Motor Operation Cost

Specific Load
or (motor nameplate)

Calculated
Or (Hour Meter)

Converts HP to kW

$$\frac{\text{HP} \times \text{Hours of Operation} \times .746}{\text{Motor Efficiency (Decimal)}} = \textbf{Kilowatt Hours or kWh}$$

(may or may not be on motor nameplate)

(kWh x Aggregate Cost per kWh) = Approximate Motor System Operating Cost

From above

kWh Price from power bill

Here is a simple way to calculate the electrical costs necessary to run a motor driving a load. There are a number of variables you'll need to apply:

HP (horsepower) is specific load. For example, the motor nameplate may say 10 HP but the motor is only 75 percent loaded as evidenced by amperage. You would apply 7.5 HP to the calculation. Most motors you will deal with are relatively efficient from 50 to 100 percent. Loads below 50 percent will decease efficiency, increasing errors in your results. By the way 75 percent of load, in most cases, is the best efficiency point of induction motors less than 200 HP.

Hours of operation is the cost over a time span. For example, if you're interested to know the cost of a motor running for a year 24/7 (365.25 days x 24 hours) you would insert 8,766 hours.

.746 converts horsepower (SAE) to kilowatts (metric).

Motor efficiency can be found on the motor nameplate and would be inserted as a decimal. For example .855 would be used for an 85.5% efficient motor.

Aggregate cost per kWh is the total utility power billing divided by the total number of kilowatt hours. The aggregate can be adjusted by removing power factor, demand, or other charges based on the use of the result.

Full Load Efficiencies NEMA Premium®, Table for TEFC

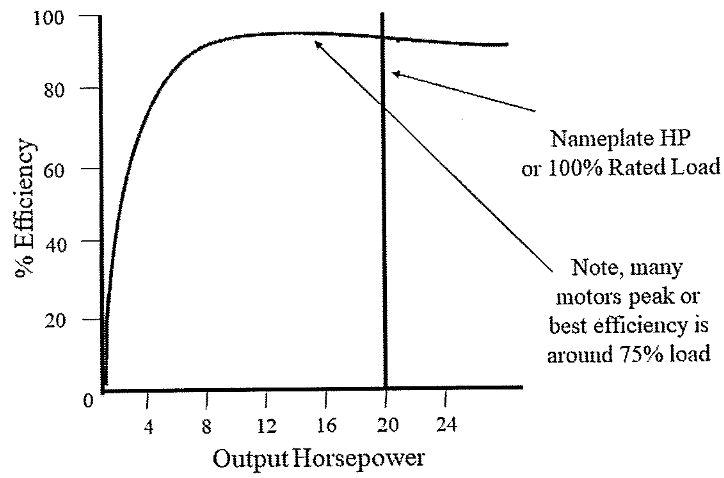
	2 Pole		4 Pole	
HP	Nominal	Minimum	Nominal	Minimum
1	77.0	74.0	85.5	82.5
1.5	84.0	81.5	86.5	84.0
2	85.5	82.5	86.5	84.0
3	86.5	84.0	89.5	87.5
5	88.5	86.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2
10	90.2	88.5	91.7	90.2
15	91.0	89.5	92.4	91.0
20	91.0	89.5	93.0	91.7
25	91.7	90.2	93.6	92.4
30	91.7	90.2	93.6	92.4

	2 Pole		4 Pole	
HP	Nominal	Minimum	Nominal	Minimum
40	92.4	91.0	94.1	93.0
50	93.0	91.7	94.5	93.6
60	93.6	92.4	95.0	94.1
75	93.6	92.4	95.4	94.5
100	94.1	93.0	95.4	94.5
125	95.0	94.1	95.4	94.5
150	95.0	94.1	95.8	95.0
200	95.4	94.5	96.2	95.4
250	95.8	95.0	96.2	95.4

Values continue unchanged through 500 HP

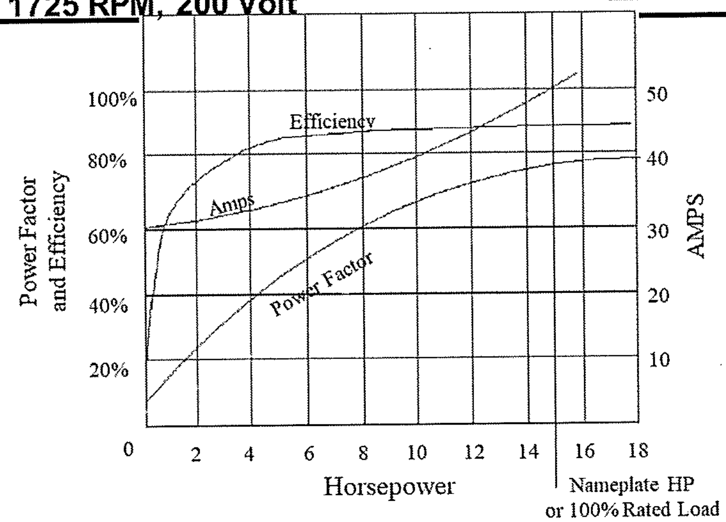
Efficiency Curve

Typical 20 HP, 1725 RPM, 3 phase



Typical Motor Characteristics

15HP, 1725 RPM, 200 Volt



Exercise 1A: Calculation

20 HP, 7200 hrs, $0.10 per kWh full load

Year	Standard Efficiency	Year	Standard Efficiency	Premium Efficiency
1945	**88%**			
1955	**90%**	1985	**87.5%**	**92%**
1965	**88.5%**	1995	**89%**	**93%**
1975	**87.5%**	2000/2010	**91% Epact**	**93%**

$$\frac{(\_\_\_\_\_\ \text{HP} \times 7200\ \text{hrs}) \times .746}{\_\_\_\_\_\_\_\ \text{Efficiency (Decimal)}} = \_\_\_\_\_\_\_\_\_\ \text{kWh}$$

____________ kWh x \$ 0.10 = \$ ______ Est. Operating Cost

Using this template, fill in the information listed and calculate the approximate cost of operating this fully loaded motor. Do several calculations using various efficiency and note the impact of variables. What could be done to reduce energy use and operating costs?

Find the solution to this Exercise 1A in the Appendix of your BOC 211 Student Handbook.

Exercise 1B: Calculation

20 HP, 2400 hrs, $0.10 per kWh full load

Year	Standard Efficiency	Year	Standard Efficiency	Premium Efficiency
1945	**88%**			
1955	**90%**	1985	**87.5%**	**92%**
1965	**88.5%**	1995	**89%**	**93%**
1975	**87.5%**	2000/2010	**91% Epact**	**93%**

$$\frac{(\_\_\_\_\_\ \text{HP x 2400 hrs) x .746}}{\_\_\_\_\_\_\_\ \text{Efficiency (Decimal)}} = \_\_\_\_\_\_\_\_\_\ \text{kWh}$$

____________ kWh x $ 0.10 = $ ________ Est. Operating Cost

Please, run the numbers once again, reducing the run hours per year from 7,200 down to 2,400 hours.

Find the solution to this Exercise 1B in the Appendix of your BOC 211 Student Handbook.