LIGHTS:

4200 × 3.413 = 14,335 Btu per hour.

SUMMARY:

COMPONENT OF LOAD	BTU PER HOUR
Combined Normal and Solar Radiation Transmission	21,413
Normal Transmission	5,993
Solar Radiation Through Glass	18,965
Outside Air	14,410
Occupants	21,550
Lights	14,335
Total (Sensible and Latent Heat Gain)	96,666

LATENT HEAT:

Outside air 6.03 lb water per hour.
Occupants 9.90 lb water per hour.

15.93 lb water per hour.

$15.93 \times h_{fg} = 15.93 \times 1062.7 = 16{,}929$ Btu per hour.

CONDITION LINE:

The condition line for this application may be determined from Equation 25 in Chapter 1 by taking the ratio of 96,666 ÷ 15.93 = 6070 Btu per pound water. In this case, it crosses the saturation curve at a temperature for which the enthalpy h_s and the humidity ratio W_s satisfy the equation,

$$\frac{31.40 - h_s}{0.01115 - W_s} = 6070.$$

A trial-by-error computation gives a quick solution of 57.4 F, which can also be determined graphically on a Mollier chart. This is the apparatus dew-point as explained in Chapters 1 and 20.

REFRIGERATION LOAD:

Assuming 100 per cent saturation efficiency for the air conditioning apparatus, operation at the apparatus dew-point is possible. The thermodynamic properties involved in calculating the refrigeration required are:

	Inside Air	*After Cooling*	*After Separating*
t	80.0	57.4	57.4
h	31.40	24.678	24.65
W	0.01115	0.01115	0.01004

The refrigeration required is 31.4 − 24.678 = 6.722 Btu per pound dry air. The total outside and recirculated dry air to be circulated through the air conditioning apparatus is 96,666 ÷ (31.40 − 24.65) = 14,321 lb per hour. Hence, the total refrigeration required or the cooling load is 14,321 × 6.722 = 96,265 Btu per hour, or 96,265 ÷ 12,000 (Btu extracted per hour per ton of refrigeration) = 8.02 tons.

The energy removed with the water eliminated is 14,321 × (24.678 − 24.65) = 401 Btu per hour. This plus the refrigeration accounts for the total removal of 96,265 + 401 = 96,666 Btu per hour as required.

CHAPTER 8

Combustion and Fuels

Principles of Combustion, Classification of Coals, Firing Methods for Coals, Firing Methods for Coke, Classification of Oils, Combustion of Oil, Classification of Gas, Combustion of Gas, Dustless Treatment of Coal

THE data given in the first part of this chapter are of general application to the various fuels used in domestic heating which are coal, coke, oil and gas. The choice of fuel is a question of dependability, cleanliness, fuel availability, economy, operating requirements and control.

FUNDAMENTAL PRINCIPLES OF COMBUSTION

Combustion may be defined as the chemical combination of a substance with oxygen with a resultant evolution of heat. The rate of combustion depends partly upon the specific rate of reaction of the combustible substance with oxygen and partly upon the rate at which oxygen is supplied and the surrounding conditions as they define the temperature.

Complete combustion is obtained when all of the combustible elements in the fuel are oxidized with all of the oxygen with which they can combine. All of the oxygen supplied may not be utilized.

Perfect combustion is defined as the result of supplying the required amount of oxygen for combination with all of the combustible elements of the fuel and utilizing all of the oxygen so supplied.

The oxygen required for the process of combustion is obtained from air which is a mechanical mixture of oxygen, nitrogen and small amounts of carbon dioxide, water vapor and inert gases. These inert gases are generally included with the nitrogen, and for engineering purposes the values given herewith may be used.

	BY VOLUME PER CENT	BY WEIGHT PER CENT
Oxygen, O_2	20.9	23.15
Nitrogen, N_2	79.1	76.85

The combination of oxygen with the combustible elements and compounds of a fuel is in accordance with fixed laws. In the case of perfect combustion the reactions and resultant combinations are shown in Table 1.

The most important condition governing the process of combustion is temperature. It is necessary to bring a combustible substance to its ignition temperature before it will unite in chemical combination with oxygen to produce combustion. The ignition temperatures for several of the combustible constituents of fuels are presented in Table 1.

HEAT OF COMBUSTION

As previously stated, the process of combustion results in the evolution of heat. The heat generated by the complete combustion of a unit of fuel is constant for a given combination of combustible elements and compounds, and is known as the *heat of combustion*, *calorific value*, or *heating value* of the fuel.