appropriate duct work may be required by space or other considerations. Units are available for floor, wall, or ceiling mounting, thus providing an upward, downward, or horizontal discharge. Power, refrigerant, and drip pan connections are required, plus additional connections for defrosting, if necessary.

Various methods of defrosting are used. In one method, hot gas is supplied to the interior of the tubes uniformly throughout the coil. The entire refrigerant circuit is thus contacted to obtain complete defrosting of all frosted surfaces. Electric defrosting generally involves the incorporation of heating elements within the construction of the coil, or the use of strip heaters in a dampered closed air circuit. Warm water may be sprayed over the coil surface for defrosting. With storage temperatures above 32 F, defrosting may be accomplished by shutting down the refrigeration system and circulating the room air over the coil. In every case, defrosting requires a cessation of refrigeration and fan shut down. Where continuous operation of the system is desired, a brine spray over the coil may be used unless it might damage the product in storage.

Ratings

As various means of expressing unit cooler capacity are utilized in the industry, different manufacturers suggest different methods of selection. The engineer should be aware of the conditions and factors which affect rating, selection, and performance of a cooler. These items are discussed in following paragraphs.

The refrigerating capacity of the unit may be either gross or net, the latter being less than the gross by an amount equal to the heat equivalent of the input to the unit cooler motor. In either case, the capacity should be given for a particular air volume.

Dry or flooded rating conditions should be stated, as well as temperature level. The temperature level determines whether the coil surface is wetted or frosted, and it will also establish the refrigerant side pressure drop for any given load applied to a specific unit cooler. The refrigerant side pressure drop increases as the evaporating temperature decreases, and thus temperature level exercises a significant effect on the average coil surface temperature and the consequent condensing unit selection.

Coil capacity rating is usually expressed as *simplified rating* or *sensible heat ratio rating*: the latter derives its name from the ratio of the sensible heat load to the total load. The *simplified rating* expresses the capacity in terms of Btu per (hour) (Fahrenheit degree temperature differential *between the refrigerant and the air*). The *sensible heat ratio rating* expresses the unit cooler capacity in terms of Btu per (hour) (Fahrenheit degree temperature differential *between the refrigerant and the coil surface temperature*). The *simplified rating* method does not require knowledge of the sensible heat ratio. When the total load has been obtained from the load calculations, it is necessary only to assume a temperature differential between the air and the refrigerant in order to select a unit cooler. Since the extent of dehumidification will be a function of this assumed temperature differential, it is apparent that the relative humidity in the storage space is dependent upon the correct assumption of this temperature differential. For many applications, the correct temperature differential has been established between certain maximum and minimum values. In such applications, the simplified rating offers a quick method of selection. Where past experience is lacking, and in any case where close control of relative humidity is desired, the simplified rating may be used for tentative selection of the unit, but the sensible heat ratio method should be used in the final selection.

In the sensible heat ratio selection method, the total heat is used in conjunction with the air distribution requirements for making a tentative selection of a unit cooler. Then, for the specific air volume and surface area of the unit cooler selected, it is necessary to determine the refrigerant temperature required to maintain the dry-bulb temperature and relative humidity desired in the storage space. In order to apply air conditioning psychrometric techniques for accurate control of the room conditions a knowledge of the sensible and latent loads is required. The relationship of these loads is evident in the term, sensible heat ratio. From this ratio and the unit cooler air volume, the supply air conditions to maintain the storage room design conditions may be calculated.

The extent to which these supply air conditions differ from the average coil surface temperature is a function of the fin spacing, fin style, coil depth, and other factors inherent in the design of the coil. From a knowledge of the efficiency of his specific coils, a manufacturer can use the sensible heat ratio to determine the average coil surface temperature necessary to maintain desired storage room conditions, without actually evaluating the supply air conditions.

For a unit cooler adjusted to deliver a specific air volume, there exists a specific differential between the storage room conditions and the average coil surface temperature, and, therefore, it is possible to rate coolers on the basis of this room-to-surface temperature differential.

Refrigerant side pressure drop and the characteristics of the heat transfer surface, introduce a differential between the average coil surface temperature and the refrigerant temperature. Thus, the manufacturer must also present data from which the engineer can determine the overall room-to-refrigerant temperature differential necessary with the unit cooler selected. Some manufacturers rate cooling equipment on the basis of the overall room-to-refrigerant temperature differential instead of using the intermediate average coil surface temperature. In either case the significant consideration is, that this overall temperature differential must be determined from a knowledge of the sensible heat ratio and the air volume of a unit cooler under consideration. If the tentatively selected unit cooler does not possess the proper capacity, it may often be possible to adjust the fan speed to a new air volume. At the new air volume and new overall differential, the cooler may be able to deliver the necessary cooling capacity. If not, the procedure must be repeated with another size of unit cooler, the final selection being based on the economical balance between unit cooler, the compressor, and the condenser.

Procedures for rating and testing room coolers are given in an *ASRE* Standard[3] which establishes four groups of conditions (numbered I to IV) under which units may be rated. Many manufacturers establish and publish their ratings in accordance with this standard.

In this standard, forced circulation air coolers are classified according to air side surface conditions as (1) dry coil, (2) sprayed coil, and (3) spray—no coil; or according to type of air delivery to room as (1) free delivery fan, or (2) pressure fan. Natural convection air coolers are classified according to type as (1) external baffle, (2) built-in baffle, and (3) without baffle.

Arrangement and Operation

The refrigerant is usually supplied to the evaporator through a thermostatic expansion valve, thus obtaining dry expansion in the evaporator.