ventilators or fans for exhausting the moisture-laden air. (See discussion of condensation in Chapter 2.)

Types of Unit Heaters

There are many types of unit heaters available. Most of them employ heating coils to be supplied with steam or hot water. Some are designed primarily for mounting on the floor, whereas others are designed for suspension overhead. Heating surfaces in the form of pipe coils, non-ferrous tubes or shapes with extended surfaces, cast-iron, and pressed and built-up sections of the cartridge or automotive type are all used in unit heater construction.

Among the unit heaters available are types having from one to four outlets per heater which may be arranged to discharge in selected directions and which will project their heating effect over distances of from 30 to 200 ft. from the heater, depending upon the capacity of the heater and upon the design of the fans and outlets. These heaters have been successful when placed as far as 400 ft. from each other. This makes it possible to select the heater location best suited to the production layout in factories. There are also available propeller fan type heaters of smaller capacity with outlet velocities of from 300 to 600 ft. per minute, and these may be placed from 60 to 100 ft. apart.

Heating Mediums

Unit heaters are made to operate on hot water, or with steam at high pressure or at vapor pressure. When high pressure steam is used, the heater must of course be especially designed for that purpose.

The present day tendency is to use steam at low pressure when the boiler supplies steam for heating purposes only, and when the transmission lines are short. Many industrial plants, however, generate steam at high pressure either for long distance transmission or for process uses. When such high pressure steam is available in sufficient quantity for the peak load, it is economical usually to use high pressure unit heaters. Thus the line pressure may be turned into the units directly without reducing valves and the condensation may be trapped to overhead returns when desired. Smaller coils may be used in high pressure heaters to lessen their cost and to produce a final temperature which will not be too high. Steam turbines may be used for fan power, each exhausting directly into its own heater.

Procedure for Determining Heat to be Supplied

The heat losses of a building to be equipped with unit heaters are determined in the same manner as for any other heating system, excepting so far as the unit heaters may change the air temperature at the ceiling or at the mean height of the walls. (See Chapter 2).

Unit heaters may be arranged to recirculate the air or to supply warmed air from the outside for ventilation or to make up air exhausted.

If all or a part of the air is to be taken in from out-of-doors, the heat necessary to warm this air from the outside temperature to the inside temperature must be added to the transmission or other losses. Unit heaters of the number and size needed to furnish the total heat required

are then selected from the manufacturers' rating tables, using these ratings at the steam pressure to be used and at the temperature at which the air will enter the heater.

Temperature of Air Entering Heater

For recirculating heaters with intakes at the floor level, use the temperature to be maintained in the room as the temperature of the air entering the heater. Where suspended heaters are used without any intake boxes extending down to the floor level, a higher entering air temperature should be used than that at which the room is to be maintained. With suspended heaters taking in air at some distance above the floor, the temperature variation from floor to ceiling may reach as much as 1½ deg. fahr. for each foot of elevation during periods when the maximum capacity of the heaters is required. Unit heaters taking in recirculated air at the floor level should maintain temperature differentials of less than 1 deg. per foot of elevation when the maximum capacity of the heaters is required. These temperature differences per foot of elevation are less than the corresponding variations per foot of elevation for spaces heated by direct radiation.

Delivery Air Temperature

A rapid recirculation or turnover of the air in the room makes for fuel economy. This calls for the selection of heaters having a liberal air capacity for the required heat output, which in turn means a relatively low final temperature. Extremely low final temperatures can be had only at the expense of larger heaters and increased power, so that a commercial limit is imposed. Contributing conditions vary too widely to permit of a suggested standard, but in general for heating purposes, it is advisable to use a delivery temperature which is 70 deg. or less above the average room temperature desired.

Ratings and Capacities

It is standard practice to rate unit heaters in B.t.u. per hour at a given temperature of air entering the heater and at a given steam pressure maintained on the coil. Steam at 2 lb. pressure and air entering at 60 deg. fahr. are used as the standard basis of rating. The capacity of a heater increases as the steam pressure increases, and decreases as the entering air temperature increases. The heat capacity for any condition of steam pressure and entering air temperature may be calculated approximately from any given rating by the use of factors in Table 1. This table is accurate within 5 per cent.

The ratings customarily published for unit heaters, apply only for recirculation and free discharge, unless otherwise noted in the rating tables. If outside air intakes, filters or ducts on the discharge side are used with the heater, proper consideration should be given to the reduction in air and heat capacity that will result because of this added resistance.

The percentage of this reduction in capacity will depend upon the characteristics of the heater and on the type, design and speed of the fans employed, so that no specific percentage of reduction can be assigned for all heaters for a given added resistance. In general, however, disc