6. The meter body and meter piping should be kept from freezing temperatures.
7. It is best not to connect a meter body to more than one service.
8. Special instructions are furnished for metering a turbulent or pulsating flow.

STEAM PER SQUARE FOOT OF HEATING SURFACE

The following factors are used in New York City for the different classes of buildings listed. The factors are based on maintaining an inside temperature of 70 F for certain hours with a minimum outside temperature of 0 deg F, and an average of 43 F for the heating season of eight months (October 1 to June 1). In this group are six types of buildings:

For manufacturing or commercial loft type where steam is used to heat the premises during the day hours to maintain 65 to 68 F from 9 a.m. to 5 p.m. No Sunday or holiday use and no night use. *Factor:* 325 lb per square foot of heating surface per season.

For office buildings using steam during daylight hours only to maintain 70 F from 9 a.m. to 6 p.m. for approximately 240 days (heating season). No night use. *Factor:* 400 lb per square foot of heating surface per season.

For office buildings using steam during day hours and at night when required to 7, 8 and 9 p.m. (customary where there are stock brokers or banking offices), 240 days. *Factor:* 500 lb per square foot of heating surface per season.

For residences of the block type (not detached) where high-class heating service is required somewhat similar to apartment buildings. *Factor:* 550 lb per square foot of heating surface per season.

For apartment houses where high-class heating service is required. (Steam off at midnight). *Factor:* 650 lb per square foot of heating surface per season.

For hotels (commercial type) where very high-class service is required for 24 hours. *Factor:* 800 lb per square foot of heating surface per season.

By assuming one square foot of equivalent heating surface for each 100 cu ft of space heated, which seems a fair ratio in New York City, it is possible roughly to estimate the steam required per cubic foot of space, information which is often more easily obtained than the square feet of heating surface. Additional data on the heating requirements of various types of buildings in a number of cities may be found in the Handbook of the *National District Heating Association*.

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Chapter 37

RADIANT HEATING

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

THE general theory behind heating for comfort is that heat must be supplied to regulate the rate of heat loss from the human body so that the physiological reactions are conducive to a feeling of comfort in the individual. While in convection heating, as described in Chapter 30, heat is transferred from a heating unit to the air and thence to the occupant, the primary object of radiant heating is to warm the occupant directly without heating the air to any extent. Thus, the difference between convection heating and radiant heating is partly physical and partly physiological.

PHYSICAL AND PHYSIOLOGICAL CONSIDERATIONS

Comfort requires that heat be removed from the body at the same rate as it is generated by the oxidation of the foodstuffs in the body tissues. The normal rate of heat production in a sedentary individual is about 400 Btu per hour[1], or, since the entire surface area of an average adult is 19.5 sq ft, about 20.5 Btu per square foot per hour. Conditions should be such as to remove heat at this rate if the surface is to be maintained at the mean normal surface temperature of the human body.

Heat is transferred from any warm, dry body to cooler surroundings principally by convection and by radiation, the total rate of heat loss being the sum of the two. Where the body surface is moist 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 that of the surrounding air, and on the rate of air motion over the body. The loss by radiation depends entirely upon the difference between the temperature of the body and the mean surface temperature of the surrounding walls and objects. This latter difference is called the *mean radiant temperature* (MRT). Because these two types of heat loss act in a supplementary manner toward each other, a required rate of heat loss can be secured by having a relatively low air temperature and a relatively high MRT, or *vice versa*. Thus, if the air is

[1]Heat and Moisture Losses from the Human Body and Their Relation to Air Conditioning Poblems; by F. C. Houghten, W. W. Teague, W. E. Miller, and W. P. Yant (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929).