equivalent of direct radiation by multiplying the square feet of heating surface in the fan blast coils by 3; and after all surface is reduced to equivalent direct steam radiation, to ascertain the total steam required per annum, the number of square feet of equivalent direct steam radiation is multiplied by 500. This is used as a check on the first assumption, and the mean of the two quantities is usually taken.

Indirect steam radiation (where no fan is used) is reduced to equivalent direct steam radiation by multiplying by 1½.

To reduce direct hot water to direct steam equivalent, it is divided by 1.6.

The average demand for electric power and light will be the total annual consumption divided by 8760, and the maximum demand will be two and one-half times the average demand in a 24 hour building and five times the average demand in an 8 hour building.

High grade 4-valve or una-flow engines are assumed to require 50 lb. of steam for each kilowatt-hour generated, on the switchboard, with 80 per cent allowance for the exhaust into the heating system. A rough check is to allow 5 lb. of coal for each kilowatt-hour generated. In the old style engine in common, use 70 lb. of steam per kilowatt-hour is a fair average.

To reduce the pounds of steam to coal, covering all losses in the plant, an average evaporation of 8 to 1 is assumed for bituminous coal in the larger plants, 7 to 1 in the smaller plants, and 6 to 1 for anthracite pea or buckwheat coal.

Roughly, 6/10 lb. of coal per cubic foot is required per year for heating the ordinary building, while in buildings containing electric generating plants 1 lb. of coal per cubic foot is approximately correct for all purposes. Roughly, the maximum electrical demand in the large buildings averages 6/10 k.w. per square foot of gross floor area.

For boiler room repairs allow $2.00 per horsepower nominal rating.

For engine room repairs allow $2.00 per annum per kilowatt total nominal rating of generator.

For boiler and engine room supplies allow $2.00 per annum per horsepower of boilers installed.

Boiler room labor averages $2.00 per ton of coal fired, based on an 8 hour shift and 48 hours per week.

Ash removal averages 1/5 of a cubic yard to each ton of coal burned and is estimated to cost $1.00 per cubic yard to remove it.

The labor in a Federal Building containing an electric generating plant will roughly average the same as the cost of the coal, supplies and repairs to the boilers and electric generators.

The fixed charges for machinery in a Federal Building are 3 per cent interest and 5 per cent depreciation per annum on engines, boilers, etc. while on buildings, tunnels, etc., 2 per cent depreciation per annum is allowed.

The annual dividend which must be earned by the ordinary isolated Federal plant in comparison with the purchase of current from a public utility company is 10 per cent on the cost of the Government plant.

PART II—VENTILATION

CHAPTER XXIII

MODERN STANDARDS OF VENTILATION AND MEASUREMENTS OF AIR QUALITY AND QUANTITY

General Requirements, Air Supply, Temperature, Recirculation, Testing Methods, Instruments, Physiological Effects, Human Comfort, Comfort Charts, Comfort Zone, Humidity and Comfort.

VENTILATION is the science that treats of air in relation to human comfort, health, and efficiency. A study of the science of ventilation is a study of the best methods of conditioning and handling air, and a study of the effect of that air on the human system. The test of good ventilation is the measure of health, comfort and efficiency derived from it.

In general the application of ventilation applies to spaces which are densely occupied by human beings, such as auditoriums and school rooms, to spaces in which atmospheric contamination or overheating would otherwise occur, as under certain industrial conditions, and to spaces in which a fixed and controlled air condition is required, as in certain manufacturing processes. It is the object of ventilation to provide and maintain the desired atmospheric conditions.

GENERAL REQUIREMENTS OF VENTILATION

In the present status of the art of ventilation it is no longer felt that the chemical composition of the air is the important factor, but that proper ventilation depends upon a number of other factors which may be stated as follows:

1. Air Supply.
2. Air Temperature.
3. Relative Humidity.
4. Air Motion.

} The four factors, in combination, are the bases of what is termed "Effective Temperature."

5. Air purity, in reference to its freedom from odors, dust, bacteria, toxic gases, and other objectionable matter.
6. Air Distribution, with reference to general distribution, air movement, and freedom from drafts.
7. Psychological effects.

Prepared especially for THE GUIDE by the following committee: D. D. Kimball, *chairman;* O. W. Armspach, A. C. Davis, F. R. Still, A. C. Willard, C. E. A. Winslow and C. P. Yaglou.