3 ● At what rate for electric power is electric heating feasible?

a. The answer is complicated because operating cost of electric heaters depends upon at least three factors, namely, demand charge, energy charge, and the sliding scale according to the amount of power used for all purposes.

b. For off-peak use which avoids the demand charge an energy rate of 1 cent per kilowatt-hour is often attractive for heating systems of moderate size. Larger jobs usually require a rate of about ¾ cents per kilowatt-hour.

c. For unrestricted heating service for auxiliary purposes an average rate of 2 cents per kilowatt-hour may be satisfactory for small installations.

d. Wherever other factors make electric heating especially desirable the rates may be even higher than those mentioned above.

e. For domestic hot water supply a rate of 1 cent per kilowatt-hour is usually satisfactory.

4 ● What advantages have electric fan unit systems over plain convection heaters?

a. Better distribution of heat to the floor level.

b. Elimination of condensation on machinery, windows, and other cool surfaces.

c. Wider choice as to location of the heater, and reduced cost of wiring connections.

d. The fan can be operated for air circulation only, during periods when heat is not required.

5 ● In a fan type electric heating system, what important features are required that are not needed for a steam system?

a. A heating coil supplied with steam at constant pressure will remain at approximately constant temperature regardless of the amount of air passing over it, but the condensation rate will change. The temperature of an electric coil supplied with a constant amount of energy will rise if the quantity of air is decreased, and fall if the quantity of air is increased. This happens because the input of electrical energy is constant while the input of steam energy varies with the condensation rate.

b. Because the temperature of an electrical coil will rise upon decreased air flow, the Underwriters require the installation of an approved thermal safety trip switch located in the heating chamber to cut off the electrical heating circuit automatically in case the air flow should be interrupted. This switch should remain off until manually reset.

c. Electrical heating elements vary greatly in their capacity for storing heat units after the power is shut off. In a fan system it is very important to use elements having the lowest possible heat storage capacity to avoid overheating motors and improperly operating the thermal safety trip switches when air flow ceases due to normal shut-downs.

d. Because the input of an electric heater is constant for a given rating, it is necessary to provide a selective electrical control which will automatically compensate for variations in the volume of air flow. This cannot be done by mixing dampers alone as in a steam system.

6 ● What problems must be considered in connection with electric water heating?

a. For the best available power rate consult the Electric Power Company supplying service.

b. The maximum daily and hourly demand for hot water.

c. The size of storage tank necessary to carry over the peak load periods when no reheating is done.

d. The kilowatt rating required to reheat enough water during off-peak periods.

e. Standby radiation losses of the storage tank and hot water piping.

f. Cost of providing electrical supply lines of ample capacity with fuses, meters and switches.

g. Tank materials and design to avoid expensive replacements due to corrosion.

Chapter 41

RADIANT HEATING

Physical and Physiological Factors, Control of Heat Losses, Rate of Heat Production, British Equivalent Temperature, Application Methods, Calculation Principles, Mean Radiant Temperature, Measurement of Radiant Heating

HEATING for health and comfort is generally understood to mean that heat must be supplied in order to control the rate of heat loss from the human body so that the physiological reactions are conducive to a feeling of comfort. In convection heating, it is generally the function of the heating medium to transfer the heat to the air and thence to the occupant of the room, while the primary object of radiant heating is to warm the surrounding surfaces without appreciably heating the air. The difference between convection heating and radiant heating is therefore partly physical and partly physiological. Reference to low temperature radiation is actually not heating at all, except in a secondary sense. Low temperature radiation is produced not to heat the individual in the room, but to reduce the net rate at which the body surface loses heat by radiation.

Comfort requires that heat be removed from the body at the same rate as it is generated by the oxidation of food stuffs in the body tissue. Furthermore, the heat should be dissipated in a manner conducive to the physiological requirements of the human body. Actually the feeling of heat and cold in an individual is not so much a measure of the rate at which body heat losses take place as compared with the heat generated within the body, as it is an indication that the sensation of the body is more susceptible to the manner in which the heat is abstracted from the body. This principle is the basis upon which radiant heating is founded.

CONTROL OF HEAT LOSSES

Heat is transferred from any warm dry body to cooler surroundings principally by convection and by radiation, the approximate total being the sum of the two. Where the body surface is moist as with the human body, there is additional loss of heat through evaporation from both the body surface and the respiratory tract.

The rate of heat loss by convection depends upon the difference between the temperature of the body and of the surrounding air, and on the rate of air motion over the body.