

Table 1....Standard Rating Basis for Self-Contained Air-Conditioning Units

Functions	Types of Units	Rating Condition		
		Item	Description	Value
All	All	a	Barometric pressure	29.92 In. Hg
		b	Unit ambient and air entering room—air inlet (1) Dry-bulb (2) Wet-bulb	80 F 67 F
		c	Ventilation air	See Note
		d	Water temperature entering unit	75 F
		e	Water temperature leaving unit	95 F
Cooling	Water-cooled, air-cooled, and evaporatively cooled condensers	f	Air entering outdoor air inlet (1) Dry-bulb (2) Wet-bulb	95 F 75 F
		g	Unit ambient and total air entering unit	70 F
		h	Heating medium, pressure or temperature (1) Dry saturated steam (2) Water in (3) Water out	16.7 psia 180 F 160 F
		i	Unit ambient	70 F
		j	Total air entering unit (1) Dry-bulb (2) Wet-bulb	70 F 53 F
Humidifying	All types provided with humidifying function	k	Filters	New and clean
Air circulation	All	k	Filters	New and clean

Note: Rating shall be based on both ventilation and recirculated room air entering at 80 F dry-bulb and 67 F wet-bulb temperature. (The Note as given in the code has been condensed in order to remove material not pertinent to this chapter.)

conditioners are selected for the usual range of external resistances commonly used with the specific size of conditioner. The larger conditioners are capable of serving larger areas and therefore require fan and motor capacity for the greater external duct resistances that may be imposed on such conditioners.

When locating unitary equipment, floor and beam loadings should be carefully checked. Suspended horizontal units can add 50 to 100 lb per square foot to the loading on the floor above. Should this floor be already heavily loaded, or be a roof structure designed for a 40 lb per square foot snow load, excess beam deflection may occur and cause cracking of plaster or concrete fireproofing. A small fire, normally of

little consequence, may cause a rupture of a heavily loaded structure and permit the equipment to drop with extensive property damage. Self-contained units should be carefully installed since their weights run as high as 200 lb per square foot. When they are installed in street floor shops, the extra precaution of placing a column beneath them in the basement is an inexpensive method of reducing vibration, as well as providing insurance against overloaded floor beams.

The services required for operation of unitary equipment should conform to the many restrictive, but necessary, local municipal codes. Existing buildings seldom are wired adequately for the electrical load imposed by the starting of an air-conditioning compressor on any branch circuit. Even the smallest room cooler can draw enough current to reduce the voltage of a lighting circuit to the point where it is visibly apparent. This voltage drop may even affect the life of the unit due to the relatively slow starting. The cost of a separate electrical circuit of adequate capacity from the main panel is more than justified; it is a necessary expense in the majority of installations.

A water supply of adequate capacity and pressure is necessary to prevent overloading of electrical equipment by high head pressures. The average city water supply pressure is adequate for installations up to the third floor. Since most water-cooled units require about 20 psi pressure, including control valve losses, it is important that any units served by gravity from roof tanks be checked carefully if located less than 40 ft below the tank.

Drain connections from condensers should flow to an open and properly trapped sink as required by most city codes. This prevents back pressures on the city water system in the event of condenser failure. A check valve should also be installed in the water supply as a further precaution against contamination.

When installing small remote or self-contained units with outdoor air connections in buildings more than 6 stories high, the effect of wintertime stack action in elevator and stairwells requires special attention. This stack action is the cause of negative pressures on the lower floors, tending to draw cold air through the units, and positive pressures on the upper floors preventing adequate ventilation and disrupting air distribution. It can also cause annoying whistling at door openings and lead to serious complaints in hotels and offices. Wherever the removal of such units is impracticable, it is important that carefully fitted, felt-edged dampers be installed in the outdoor air intakes and that they have adequate locking devices.

One further consideration when installing self-contained units in conditioned areas is to ensure that space is adequate for any maintenance or repairs to be required in future years.

Sound Isolation

Both suspended and vertical floor-mounted units can transmit vibration through the supports. Wherever such transmission of sound might be objectionable, the supports should be isolated through rubber-in-shear or other sound deadeners. (For design of suitable sound deadeners see section Controlling Vibration from Machine Mountings in Chapter 25.)

UNIT AIR COOLERS

Unit air coolers are intended principally for product cooling, but are often used for cooling spaces to low temperatures. They differ from normal air-conditioning units only in features required to produce lower temperatures. In using such units, dry-bulb temperatures should be considered first, after which room moisture conditions and air distribution should

be considered, depending on the product being cooled or stored.

Products to be cooled or stored may be divided into four general classifications based on their sensitiveness to moisture loss.¹ Selection of the proper temperature differential between storage-room air temperature and evaporating refrigerant temperature will produce adequate moisture control for all practical purposes. The differentials required for gravity circulation and for forced air circulation are different, the latter requiring closer differentials. The four classes and differentials which have been successfully used are:

Class 1. Products requiring high room-moisture content, which are highly susceptible to moisture loss and are being stored for extended periods, for example, eggs.

Gravity Circulation 18 F or less.
Forced Air Circulation 6 to 9 F.

Class 2. Products similar to Class 1 but which are being stored only for a limited time as in retail stores where the turn-over is usually 3 days or less, for example, cut meats.

Gravity Circulation 18 to 22 F.
Forced Air Circulation 9 to 12 F.

Class 3. Products requiring moderate room moisture content and which are moderately susceptible to moisture loss, for example, carcass meats and some fruits.

Gravity Circulation 21 to 27 F.
Forced Air Circulation 12 to 20 F.

Class 4. Products from which there is a very low moisture loss or none at all and where room moisture content is not important, for example: canned goods, furs, woolens, bottled goods, dried fruits, foods packaged in good moisture vapor barrier packages.

Gravity Circulation 25 F and up.
Forced Air Circulation 20 F and up.

When using Class 4 application, with finned evaporators and automatic defrosting at each cycle of the condensing unit, it is important to avoid using too wide differentials with very low refrigerant temperatures. In many applications, prime-surfaced evaporators prove unsuitable for this type of defrosting and will require some positive method of defrosting.

Unit coolers can perform satisfactorily in installations requiring accurate control of relative humidity, air motion, and dry-bulb temperature, and thereby prevent excessive weight loss, mold and slime growth, and moisture absorption by hygroscopic materials such as dried fruits.

Unit coolers, especially in the smaller sizes, are very similar in appearance to unit heaters. Copper, aluminum, or steel prime or finned-surface tubes are used. Propeller or centrifugal fans either blow or draw room air over the tubes. The fan and coil are generally enclosed in a casing provided with a drip pan. The motor horsepower requirements are a function of resistance due to coil construction and arrangement, and air volume required. Fin spacing is based principally on operating temperatures. For operation below 35 F, fin spacing is preferably not more than four to the inch. Above 35 F it may run as high as 8 fins per in., depending on room temperature and refrigerant temperature used. Both direct expansion refrigerants and brine are used successfully as cooling mediums.

Unit coolers may be arranged for either free or duct delivery. Face velocities vary, depending principally upon the intended application of the unit. In the larger sizes particularly, speed adjustment of the fan is generally provided to permit variation of the air delivery. While unit coolers are usually installed in the storage space, remote installation com-

bined with appropriate ductwork 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.

For storage temperatures below 35 F, some positive means of defrosting is mandatory. At 35 F or higher storage temperatures, cycling of the condensing unit with low-pressure control at proper settings will provide automatic defrosting at each cycle. At above 35 F design refrigerant temperatures, frost and ice formation will not normally occur.

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 dampened 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 on the unit being defrosted. 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, or cause too much corrosion of room fittings, ducts, and equipment.

Ratings

Since 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. Air throw data are also valuable.

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 total heat absorbed with no distinction between sensible and latent heat. The rating expresses the capacity in terms of Btu per (hour) (Fahrenheit degree temperature differential between the refrigerant and the air). The term basic rating may be used. This is the Btu per hour absorbed with one Fahrenheit degree differential between room air and evaporator refrigerant temperature. When the total load has been obtained from the load calculations, a temperature differential between the air and the refrigerant is selected. It is based on product classification previously discussed. The extent of dehumidification will be a function of this temperature differential. Moisture conditions in the storage space are dependent upon the correct selection of this temperature differential. It offers a quick and sufficiently accurate practical basis for coil selection. Where close control of relative humidity is desired, heating coils or electric heaters for reheat may have to be added. The