ments. It should be noted that this figure is given in terms of the fuel consumption per 1000 degree-days per 100 sq ft of equivalent heating surface (steam) based on an emission of 240 Btu per square foot. Unless the *radiation* is calculated with reasonable accuracy, unit factors will be of little value even for rough approximations, since it is obvious that such *radiation* requirements must bear some relationship to the actual heating requirements of the building.

Example 3. Estimate the approximate coal consumption for a building located in New York City in which the calculated heating surface requirements (steam) are 1000 sq ft based on design temperatures of zero and 70 F.

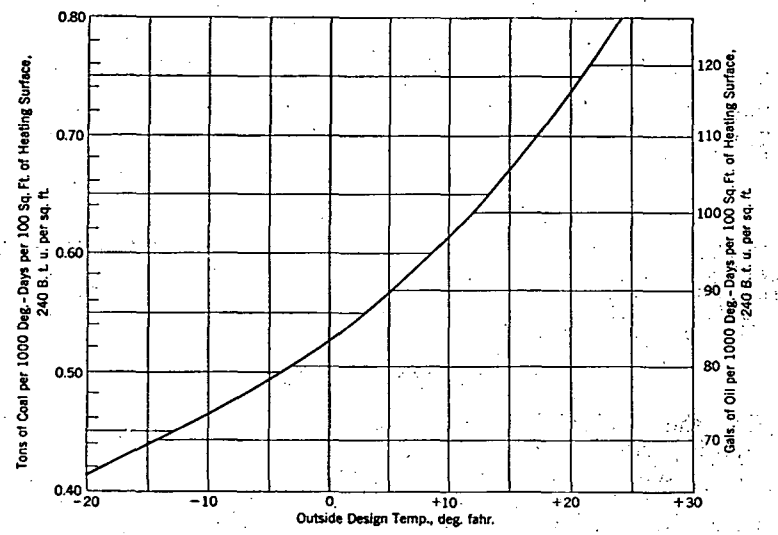

FIG. 1. CURVE FOR OBTAINING ROUGH APPROXIMATION OF ANNUAL FUEL CONSUMPTION IN TONS OF COAL OR GALLONS OF OIL PER 1000 DEGREE-DAYS PER 100 SQ FT OF EQUIVALENT STEAM HEATING SURFACE[a]

[a]This curve is based on heating efficiencies of 60 and 70 per cent for coal and oil, respectively, a calorific value of coal of 13,000 Btu per pound, a calorific value of oil of 14,000 Btu per gallon, an inside temperature of 70 F, and an emission of 240 Btu per equivalent square foot of heating surface (steam), and does not allow for unusual factors which would affect the fuel consumption, such as open windows, week-end shutdowns, etc. For hot water, divide the result obtained by means of this chart by 1.6.

Solution. From Fig. 1, the fuel consumption for a design temperature of zero is 0.53 tons per 1000 degree-days per 100 sq ft of heating surface. Since there are 5348 degree-days in New York City in a normal heating season, the fuel consumption will be approximately $0.53 \times 5.348 \times 10 = 28.34$ tons.

Fig. 2 is taken from the 3rd edition of Industrial Gas Series on House Heating, published by the *American Gas Association*, and indicates the average gas consumption per degree-day for various heat contents. While the fuel consumption in individual cases may vary somewhat from the curve values, these average values are sufficiently accurate for estimating purposes and give very satisfactory results.

The value generally used in the manufactured gas industry for residences is 0.21 cu ft per degree-day per square foot of equivalent steam

radiation (240 Btu) based on the theoretical requirements. A correction for warmer climates is necessary and it is customary to gradually increase the relative fuel consumption below 3,000 degree-days to about 20 per cent more at 1,000 degree-days.

For hot water or warm air heat the fuel consumption is about 0.19 cu ft per degree-day per square foot of equivalent steam *radiation*, that is, per 240 Btu per hour. The actual requirements likewise relatively increase with hot water or warm air systems as the number of degree-days decreases below 3,000. For larger installations, that is, 1,000 sq ft of

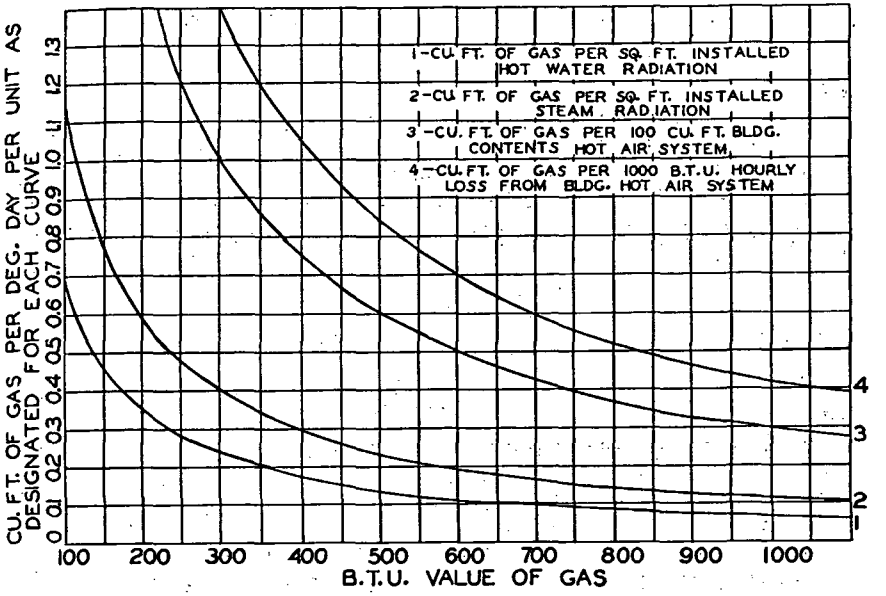

FIG. 2. CHART GIVING GAS REQUIREMENTS PER DEGREE-DAY FOR VARIOUS CALORIFIC VALUES OF GAS AND FOR DIFFERENT HEATING SYSTEMS[a]

[a]This chart is based on an inside temperature of 70 F and an outside temperature of zero. If the *radiation* is installed on the basis of any other temperature difference, multiply the result obtained from this chart by 70, and divide by the actual temperature difference.

theoretical *radiation* and above, there is an increase in efficiency, and a consequent decrease in the fuel consumption per degree-day per square foot of heating surface.

The approximate quantities of steam required in New York City per square foot of heating surface, for various classes of buildings are given in Chapter 36.

The preceding discussion on fuel consumption has dealt with the heating requirements of the building irrespective of any air that may be introduced for ventilation purposes other than the normal infiltration of outside air. The heat required for warming air brought into the building for ventilation may be estimated from data given in Chapters 2 and 22.