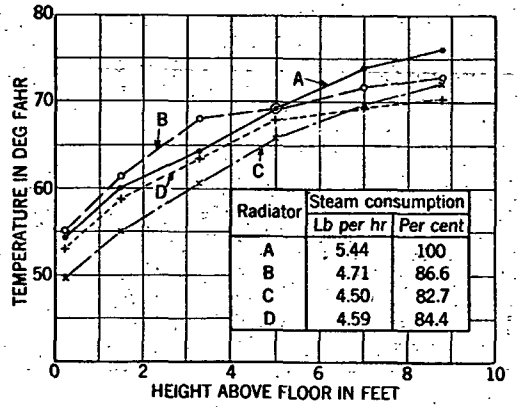
ing line may not be indicative of the actual heating effect of a radiator in the room. The comfort-indicating temperature should be taken below the breathing line level.

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.

HEATING THE RADIATOR AND CONVECTOR

The maximum condensation occurs in a heating unit when the steam is first turned on. Tests[18] 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 radiator 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 elimination of air through air valves or traps. In two-pipe systems auto-



Radiator	Steam consumption	
	Lb per hr	Per cent
A	5.44	100
B	4.71	86.6
C	4.50	82.7
D	4.59	84.4

FIG. 4. STEAM CONSUMPTION OF EXPOSED AND CONCEALED RADIATORS

matic control valves may also retard the supply of steam. Vacuum types of air venting valves may be used to reduce the length of the venting periods.

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.

Investigations[12] indicate that in the design of the enclosure three things should be considered:

1. There should be better distribution of the heat below the breathing line level to produce greater heating comfort and lowered ceiling temperatures.

2. The lessened steam consumption may not materially change the radiator heating performance.

3. The enclosed radiator may inadequately heat the space.

A comparison between a bare or exposed radiator (A) and the same radiator with a well-designed enclosure (B), with a poorly-designed enclosure (C), and with a cloth cover (D) will illustrate the relative heating characteristics. In Fig. 4 the curve (B) reveals that the enclosed radiator used less steam than the exposed radiator, but gave a satisfactory heating performance. A well-designed shield placed over a radiator gives about the same result. Curve (C) shows the unsatisfactory effects produced by improperly-designed enclosures. Curve (D) shows that the effect of a cloth cover extending downward 6 in. from the top of the radiator was to make the performance unsatisfactory and inadequate.

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[19] show that an average evaporative rate of about 0.235 lb per square foot of water surface per hour may be obtained from such pans, when a radiator is steam heated and the relative humidity in the room is between 25 and 40 per cent. This source of supply of moisture alone is not adequate to maintain a relative humidity above 25 per cent on a zero day.

REFERENCES

[1] I-B-R Installation Guide No. 5, Baseboard Heating Systems, *Institute of Boiler and Radiator Manufacturers*, New York.

[2] A Study of Radiant Baseboard Heating in the I-B-R Research Home, by Alonzo P. Kratz and Warren S. Harris (University of Illinois, *Engineering Experiment Station Bulletin* No. 358, 1945).

[3] A.S.H.V.E. Code for Testing Radiators (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 18).

[4] A.S.H.V.E. Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam), (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931, p. 367); (Hot Water), (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 237). (See also A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 38, and Vol. 42, 1936, p. 29).

[5] 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).

[6] Factors Influencing the Heat Output of Radiators, by A. C. Davis, W. M. Sawdon and David Dropkin (A.S.H.V.E. TRANSACTIONS, Vol. 42, 1942, p. 185) and Cornell University, *Engineering Experiment Station Bulletin* No. 29, April, 1942.

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

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

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

[10] Heat Output of Concealed Radiators, by E. A. Allcut (University of Toronto, *School of Engineering, Research Bulletin* No. 140, 1933).

[11] The Heating Effect of Radiators, by Charles Brabbée (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 33).

[12] University of Illinois, *Engineering Experiment Station Bulletins* Nos. 192 and 223, and Investigation of Heating Rooms with Direct Steam Radiators Equipped with Enclosures and Shields, by A. C. Willard, A. P. Kratz, M. K. Fahnestock and S. Konzo (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929, p. 77).

[13] A.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).

[14] The Kata Thermometer—Its Value and Defects, by W. J. McConnell and C. P. Yagloglou. (Reprint No. 953 from *U. S. Public Health Service Report*, pp. 2293–2337, September 5, 1924).

[15] The Thermo-Integrator—A New Instrument for the Observation of Thermal Interchanges, by C.-E. A. Winslow and Leonard Greenburg (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 149).

[16] The Calibration of the Thermo-Integrator, by C.-E. A. Winslow, A. P. Gagge,