	1.81	1.67	1.54	2.86	2.61	2.38	2.20	2.03	1.89	1.76
20.3	4.7	160	2.34	2.14	1.94	1.75	1.62	1.50	1.37	2.38	2.20	2.03	1.89	1.76	1.64	1.56
17.7	6.0	170	2.01	1.86	1.70	1.56	1.46	1.36	1.26	2.03	1.89	1.76	1.64	1.54	1.44	1.38
14.6	7.5	180	1.76	1.65	1.53	1.42	1.32	1.24	1.15	1.76	1.64	1.55	1.44	1.38	1.29	1.23
10.9	9.3	190	1.53	1.45	1.36	1.28	1.20	1.12	1.03	1.54	1.44	1.37	1.29	1.22	1.16	1.09
6.5	11.5	200	1.38	1.31	1.24	1.16	1.09	1.02	0.95	1.38	1.29	1.23	1.16	1.09	1.05	1.00
Lb per sq in.																
1	15.6	215	1.17	1.12	1.06	1.00	0.95	0.90	0.85	1.16	1.10	1.05	1.00	0.95	0.92	0.88
6	21	230	1.00	0.97	0.93	0.90	0.86	0.82	0.78	1.00	0.96	0.92	0.88	0.84	0.81	0.77
15	30	250	0.88	0.85	0.82	0.78	0.75	0.71	0.67	0.86	0.82	0.79	0.76	0.73	0.70	0.68
27	42	270	0.75	0.73	0.70	0.68	0.65	0.62	0.59	0.73	0.70	0.68	0.66	0.63	0.61	0.59
52	67	300	0.62	0.60	0.58	0.56	0.54	0.52	0.50	0.58	0.57	0.55	0.53	0.52	0.51	0.49

[a] To determine the heating capacity under conditions other than the basic ones with the heating medium at a temperature of 215 F, and the inlet air temperature at 65 F, divide the the heating capacity at the basic rating conditions by the proper factor from the above table.

ENCLOSED RADIATORS

The general effect of an enclosure placed about a direct radiator is to restrict the air flow, diminish the radiation and, when properly designed, improve the heat distribution within the heated space.[6, 12]

Some commercial enclosures and shields for use on direct radiators are equipped with water pans for the purpose of adding moisture to the air in the room. Tests[13] show that an average evaporative rate of about 0.235 lb per (hr) (sq ft of water surface) may be obtained from such pans, when a radiator is steam heated and the relative humidity in the room is between 25 and 40 percent. This source of supply of moisture alone is not adequate to maintain a relative humidity above 25 percent on a zero day.

HEATING THE RADIATOR AND CONVECTOR

The maximum condensation occurs in a heating unit when the steam is first turned on. Tests[14] on an old-style column-type cast-iron radiator indicated that in the first 10 min the condensation rate reached a peak of 0.95 lb per sq ft of radiation per hour and 10 to 15 min later dropped to a rate of 0.24 lb. In one-pipe gravity systems the rate of steam supply to the heating unit, while heating up, is frequently retarded by controlled