Premium Efficiency Motors Fact Sheet

Motors turn electrical energy in to mechanical energy very efficiently. They are used in a variety of applications, such as in ventilation for heating and air conditioning systems, manufacturing processes and water pumping. Small efficiency improvements can often make favorable economic sense for equipment that often operates for thousands of hours per year.

The Sure Bet Team recommends replacing any standard-efficiency motors with premium-efficiency motors when the payback period is less than 5 years, or a new motor is to be installed. In addition, motors for which replacement costs would require more than 5 years for the simple payback should similarly be replaced with premium efficiency motors when they burn out or are otherwise replaced.

The power that a motor draws under a given load is dependent upon the electrical efficiency of the motor. The higher the motor's efficiency, the lower the input kW for a given mechanical shaft load. Electric motors are available in a wide variety of efficiencies. For any given size motor, the efficiencies available can range by 5 percent or more.

With recent improvements in motor technology, the NEMA (National Electrical Manufacturers Association) high-efficiency rating point can sometimes be misleading. Motors that meet or exceed the NEMA high-efficiency threshold can be labeled as high-efficiency motors. The high-efficiency threshold is actually at, or slightly above, the midpoint of the range of efficiencies that are available. Premium-efficiency motors have an efficiency that is significantly above the high-efficiency threshold. Premium motors, therefore, use the lowest power for a given load.

Based on list prices, premium-efficiency motors cost more than high efficiency or standard efficiency motors. However, because they use less power, they save on electricity and operating costs. For a given mechanical load, the kW savings for a premium-efficiency motor versus a rebuilt or new standard or high-efficiency motor depends on the load on the motor and the relative efficiencies of the motors. The greater the load and the greater the difference between the premium and the lower efficiency alternatives, the greater the kW savings will be. The kilowatt hours saved depends on the load, relative efficiencies, and the hours of operation of the motor. The more hours a motor operates, the greater the kWh savings will be.

The cost difference between a premium motor and a lower efficiency motor can be significant, but unless motors are a special-purpose type, a special-duty type, or a special size, it almost always pays to replace burned out standard-efficiency and high-efficiency motors with premium-efficiency motors, rather than to install new standard- or high-efficiency motors or rewind the old motor. Generally speaking for larger motors, the additional cost for buying a premium-efficiency motor instead of a new standard-efficiency, or even high-efficiency motor will be paid back in electricity savings within 1 year if the motor runs for 7,500 or more hours per year. As the operating hours fall to 4,000 per year, the payback increases to 2-5 years.

In Summary:

- The Sure Bet Team recommends that the motors with a payback under 5 years be replaced with premium efficiency motors.
- Motors should be replaced with a premium-efficiency motor when they burn out or are otherwise replaced for some reason when the payback is over 5 years. The potential energy savings will nearly always justify the incremental cost of a premium-efficiency motor.
- Be sure that the efficiency meets the Sure Bet Program minimum efficiency level.

To calculate the savings for installing an efficient motor, the following equation can be used:

$$\text{kWh}_{\text{savings}} = \text{hp} \times 0.746 \frac{\text{kW}}{\text{hp}} \times \text{hours} \times \text{load factor} \times \left(\frac{1}{\eta_{\text{base}}} - \frac{1}{\eta_{\text{new}}}\right)$$

where,

- Hours = the estimated operating hours of the motor,
- Load factor = the amount the motor is loaded – typically 80 percent is used, and
- η_{base} and η_{new} = the efficiency of the old (standard efficiency) and new (premium efficiency) motors.

The following savings example shows the incremental savings (using incremental cost) achieved by replacing a new standard efficiency 10 hp motor with a premium efficiency 10 hp motor. The minimum efficiency required for a 10 hp closed, 1200 rpm motor is 91.0. The incentive is $40 per motor. The table below shows the economics on this example, using a rate of $0.09 per kWh.

$$\text{kWh}_{\text{savings}} = 10\text{hp} \times 0.746 \frac{\text{kW}}{\text{hp}} \times 5{,}000\text{hours} \times 0.8\text{load factor} \times \left(\frac{1}{0.895} - \frac{1}{0.91}\right)$$

Motor Energy Savings Example[1]

Demand Savings	0.1 kW
Electrical Savings	550 kWh
Annual Energy Cost Savings	$49.50
Incremental Cost	approx. $250
Payback Period	4.2 years

[1] Cost and efficiency data is from Motor Master+ 4.0, http://www.oit.doe.gov/bestpractices/software_tools.shtml. Data is for a Totally Enclosed Fan-cooled 1200 rpm 10 hp motor. It is assumed that the motor operates 5,000 hours per year.