air quantity through heating coils is often made the same as that necessary to handle the summer cooling load. The air handled may be fixed by the use of old ventilating ducts as an air distribution system for new air conditioning apparatus, or may be dictated by requirements of satisfactory air distribution or ventilation. The resistance through the air circuit influences the fan horsepower and speed. This resistance may be limited to allow the use of a given size of fan motor, or to keep the operating expense low, or it may be limited by the maximum fan peripheral velocity which requirement of quietness may permit. The friction through the water or brine circuit may be dictated by the head available from a given size of pump and pump motor. As the fan and pump motor inputs represent a refrigerating load on cooling installations, it is economical to keep them low.

Proper performance of a surface heating or cooling coil depends upon correct choice of the original equipment and upon certain other factors. The usual coil ratings are based on a uniform face velocity of air. If the air is brought in at odd angles or if the fan is located so as to block part of the air flow, the performance as given in the manufacturer's ratings cannot usually be obtained. To obtain this performance it is necessary also that the air quantity be adjusted on the job to that used in determining the coil selection, and must also be kept at this value. The most common causes for a reduction of air quantity are the fouling of the filters and collection of dirt in the coils. These difficulties can be avoided by proper design and proper servicing. There are a number of ways in which coils may be cleaned. A common method is to wash them off with water. They can sometimes be brushed and cleaned with a vacuum cleaner. In bad cases of neglect, especially on restaurant jobs where grease and dirt have accumulated, it is sometimes necessary to remove the coils and wash off the accumulation with steam, compressed air and water, or hot water. The most satisfactory solution, however, is to keep the filters serviced, and thus make the cleaning of the coils unnecessary.

The proper selection of coils requires an understanding of the necessities of each case and should be based on an economic analysis of the plant design as a whole. No general rule can, therefore, be laid down for the selection of heating or cooling coils. It is possible, however, to point out the limits of usual practice and to indicate the influence of the variables involved in the coil selection.

Heating Coils

Steam and *hot water heating coils* are usually *rated* within these limits:

Air Face Velocity—200 to 1200 fpm, sometimes up to 1500 fpm.
Steam Pressure—2 to 200 lb, sometimes up to 350 lb per square inch.
Hot Water Temperature—150 to 225 F.
Water Velocity—2 to 6 fps.

Individual cases may deviate widely, but the tabulation given herewith will serve as a guide to usual *heating installation practice:*

Air Face Velocity—500 to 800 fpm face, 500 being a common figure.
Delivered Air Temperature—varies from about 72 F for ventilation only to about 150 F for complete heating.
Steam Pressure—2 to 10 lb, 5 lb being common.
Hot Water Temperature—150 to 225 F.
Water Velocity—2 to 6 fps.
Water Quantity—Based on about 20 F temperature drop through a hot-water coil.
Air Resistance—The total resistance through heating coils is usually limited to from $\frac{3}{8}$ to $\frac{5}{8}$ in. of water gage for public buildings, to about 1 in. for factories.

The selection of heating coils is relatively simple as it involves dry-bulb temperatures and sensible heat only, without the complication of simultaneous latent heat loads, as in cooling coils. For a given duty, entering air temperature, and steam pressure, it is possible to select several arrangements of the same design of coil depending upon the relative importance of space, cross-sectional area, and air resistance.

Cooling Coils

Cooling and *dehumidifying coils* are usually *rated* within these limits:

Entering Air Dry-Bulb—60 to 100 F.
Entering Air Wet-Bulb—50 to 80 F.
Air Face Velocities—300 to 800 fpm, (sometimes as low as 200 and as high as 1200).
Volatile Refrigerant Temperatures—25 to 55 F, at coil suction outlet.
Water Temperatures—40 to 65 F.
Water Quantities—2 to 6 gpm per ton, or equivalent to a water temperature rise of from 4 to 12 deg.
Water Velocity—2 to 6 fps.

TABLE. 4. VARIOUS COOLING COIL ARRANGEMENTS

SELECTION	1	2	3	4
Total cooling capacity, tons	100	100	100	100
Sensible cooling capacity, tons	69	69	69	69
Latent cooling capacity, tons	31	31	31	31
Ratio total to sensible heat	1.45	1.45	1.45	1.45
Air quantity, cfm	47,800	41,700	37,100	46,800
Cfm per total ton	478	417	371	468
Face velocity, fpm	325	423	500	600
Resistance, in. water	0.11	0.27	0.51	0.37
Coil face area, sq ft	147	99.0	74.2	78.1
Coil rows deep	4	6	8	4
Coil evaporator temp. F deg	45	45	45	38

The ratio of total to sensible heat removed varies in practice from 1.00 to about 1.65, *i.e.*, sensible heat is from 60 to 100 per cent of total, depending on the application. (See Chapter 43.) Since required ratios may demand wide variations in air velocities, refrigerant temperatures, and coil depth, general rules as to their values may be misleading. On usual comfort installations air face velocities between 400 and 600 fpm are frequent, 500 being a common value. Refrigerant temperatures ordinarily vary between 40 and 50 F where cooling is accompanied by dehumidification. Water velocities range from 2 to about 6 fps.

When no dehumidification is desired, for which condition the dew-point of the entering air is equal to or lower than the cooling coil surface temperature, the coil selection is made on the basis of dry-bulb temperatures and sensible heat transfer only, the same as with heating coils. It is possible also to choose various arrangements of face area, depth, air velocity, etc., for the same duty.

Dehumidifying Coils

The selection of coils for combined cooling and dehumidifying duty is more involved than for heating or sensible cooling and requires consideration of both dry- and wet-bulb air temperatures. (See Chapter 7.) It is further complicated by the fact that the proportional amount of dehumidi-