ing or heating and ventilating system, include costs of electrical work, plumbing, miscellaneous piping, building alterations, cutting, patching, furring in of ducts or pipes, foundations, structural supports, remodeling or redecorating after installation, consulting engineer's fees, licenses, permits, etc. These vary so widely that no approximations are possible, and each case must be considered alone.

The length of the amortization period to be used depends upon: the type and remaining life of the building or space for which the system is to be used; the type of equipment to be employed as a part of the system; the character of the business; and the lease or ownership conditions.

TABLE 3. 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	
ANNUAL FIXED CHARGES		Pumps—Condenser water	
Amortization—Depreciation period Y years		Pumps—Well water	
Interest rate $I\%$		Cooling tower fans	
Amortization and Depreciation $\frac{FC}{Y} =$		Cooling tower pumps	
Interest: $\frac{Y+1}{2Y} \times I =$		Refrigeration machines	
Taxes		Miscellaneous or other	
Insurance		Gas	
Rent		Coal	
Annual Fixed Charges: (Total)		Oil—for boilers or Diesel engines	
ANNUAL MAINTENANCE COSTS		Steam	
Replacement or servicing of air filters		For Direct Heating	
Outside Maintenance service		For Ventilation—preheaters	
Water Treatment		For Ventilation—reheaters	
Lubricating oil and grease		For Turbine driven equipment	
Painting for corrosion protection or other purposes		For Engine driven equipment	
Replacement of worn parts		Sewers.	
Refrigerant		Charges for discharging water into public drainage systems	
Wages of engineer or operator		Condenser water	
Annual Maintenance Cost—TOTAL		Annual Service Costs—TOTAL	
		SUMMARY	
		Annual Fixed Charges	
		Annual Service Costs	
		Annual Maintenance Costs	
		Annual Owning and Operating Costs—TOTAL	

Depreciation, due to deterioration and obsolescence, must also be considered in arriving at the amortization period. Deterioration and maintenance generally go hand in hand. If a long depreciation period is to be used, then the item for maintenance, repair and replacement of wearing parts must be greater than for a short depreciation period.

An approximation of the useful life of various items of equipment and parts of systems is shown in Table 2. It should be noted that if an appropriate maintenance item is not established, the rate of equipment deterioration may be increased substantially.

Interest

The interest chargeable may be based on the average money rate for the period in which the first cost of the equipment will be amortized.

Some accountants do not include interest in the annual fixed charges, as they consider it a negligible item.

The formulas for computing interest and amortization are given in Table 3. This table will also serve as a check list of the various components to be considered in determining owning and operating costs.

Taxes

The taxes chargeable will be the proportion of property tax caused by the increased valuation of the property due to air conditioning.

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 of normal installations.

TABLE 4. APPROXIMATE MAINTENANCE COST FOR LARGE AIR CONDITIONING INSTALLATIONS, USING HIGH QUALITY EQUIPMENT

	DOLLARS PER TON PER YEAR
Repairs for refrigeration machinery	0.96
Refrigerant	0.40
Oil and grease	0.11
Painting (Water boxes and dehumidifiers)	0.40
Filters, clean and re-oil 4 times per year	1.36
Controls, outside service	0.24
Cleaning air conditioners	1.19

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.

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