hour. Therefore, a recirculation rate of 200 cfm is sufficient for a room of 12,000 to 16,000 cu ft. Dehumidifiers with capillary tube systems are designed for controlling relative humidities in rooms at 65 F db and higher. At or below the critical 60 to 65 F db range, the refrigerant pressures will probably be low enough to cause the evaporator temperatures to drop below freezing and ice to form on the evaporator. This condition occurs because the dehumidifier is designed for maximum capacity at established standard conditions of 80 F db room ambient temperature and 60 percent relative humidity.

Frost control with automatic timers to cycle the unit for defrosting on the *off* cycle in ambient temperatures under 65 F, is relatively ineffective in total moisture removal. This occurs because the cool air contains less moisture and the *on* cycle of the unit is shorter.

CODES

Dehumidifiers are designed to meet the safety requirements of Underwriters' Laboratories *Standards for Safety-Dehumidifiers* Bulletin UL 474, 1957; of the Canadian Standards Association, *Canadian Electric Code*, Part II, Specification C22.2 No. 32-1954, *Construction and Test of Electrically Operated Refrigerating Machines*; and of the American Standard *Safety Code for Mechanical Refrigeration* ASA B9.1-1964.

It is customary for UL and CSA approved equipment to have a label or data plate indicating this. UL also issues an equipment list for approved equipment (*Electric Appliance and Utilization Equipment List*, Underwriters' Laboratories, Chicago, Illinois).

SUMMARY OF APPLICABLE CODES AND STANDARDS

Room Air Conditioners (National Electrical Manufacturers' Association Standard CN1-1964, New York).

National Electrical Code (National Fire Protection Association, NFPA No. 70, 1962; ASA C1; Boston, Mass.).

Standards for Safety for Room Air Conditioners (Bulletin 484, Underwriters' Laboratories, Inc., Chicago, 1961).

Construction and Test of Room Air Conditioners (*Specification* C22.2, No. 117-1960, Canadian Standards Association, Ottawa, Canada).

American Standard Safety Code for Mechanical Refrigeration (ASA B9.1-1964. Also designated as ASHRAE Standard 15-63).

Electric Appliance and Utilization Equipment List (Underwriters' Laboratories, Inc., Chicago).

FHA Minimum Property Standards P606-607 (Federal Housing Administration, Washington, D. C.).

Military Specification MIL-A-21047B (U. S. Navy, Bureau of Yards and Docks, Washington, D. C.).

Specification 00-A-372 (General Services Administration, Washington, D. C.).

Test Procedures (National Safe Transit Committee, 1145 Nineteenth St., N.W., Washington 6, D. C., 1957).

ASHRAE Standard Method of Testing for Rating Room Air Conditioners (ASHRAE Standard 16-61, 1961).

Dehumidifiers—Self Contained; Electrically Operated; Mechanically Refrigerated (Publication No. DH1-1963, National Electrical Manufacturers' Association, New York).

Standards for Safety-Dehumidifiers (*Bulletin* UL 474, Underwriters' Laboratories, Inc., Chicago, 1957).

"Construction and Test of Electrically Operated Refrigerating Machines" (*Specification* C22.2, No. 32-1954, Canadian Standards Association, Ottawa, Canada).

ASHRAE Method of Determining Sound Power Levels of Room Air Conditioners and Other Ductless, Through-The-Wall Equipment (ASHRAE Standard 36A-63, 1963).

CHAPTER 65

UNITARY AIR CONDITIONERS

Background and Recent Trends; Definition and Classifications; Application; General Design Considerations: Sizes, Shapes and Configurations, Appearance, Codes and Standards; Engineering Design Details; Performance Testing

COMPLETE, pre-assembled air-conditioning systems offered as packaged units gained acceptance in the early 1930's.

BACKGROUND AND RECENT TRENDS

The first *unitary air conditioners* were low in cooling capacity and bulky in size. Progress in reducing size, weight, and cost of units has reached the point where the early, water-cooled, 2 ton floor-mounted unit is now an air-cooled unit small enough to mount on a window sill. As such, it is sometimes re-classified as the main type of the room air conditioner. (See Chapter 64, Room Air Conditioners and Dehumidifiers.)

Capacities of the earliest units ranged from 2 to 10 tons, with 2, 3, and 5 ton sizes predominating. Capacity of the largest units has increased to a current maximum of over 100 tons.

Other trends have been from exclusively water-cooled condensing to predominately air-cooled condensing systems. Hermetic compressors were adopted as soon as they were available. Unitary air conditioners were once generally represented by a single model. This was a one-piece, floor-mounted, water-cooled unit. Now the equipment group includes floor, ceiling, and wall mounted models both of one-piece unitary design and of two or more sections remotely installed with inter-connecting refrigerant piping. Condensers are water-cooled, air-cooled and evaporatively-cooled. Unit cabinets are styled either for use within the conditioned space or without ornamentation for concealed installation. A recent trend has been to weather-proof units for outdoor location.

A major shift in the market for unitary air conditioners occurred in the mid-1950's. Up to that time the application of this type of unit had been almost exclusively commercial. Within a five year period the residential application grew to represent more than two-thirds the total volume of unitary air-conditioning equipment. The impact of this shift upon the design and scope of this equipment group was considerable. The changes are reflected in a greatly increased number of equipment types and capacities, each designed to meet a specific requirement of the residential market. Design emphasis peculiar to the residential market such as heating, reduced sound level and styling have become predominant factors.

DEFINITION AND CLASSIFICATIONS

From the above discussion it can be seen that the term *unitary air conditioner* now includes an extremely broad range of equipment and, therefore, presents a difficult problem in definition and classification. The industry through its group representative, the Air Conditioning and Refrigeration Institute, has agreed upon the following definition of a unitary air conditioner.[1]

"A unitary air conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. *Where such equipment is provided in more than one assembly, the separated assemblies are to be designed to be used together, and the requirements of rating outlined in this standard are based upon the use of matched assemblies.*

Due to the broad scope of the above equipment definition, the industry has further classified this equipment group into the following categories:[1]

Group A: Air Conditioner Employing and Including Factory-Assembled Refrigeration Cycle(s).

1. With circulating fan.
2. Without circulating fan, for use with heating equipment incorporating a fan.
3. With heating function incorporated.

Group B. Air Conditioner Employing and Including Remote Condenser (With Compressor and Cooling Coil in One Assembly)

1. With circulating fan.
2. Without circulating fan, for use with heating equipment incorporating a fan.
3. With heating function incorporated.

Group C. Air Conditioner Employing and Including Remote Condensing Unit (Compressor and Condenser in One Assembly, with Cooling Coil in a Second Assembly).

1. With circulating fan.
2. Without circulating fan, for use with heating equipment incorporating a fan.
3. With heating function incorporated.

Group D. Air Conditioner Employing and Including a Remote Water Chiller (Separate Cooling Coil in a Second Assembly).

1. With circulating fan.
2. Without circulating fan, for use with heating equipment incorporating a fan.
3. With heating function incorporated.

These same categories have been assigned identifying type symbols for easier reference in tabular data.[2] Type symbols and a schematic presentation of these classifications are shown in Fig. 1.

The above definition and classifications refer to both electrically driven and heat-operated equipment. However, this chapter deals only with electrically operated units. Refer to Chapter 40 for a discussion of heat-operated unitary air-conditioning equipment.

Many of the above classified types of unitary air conditioners are also designed and manufactured for heat pump service. This type of application is rapidly becoming a significant factor in the unitary air conditioner field. Since this chapter deals only with electrically operated units for cooling, see Chapter 66 for further information on heat pumps.

APPLICATION

Unitary air-conditioning equipment is applied to either commercial or residential use, the former for comfort conditioning of commercial establishments and process control of temperature and humidity for manufacturing purposes; the latter for residential comfort only.

The functions of unitary air-conditioning equipment include cooling, dehumidifying, ventilation and exhausting;

The general responsibility for this chapter is assigned to TC 6.1, Residential and Small Commercial.