

usually installed in place of an existing radiator, is shown in Fig. 5. Furnished with chilled water from a central plant, these units offer a satisfactory method of conditioning existing office, hotel, and apartment rooms. These units may be obtained with filters and outdoor air connections, but for most satisfactory applications are used as supplements to the central systems that supply properly conditioned and filtered air to the areas served.

Induction units, using primary conditioned air under pressure to induce local circulation, are described in Chapter 19.

SELF-CONTAINED UNITS

A typical large self-contained air-conditioning unit is shown in Fig. 6. It is essentially a remote vertical-type conditioner mounted on top of a sound-insulated enclosure containing the condensing unit. Air distribution is obtained by means of grilles mounted in the discharge plenum, when the unit is located in the conditioned area. Duct distribution of conditioned air can be obtained by removing the plenum, connecting directly to the blower discharge, and saffing the top of the unit.

The heat generated by the compression of refrigerant gases and that given off by the electric motor are removed from the compressor compartment in four ways: (1) by the use of a water coil in the compressor compartment, (2) by utilizing the cold suction gases, (3) by drawing part of the return air through the compressor compartment; and (4) by circulating room air through the compressor compartment by means of a fan attached to the motor shaft.

Most self-contained conditioners are constructed with enough sound-isolation material for installation directly in the conditioned spaces of the higher-sound-level commercial-type of applications. Special sound treatment means are to be supplied as part of the installation when applying these conditioners to spaces having low sound-level requirements. Conditioners may be installed outside the conditioned area and the connecting supply and return-air ducts can be acoustically treated as required for the specific installation.

ROOM AIR CONDITIONERS

A room air conditioner is a factory-made encased assembly designed primarily as a unit for mounting in a window or through a wall, or as a console, for free delivery of conditioned air to an enclosure and without ducts for conditioned air supply or return. It includes a prime source of refrigeration and dehumidification and means for circulating and cleaning air, and may also include means for ventilating, heating, or performing other functions.* Most room air conditioners are used in residences and apartments, although many are installed in small commercial establishments. A number of multistory buildings have been completely conditioned with room units.

Although most room air conditioners are designed for conventional window mounting, many are made for mounting in casement windows, walls, or as console types in front of windows or walls. In such units, the arrangement of the basic components is often quite different from that employed in window units because emphasis may be placed on minimum depth or height rather than on width. Since great strides have been made in recent years in the reduction of overall unit dimensions, the current trend is toward units that can be mounted essentially flush with the inner wall face and protrude very little beyond the outer face. A recent innovation is the small, light-weight portable room air conditioner.

Most room air conditioners have air-cooled condensers although water-cooled versions have appeared from time to time. In air-cooled units, condensate disposal is typically provided by equipping the condenser fan with a slinger ring which picks up condensate and throws it on the condenser coil where it is evaporated into the condenser air stream and coincidentally provides some evaporative condensing effect.

Sizes

Room air conditioners are available in capacities ranging from about 3000 Btuh up to 18,000 Btuh or more. Sizes have been popularly designated in terms of the nominal horsepower of the compressor motor, although this is not necessarily an accurate indication of unit capacity. Units are available in sizes up to 2 hp, with the ¾ hp and, more recently, the 1 hp units being most popular.

The *National Electric Code** limits the amperage rating of motor-operated equipment installed on multi-outlet branch circuits to 50 percent of the circuit rating, and on single-outlet branch circuits to 80 percent of the rating. For the typical 14-gage (15 ampere) house circuit, this effectively limits room air-conditioner amperage ratings for multi-outlet and single branch circuit installations to 7.5 and 12 amperes respectively. Many room air conditioners are designed for maximum performance within these amperage limits, regardless of nominal compressor horsepower.

Component Descriptions

Although many different types and variations of components have been used in room air conditioners, it is possible to give a fairly typical picture of current production. Hermetically-sealed refrigerant circuits are now universally employed, and the compressors are usually of the welded-shell reciprocating type operated by capacitor-start, capacitor-run, or permanent-split capacitor motors. Both evaporator and condenser coils are usually of aluminum plate fin and copper coil construction. Capillary tubes are normally employed as the expansion device, although valves are sometimes used for special purposes. Both centrifugal and axial-flow fans are used, sometimes one of each, with the latter equipped with a slinger ring for condensate disposal. One shaded-pole or permanent-split capacitor fan motor, mounted on the condenser side or in the partition, is frequently employed to operate both fans although in some designs two fan motors are used. A throw-away or cleanable type of filter is standard equipment. Grilles and an increasing number of other parts are being constructed of plastic. A slide-out chassis, containing the complete refrigerant and air circuits, is often used. Nonflammable and nontoxic refrigerants (ASA B9.1, Group I Classification*) are used exclusively.

Features

A thermostat and adjustable louvers for directing the conditioned air have become standard features on most units. A ventilation or outdoor-air damper is almost always included and sometimes an exhaust air damper. Two-speed fan motors are frequently used to give quieter operation during off-peak load conditions. Special filters and other air purification devices are featured on some models.

Some room air conditioners are designed as heat-pump units to provide heating during the intermediate seasons, or for year-round conditioning in some climates. Resistance

Unitary Air-Conditioning Equipment

heating has also been incorporated into some units for the same purpose.

Electrical Characteristics

Room air conditioners are normally designed to operate on single-phase, 60-cycle power at 115, 208, or 230 volts. Units for the export market are made for 50-cycle operation. Attachment plug requirements, which are related to the *National Electrical Code* ampere limitations, are specified by Underwriters' Laboratories, Inc.*

The rapid public acceptance of room air conditioners has presented special problems to the utility companies who must supply power to meet the electrical demands of these units during summer heat waves. As a result, recommended maximum starting currents and minimum power factors have been established for room air conditioners and are listed in *ARI Standard 110-56*.

Rating

Room air conditioners are tested for rating under the provisions of the *ASRE Standard 16-56** at standard rating conditions of 80 F db and 67 F wb room air temperature and 95 F db and 75 F wb outdoor air temperature for air-cooled units. Rating requirements are specified in the *ARI Room Air-Conditioner Standard 110-56*. That organization is presently conducting a room air-conditioner rating compliance program.

Other Design Considerations

Air-flow rates vary considerably, with evaporator air quantities of 350-400 cfm per ton and condenser air quantities of 650-700 cfm per ton being approximately representative of current practices. Sensible heat factors usually average about 0.70, and performance factors (Btu per watt hour) about 6.5.

Room air conditioners should be designed to operate satisfactorily at the maximum conditions they might normally encounter. They should also be expected to perform without dripping or blowing of water from the unit. Standard test requirements for such considerations have been established by ARI in *ARI Standard 110-56*.

Safety requirements for room air conditioners are prescribed in the *American Standard Safety Code for Mechanical Refrigeration B9.1* and the Underwriters' Laboratories *Standard for Room Air Conditioners*.

Selection

Many room air conditioners are sold over the counter without careful attention being given to matching the capacity of the unit with the requirements of the load. The ARI has available a fairly simple Cooling Load Estimate Form for Room Air Conditioners* which can be used to make a reasonably proper selection. Most manufacturers also have cooling load calculation forms available and many have even simpler quick-selection charts or devices.

Installation

An installation accessory package is usually furnished with most units. These are designed so that an installation can be completed in an hour or so by one or two men using a few common tools. Accessory packages and wall sleeves are sometimes available for casement windows and through-wall mountings.

The only connection that is necessary for air-cooled units

is to insert an electrical plug into a convenience outlet of the proper rating.

Controls for Room Cooling Units

Control devices provided for self-contained cooling units generally will include all necessary means for automatic operation. Provision is also made for adding auxiliary external controls, when desired. Remote units are not generally equipped with controls. Control of remote units and the addition of auxiliary controls for self-contained units can be made by application of the control principles outlined in Chapter 19 Central Systems for Air Conditioning and Chapter 43 Automatic Control.

RATINGS OF UNIT AIR CONDITIONERS

Two standards have been used for rating and testing of unit air conditioners: (1) *Standard Method of Rating and Testing Air Conditioning Equipment*,* covering all types of air-conditioning units except the self-contained type and (2) *Standard Method of Rating and Testing Self-Contained Air Conditioning Units for Comfort Cooling** covering the self-contained type. (*ASRE Standard Methods of Rating and Testing Air Conditioners, ASRE Standard 16-56*, covers rating and testing of all types which operate nonfreezing when cooling and dehumidifying at standard rating conditions.)

The standard rating of a self-contained unit, for the conditions specified in Table 1, includes all items which apply to the function of a unit such as: (1) name of unit, (2) functions which unit performs, (3) data on cooling, (4) data on heating, (5) data on air flow, and (6) data on humidification.

The standard rating conditions for unit air conditioners, other than the self-contained type, are identical with those in Table 1, except that entering wet-bulb temperature for cooling is expressed as 50 percent relative humidity (66.7 F wet-bulb) instead of 67 F wet-bulb temperature. In addition, the saturated suction refrigerant temperature for comfort cooling is specified at 40 F. This condition is omitted from Table 1 for self-contained units because it is not separately controllable in the testing of a unit that includes the evaporator and condensing unit.

APPLICATION OF UNITARY EQUIPMENT

One of the chief advantages resulting from use of factory produced units is the saving in installation and field assembly labor, a factor that should always be kept in mind when selecting a location for these units. Because of their compactness, the tendency exists to put them in closets, storage rooms, and other inaccessible places, where installation is so difficult that much of this cost advantage is lost.

Access panels are provided on units for the proper servicing and maintenance of the equipment. Adequate outside clearance at these panels is essential. Wherever there is danger of freezing of coils or clogging with dirt, sufficient clearance should be available for replacing them without removing parts of the building.

The outstanding source of difficulties in unitary systems is usually dirty filters. The characteristics of the light-weight fans used are such that air volume drops off rapidly with increase in static resistance. Since changing of filters is an unpleasant duty likely to be neglected unless it can be done easily, the operator should be at the same level as the filters, rather than under them, when they are being removed.

Variable-pitch motor pulleys are usually provided for adjustment of the air quantity. The fans and motors of most