

Interest

The interest chargeable may not represent the existing money rates. It may include an item to cover the diversion of capital or other items depending on existing tax laws which may make it necessary to charge interest due to diversion of capital as a cost item. It should be noted that interest may be based on an unamortized balance. As an example, a 15 year amortization period with a 4 per cent interest rate will approximate a 2.1 per cent average annual interest rate.

TABLE 6. OWNING AND OPERATING COST

FIRST COST	ANNUAL SERVICE COST
Cost of mechanical system.....	Electric Power Costs
Other costs.....	Fans.....
First Cost (FC)—Total.....	Pumps—Chilled water.....
	Pumps—Condenser water.....
	Pumps—Well water.....
ANNUAL FIXED CHARGES	Cooling tower fans.....
Amortization—Depreciation	Cooling tower pumps.....
period Y years.....	Refrigeration machines.....
Interest rate I%.....	Miscellaneous or other.....
Amortization and Deprecia-	Gas.....
tion	Coal.....
FC =	Oil—for boilers or Diesel
$\frac{Y}{Y}$	engines.....
Interest: $\frac{Y+1}{2Y} \times I =$	Steam.....
Taxes.....	For direct heating.....
Insurance.....	For Ventilation—preheat-
Rent.....	ers.....
Annual Fixed Charges:	For Ventilation—reheaters
(Total).....	For Turbine driven equip-
	ment.....
	For Engine driven equip-
ANNUAL MAINTENANCE COSTS	ment.....
Lubricating oil and grease.....	Sewers.....
Painting for corrosion pro-	Charges for discharging
tection or other purposes.....	well water into public
Replacement of worn parts.....	drainage systems.....
Refrigerant.....	Annual Service Costs—
Wages of engineer or operator	TOTAL.....
Annual Maintenance Cost—	
TOTAL.....	SUMMARY
	Annual Fixed Charges.....
	Annual Service Costs.....
	Annual Maintenance Costs
	Annual Owning and Oper-
	ating Costs—TOTAL.....

Insurance

The rate for insurance may vary considerably depending on the type of structure in which the equipment is located and upon other governing factors. A rate of about \$0.60 per \$1,000 may be considered as being representative for normal installations.

Rent

If the equipment under consideration is to be located in rented or leased quarters it may be necessary to include an item for space rental.

An orderly arrangement of the various components of owning and operating costs, which will also serve as a check list to forestall inadvertent omissions, is illustrated in Table 6. The formulae for computing amortization and interest are given in the table. Interest should be computed on the undepreciated portion of investment only.

MAINTENANCE COSTS

Maintenance costs include replacement parts and the labor required for making repairs, replacing parts, cleaning, painting, etc. It should be noted that major overhauling or complete replacement may restore the capital value of certain items of equipment, and in such cases the costs incurred may not necessarily be charged as maintenance costs. Generally, routine labor requirements will be the function of an operating engineer or staff and the responsibility of this group may extend beyond the equipment being discussed here; hence, it is important to include only an equitable share of the time of this group. Extraordinary repairs involving special machinery will usually be covered by contract with equipment service divisions and should be accounted for on that basis.

Many of the items included in maintenance costs are highly variable and depend on the type and quality of the purchased equipment. For large air conditioning installations, using high quality equipment, some approximate costs per ton are given in Table 7.

In addition to the costs listed in Table 7, consideration should possibly be given to other items such as: water treatment for boilers; other boiler and heating plant cleaning and repairs; repair and replacement of heating plant valves, traps, and vents; water treatment for cooling tower or chilled spray water; drive belts, possible damage due to freezing weather; cleaning of air ducts; and repairs to insulation.

SERVICE COSTS

Service costs include the costs for power, water, steam, coal, oil, etc., consumed to operate the system.

From the selected equipment and type of installation, it is possible to segregate the relatively constant power loads and the total brake horsepower. Annual power cost can then be figured from the following formula:

$$\text{Annual power cost} = \frac{0.746 (\text{bhp}) H R}{\eta} \quad (1)$$

where

bhp = Brake horsepower.

H = Annual operating hours.

R = Power rate, dollars per/kwhr.

η = Motor efficiency (decimal).

In using Equation 1 it must be pointed out that the electric rate, R must reflect the proper combination of energy and demand rates. These vary widely between the utility companies, and sometimes the rate structure is such that it is largely the demand charge which determines the proper value of R to use in Equation 1.

Refrigerating Equipment Operating Cost

In an air conditioning system, the refrigerating equipment is usually the largest power-consuming item to be considered. Also, the prediction