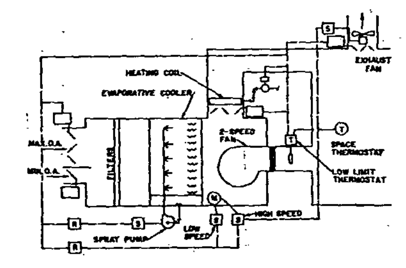
method would be to have an outdoor master thermostat to reset the sub-master dew-point controller. The dew-point control point would be lowered as the outdoor temperature drops. Another method would be to have two dew-point controllers, one for winter and one for summer. When air washers are used as the dehumidifier for comfort applications, the eliminator sprays alone may be used in winter and the main sprays are shut off. For outdoor temperatures approaching winter design temperature in the zone of 0 F outdoor design and below, the sprays should be shut off or reduced to keep condensation to a minimum.

In some parts of the western part of the United States, where maximum outdoor, wet-bulb temperatures rarely exceed 70 F, evaporative cooling can be successfully used for comfort cooling. Factory built evaporative units can be applied to many projects where only summer cooling is desired and a year-round ventilation system is not a requirement. The units are available in size ranges from 2000 to 12,000 cfm and have an evaporative cooling efficiency (ratio of entering dry-bulb minus leaving dry bulb to entering dry bulb minus entering wet-bulb temperature) between 70 and 80 percent. For year-round central station equipment using evaporative cooling, air washers, capillary type washers, rotary type evaporative cooler units, or slinger spray pad cooler units can be used to obtain the cooling. For year-round systems using evaporative cooling, it is usually desirable to have a two-speed fan. A larger amount of air is required for the summer cooling compared with the normal winter ventilation and heating requirements. Fig. 9 shows an evaporative cooling application with year-round ventilation and heating.

The control sequence allows the fan to operate on low speed when any heating is required. As the temperature rises in the space, a larger percentage of outdoor air is used, and when the maximum outdoor air dampers are full open a relay changes fan from low speed to high speed and starts exhaust fan. A further rise in room temperature will start the spray pump. A low-limit cutout controller for the evaporative cooling cycle, located in the outdoor air stream, would be desirable in areas where outdoor temperatures go below freezing.

For any of the psychrometric and control processes illustrated heretofore, it might be necessary to have more than one zone of control. Where humidity control is not an important factor, this can be done very simply with the blow-through mixing damper type system as illustrated by Fig. 3. A separate set of mixing dampers is all that is required for each zone of control. Where humidity control is important, zoning becomes more expensive.



* Year-round ventilation and heating.

Fig. 9 .... Equipment Arrangement for Evaporative Cooling System*

For a single fan central station system, the simplest method of providing zone control is to have a separate reheat coil on the discharge of the fan for each zone. If the zones are large, a separate fan and bypass reheat coil as shown in Fig. 6 would be provided for each zone. The dehumidifier face damper would have to be divided proportionally with separate damper motors for each zone.

SELECTION OF REFRIGERATION

Although it is not within the scope of this chapter to cover all the various types of refrigeration systems in detail, one of the most important decisions that must be made for an air conditioning application is the type of refrigeration system to be used. On small projects (below 50 tons), electrically driven reciprocating compressors are usually the most practical type of refrigeration, since this is below the economical size range of centrifugal and absorption refrigeration. For larger installations, many economic factors may be involved, such as initial cost, energy cost, life expectancy, dependability, and maintenance considerations.

Refrigeration equipment for use in central systems is discussed in Chapters 28, 29, 30, 32, 37, and 53 of the 1961 Guide And Data Book.

Information on owning and operating costs will be found in Chapter 79 of this volume.

SELECTION OF CENTRAL STATION EQUIPMENT

Before central station air-conditioning equipment can be selected, the following data must be determined:

1. Total air supply quantity, which is usually based on the maximum sensible heat gains for each zone of the air-conditioned space, with an assumed temperature difference between supply air temperature and design room temperature. Normally, the temperature difference between the supply air and room temperature would be between 15 and 25 F deg.

2. The dehumidified air quantity must be determined, and is based on the maximum simultaneous sensible heat gain of the entire air conditioned space served by the central station equipment, with an assumed difference in dehumidified temperature and the design room temperature. The temperature difference between dehumidified air and room temperature is usually 5 F deg or so greater than the difference between supply air temperature and design room temperature. The dehumidified air temperature must be at the required dew point to offset the internal latent heat load. By considering the proper diversity factors, the dehumidified air for a system serving a space with east, west, south and north zones, may be as little as 50 percent of the total air supply. The dehumidified air quantity is calculated on the basis of the maximum simultaneous heat gain of the entire space, which might at 4:00 p.m. in the afternoon; while total air supply is based on maximum gain for each zone. For example, the east zone maximum air supply requirement might occur at 9:00 a.m., and at 12:00 noon for the south zone.

3. The amount of outdoor air used will have a considerable effect on the total refrigeration load and the selection of the dehumidifier. Some of the conventional methods of establishing the amount of outdoor air are as follows:

a. 25 percent of total supply air.
b. 25 percent of dehumidified air.
c. 5 to 15 cfm per occupant in the building. (5 cfm should only be used where there is a large occupancy and smoking is controlled.)
d. ¼ cfm per square foot of floor area.
e. Minimum of one outdoor air change per hour.

There are a number of applications that might require 100 percent outdoor air, such as hospital operating rooms or laboratory rooms where there is considerable exhaust through hoods. Local codes regulate the amount of ventilating air in many applications.

Factory Assembled Air Handling Units

Factory assembled air handling units are available in a wide range of sizes, and component arrangements. Almost all the arrangements given in Figs. 3–8 are available in pre-assembled sections except the arrangement shown in Fig. 6. Dehumidifier dampers and return air bypass reheat coils as shown in Fig. 6, are not normally furnished with standard factory assembled units. The maximum air handling capacity available in factory units is approximately 35,000 cfm. When using units of the larger sizes, the designer must carefully check building opening sizes and space requirements so that factory assembled units can be properly installed.

Although factory assembled units, when properly utilized, can provide successful and economical air-conditioning installations, they have certain limitations which should be given careful consideration when selecting central station equipment. In addition to some previously mentioned, such as generally poor accessibility to components and shorter life, factory assembled units normally have a very narrow selection range between total air supply and dehumidified air. As noted previously, it is possible to size the dehumidifier for considerably less air than the total supply air, by giving consideration to load diversity. It is usually not possible to take full advantage of such items as load diversity with standard factory units since the coil sizes and total air supply are very closely related for a given size.

Built-Up Central Station Equipment

For large central station fan systems, a built-up system will result in maximum accessibility and ease of maintenance, more flexibility in control and more accurate selection of components. Some of the commonly used design standards for the selection and arrangement of the various components of a built-up central station system are presented here. The standards presented are to be used as a guide only, and specific conditions must be considered for each application.

Outdoor Air Intakes. Outdoor air louvers are usually sized on the basis of a face velocity from 500 fpm to 750 fpm maximum. For areas with heavy snowfall, the maximum face velocity should be 600 fpm. Outdoor air hoods are sized on the basis of 1000 fpm and up to 2000 fpm for large air quantities.

Automatic Dampers. The sizing of automatic dampers can vary greatly, but for modulating dampers, it is desirable to have the velocity high enough to generate sufficient pressure drop, so that when the damper opens or closes slightly there will be a definite change in air volume passing through it. A face velocity of 1000 fpm is commonly used, but velocities up to 2000 fpm are desirable on bypass dampers. Opposed-acting blades should be used for modulating dampers.

Dehumidifiers and Cooling Coils. For sizing spray dehumidifiers and cooling coils, a velocity of 500 fpm is commonly used. For coils over 6 rows, the velocity should not exceed 600 fpm. Velocities lower than 500 fpm resulting in lower pressure drop and higher degree of saturation are sometimes desirable on special applications: For further information, see Chapter 34 in the 1961 Guide And Data Book.

Heating Coils. Preheat coils are sized on the basis of 600 to 800 fpm velocity. When a two-position control is used to prevent freezing preheat coils, the temperature rise should be limited to that required to raise the lowest expected outdoor air temperature to a few degrees above freezing. As previously emphasized, it is desirable to provide two preheat coils, controlled in sequence to limit the temperature rise for areas having outdoor air temperatures at 0 F and below in order to prevent overheating in mild weather.

Reheat coils in the bypass should be sized at relatively high face velocities to help equalize the pressure drop through the apparatus. A face velocity of 800 fpm is commonly used.

Booster reheat coils in ducts are sized from 600 to 750 fpm face velocity.

Reheat coils at the fan inlet are normally sized at approximately 600 fpm.

For further information, see Chapter 39 in the 1961 Guide And Data Book.

Fans. Many designers use an outlet velocity between 1600 to 1900 fpm as the basis for sizing fans. This practice can lead to trouble on higher static pressure systems. The fan efficiency curve is an important factor in correctly sizing fans, and with higher total static pressures, outlet velocities up to 2700 fpm are desirable. For unusually low static pressures, the correct design outlet velocity may be as low as 1400 fpm. Noise is another important consideration in fan selection. In selecting for minimum fan noise, high efficiency is more important than outlet velocity. Refer to Chapter 40 in the 1961 Guide And Data Book for further details on fans.

Filters. The sizing of filters should be on the basis of the manufacturers' ratings. Different types of filters vary widely as to air cleaning efficiency and many times economic studies are required to determine the proper type of filter to apply to a system. Among the things to consider in the selection of filters are the initial cost, maintenance (cleaning or replacement) cost and the air cleaning efficiency together with its effect on the cost of cleaning the building and the cost of replacing spoiled merchandise or products that might result from insufficiently cleaned air.

For further information, see Chapter 48 in the 1961 Guide And Data Book.

Chemical Drying and Sorption Equipment. The sizing of chemical drying and sorption equipment should be based on the manufacturers' ratings and recommendations. It is important to take in account the sensible heat added to the air when it is dehumidified with sorption equipment.

Evaporative Coolers. In the selection of pad type evaporative coolers, the manufacturers' ratings should be followed. When using spray washers for evaporative cooling, a face velocity up to 600 fpm may be used. It is usually desirable to select equipment having an evaporative cooling efficiency around 80 percent. Higher evaporative cooling efficiencies should not be used unless reheat coils are used for the summer operation, since this will result in space humidities being too high.

For further information, see Chapter 38 in the 1961 Guide And Data Book and Chapter 77 in this volume.

Equipment Arrangement. Fig. 10 shows a recommended ideal spacing arrangement for a built-up central station equipment with walk-in access doors to each component. Sometimes compromises must be taken to reduce clearances between components from those shown in Fig. 10, but for maxi-

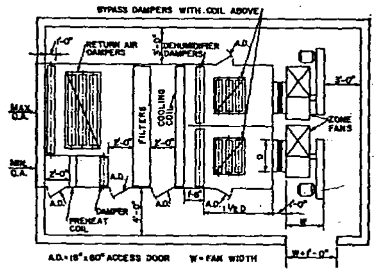


Fig. 10 .... Recommended Space Requirements and Clearances for Central Station System Fan Room