ment, and the local power rate. It is also influenced by human factors such as operation of equipment only during the hottest weather, opening windows at night[9], and difference in preferred indoor temperatures. Nevertheless, it is important that lending agencies and prospective buyers of equipment be given a reasonably accurate estimate of the operating cost during normal summer weather and under usual operating conditions. Adjustments can then be made for any special conditions anticipated. The approximate electrical power inputs for the various motorized components in mechanical cycle air conditioners are shown in Table 1.

Power cost per hour can be estimated by multiplying the estimated power per ton, the cooling capacity in tons and the cost per kilowatt-hour. Thus the estimated cost per hour for a 3-ton air conditioner cooled with city water will be 1.1 kw × 3 tons × the power rate. It is essential to use the correct step of the utility residential rate structure to get a good estimate. The basis of the method used[10] requires the use of a table of the estimated

TABLE 2. ESTIMATED ANNUAL HOURS OF OPERATION FOR PROPERLY SIZED EQUIPMENT IN TYPICAL CITIES DURING NORMAL COOLING SEASON

CITY	HOURS	CITY	HOURS
Atlanta, Ga.	750	Jacksonville, Fla.	1600
Boston, Mass.	200	Minneapolis, Minn.	350
Chicago, Ill.	400	New Orleans, La.	1500
Cleveland, Ohio	450	New York, N. Y.	350
Dallas, Texas	1400	St. Louis, Mo.	1000
Fresno, Calif.	900	Washington, D.C.	800

annual hours of operation for properly sized equipment in typical cities See Table 2.

The values in Table 2 have been substantiated by utility records of actual performance in several major cities when the average indoor temperature is maintained at 80 F. Low indoor temperatures increase operating cost as do weather conditions above normal.

Water usage is another important factor with water-cooled equipment. Various manufacturers have published water usage data for their equipment at varying summer water temperatures. Representative water consumption values are given in Table 3.

For a given application the power rate and water rate may be obtained from the local utilities. Since the average power requirement depends on the particular equipment used and the condensing method, values obtained from the manufacturer should be used in preference to those given in Table 1.

If the evaporator fan cycles with the compressor, the power requirement as found from Table 1 also represents the total power requirement for air-cooled condenser applications. For continuous fan operation the number of hours of compressor operation should be subtracted from the number of hours in the cooling season to obtain the extra hours of fan operation. This value may then be used with the appropriate value of power consumption and power cost for the fan motor only, to find the added power cost for continuous fan operation and the result should then be added to the power cost during compressor operation.

For water-cooled condenser applications the water cost, as determined from the operating hours, water rate and manufacturer's data on equipment water usage, is added to the power cost to obtain the estimated total operating cost.

Another method has been developed using cooling degree days above 70 F as a criterion but tabulated values of cooling degree days for various localities are not available.[11] Approximate values can be obtained from degree day maps.[12, 13] The daily range of temperatures for various localities are also required with this method.[14] It is important that the method used in estimating operating cost be consistent with the method used in calculating the heat gain of the structure.

EFFECTS ON FUTURE HOUSE DESIGN

Air conditioning, like automatic heating, has brought about improved practice in residential construction, particularly in those regions where cooling is of primary importance. Although it is true that construction practices which reduce the heating load also reduce the cooling load, there are certain

TABLE 3. WATER USAGE FOR WATER-COOLED EQUIPMENT

SUMMER WATER TEMPERATURE, NORMAL EXTREMES F	GALLONS PER (HOUR) (TON)	SUMMER WATER TEMPERATURE NORMAL EXTREMES F	GALLONS PER (HOUR) (TON)
55	34	75	58
60	39	80	70
65	44	85	88
70	50		

considerations which are unique in their effect upon the cooling load. Special attention must be paid to window orientation and means of shading the windows. South windows may be shaded by awnings or roof overhangs, but it is not practicable to shade large window areas having an east or west orientation except by exterior solar screening of some type. The use of insulation in the walls and ceiling of the residence will reduce the cooling load appreciably. In addition, attention should be paid to adequate ventilation of the attic. Double-glazed and weatherstripped windows, heat-absorbing glass, planned shade tree locations, and light colored exterior wall and roof surfaces, also help to reduce the cooling load.

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