## EQUIPMENT CAPACITY SELECTION

There are two industry-accepted methods of calculating residential cooling loads. These are as given in Manual 11, Summer Air Conditioning, of the *National Warm Air Heating and Air Conditioning Association* and Standard 6-10, Application Engineering Standard for Year-Round Residential Air-Conditioning published by the *Air Conditioning and Refrigeration Institute*. Published procedures of reliable manufacturers when used in conjunction with their equipment are also adequate.

Both of the industry methods mentioned employ cooling load factors for the various components of the load that are averaged over a peak period of several hours and thereby make allowance for thermal storage effects. They avoid the possibility of pyramiding non-concurrent, instantaneous peak loads.

With most methods it is possible to select the desired design indoor-outdoor temperature difference, using 80 F or the user's preference for the indoor temperature, and the commonly used outdoor temperature for the area as listed in Chapter 13.

Design methods which average load conditions for a period in excess of 12 hr have not been accepted by the industry committees. Such methods require the introduction of factors that are not at present considered to be adequately substantiated by mathematical analysis or to be justified by the thermal storage effects of a typical residence.

The contractor should avoid any capacity selection procedure based on a rule of thumb such as *10 average windows or doors per ton* or *500 sq ft of floor area per ton*. Insulation, glass areas, shading effects, and solar orientation must be given careful consideration which is only possible with an accurate, step-by-step procedure for estimating the load.

In residences peak lighting loads will not usually occur during the period of greatest load from outdoor temperature and solar conditions. Unlike summer air conditioning in commercial or industrial establishments where internal heat producing sources may be a major portion of the load, internal loads in residences may generally be neglected except under the most unusual circumstances.

The heat and moisture introduced by a clothes drier or water heater should be vented to outdoors. Heat introduced by the kitchen range should be discharged through an exhaust fan. These are major internal sources which must be taken into account if adequate venting is not to be provided.

The load calculation method presented in Chapter 13 is not recommended for residences where it has been found[2] to result in oversizing because internal loads which are generally a prime consideration in commercial applications are not generally significant in residences. Furthermore the method outlined in Chapter 13 gives an instantaneous peak load without consideration of residential usage and heat storage effects applied in the *ARI* and *NWAH and ACA* load calculation procedure. Oversizing is objectionable from at least two viewpoints: (1) it increases the capacity and consequently the cost of the equipment installed, and (2) it results in less desirable humidity conditions within the residence because of the increased size.

## TYPES OF EQUIPMENT

### Low Side

Three types of low side equipment (the equipment that actually removes the heat from the conditioned space) have been developed for residential



work as follows: (1) refrigerated coils, (2) chilled-water coils, and (3) water-cooled coils.

The first and most commonly used method of absorbing heat from the conditioned air is to use direct evaporation of the refrigerant in a coil with the air to be conditioned passing over the outside of the coil surface. The heat is passed directly from the air into the refrigerant for removal. This requires the use of an air distribution system and, although generally most economical in new construction, may present costly problems in modernization work where ductwork is not installed.

In a chilled-water system, water is circulated through a closed circuit containing two coils. In one coil the water removes heat and moisture from the air in the conditioned space. In the other coil (water chiller) the heat is removed from the water by mechanical refrigeration. This type of system is called a duplex system in that the heat is picked up by chilled water and later removed from the water by means of a refrigeration system.

The water-cooled coil using water directly from city mains or wells is the simplest type of installation but, because of limitations imposed by the capacity, cost, or temperature of the available water supply, its use is not generally practicable. Cold water is circulated directly through the coil while air from the conditioned space is passed over the coil to remove heat and moisture. After the water has passed through the coil, it is wasted. To operate satisfactorily, an installation of this type requires water of sufficiently low temperature to chill the air enough to remove the desired amount of heat and moisture. Where a large supply of cool water is obtainable, the water-cooled coil will operate with satisfactory results. As a general rule a water-cooled coil should not be used unless there is a supply of 52 F or colder water at the peak of the cooling season and in sufficient quantities to take care of the cooling load with a temperature rise of no more than 10 deg. Where water is not obtainable in sufficient quantities or at the required temperatures, it is necessary to chill the water to the desired temperature by using mechanical refrigeration.

### High Side

The high side of a conditioning system, the section of equipment that removes the heat from the refrigerant and reclaims the refrigerant for further use in the system may be either the air or water-cooled type. The air-cooled high side is so constructed that the heat is removed from the compressed or hot refrigerant by passing it into a cooling coil over which outside air (air taken from outside the conditioned area and returned to outside of the conditioned area) is circulated.

The major advantage of air-cooled equipment is that no water is required to accomplish the removal of heat from the refrigerant and only an electrical supply is needed. The disadvantage is that operating pressures are higher because of the inability to cool the refrigerant as much by air as by water. This results in an increase in electrical input to the compressor motor.

Water-cooled equipment can be of two types. In one type the water drawn from a well or from city mains is passed through the condenser of the high side and is allowed to flow to a drain, swimming pool, a wetted roof, or to other means of disposal. Where the water supply is sufficient and at low cost, this type of water-cooled unit is the better type installation because of lower equipment cost, lower operating costs and quieter operation. In a second type, if water is in short supply or is expensive, about 95 per-