Energy Efficiency Using a Motor Management Program

FACT SHEET

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Any setting, be it a commercial business, home or an industrial facility, contains many more motors than may be obvious. In the United States, half of the electricity produced powers motors.

In the industrial setting, motors are responsible for about 75 percent of electricity used. Because motors are responsible for such a large portion of the electricity used in this country, a great opportunity exists to make a significant impact on energy consumption through motor efficiency improvements. This also means that a motor management program may bring significant payoffs in reduced electricity bills.

Motor Efficiency

An electrical motor system includes a power supply, motor controls, the electric motor itself, and a mechanical transmission system. These motor systems are often components of other systems such as HVAC and air compressors and are easy to overlook. Most facilities are comprised of dozens of motors.

Aside from eliminating the need and use of motors, savings can be obtained from maximizing the efficiency of motors. A motor is termed "energy efficient" if it meets full-load efficiencies determined by the National Electrical Manufacturers Association. This is a specific classification – other terms such as "energy saving" and "high efficiency" may have different meanings.

Nominal Efficiency

Energy efficiency is the ratio of mechanical output energy to electrical input energy. Several types of measurable efficiencies depend on the state of the motor during the test and the testing methods used.

The efficiency measure most commonly used is "nominal efficiency." Nominal efficiency is determined by finding the average full-load efficiency of a sample of motors of the same model. This measure of efficiency can be found on the motor faceplate.

Power Factor

Another important term for understanding and communicating motor efficiency is "power factor." Power factor is the ratio of true power used in a system to the apparent power drawn from the source. In general, a high power factor corresponds to higher efficiency.

Motor Load

The final and possibly the most important factor in motor efficiency is motor load. A "load" is the burden put on the motor by the mechanical task. Motors are most efficient between 75 percent and 125 percent of rated full-load capacity. Mismatching motors and loads is the leading contributor of motor inefficiency.

Efficiency Measures

Measures you can take to improve efficiency:

- **Check that the motor matches the load.** As mentioned above, mismatched motors and loads are the leading cause of motor inefficiency.

- **Recover waste heat.** Waste heat from the running motors may be used to preheat process air or water and provide space heating.
- **Provide shutoff controls.** Shutoff controls can improve efficiency by allowing unnecessary motors to be shut off during off-peak times.
- **Use variable speed drives.** Variable speed drives can greatly aid in energy efficiency in a setting where loads may vary by allowing the motor to run at different speeds.
- **Institute a good maintenance program.** Ensuring that motors are clean, properly lubricated and maintained according to manufacturer specifications is the best way to ensure motor longevity and efficiency.

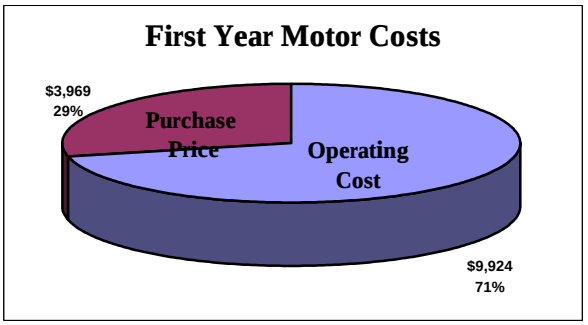
Choosing a Motor

Improving current motor efficiency is valuable; however, choosing the right motor to begin with is an even more effective way to reduce energy consumption. Because the annual operating costs of a motor far exceed its original purchase price, it is important to choose a motor that will save the most on an annual basis.

When a motor fails, three options exist. You may decide to rewind the current motor, replace the motor with a standard efficiency motor, or replace the motor with an energy efficient model. Each of these replacement options may be the most desirable option given different situations.

Example*

Motor purchase price	$3,969
Motor size	40 hp
Efficiency	90.2%
Price per kWh	$0.05/kWh
Annual operating hours	4,000 hrs
Annual operating costs	$9,924/yr
Operating cost as a percent of purchase price	250%



** Source: Motor Survey How-To by Advanced Energy*

Rewinding a motor

Initially, this is the cheapest option. However, rewinding a motor decreases efficiency, sometimes by as much as 25 percent. If the motor was initially only standard efficiency, you will pay more to operate the rewound motor.

Generally speaking, it is unwise to rewind a motor if the motor has already been rewound, the motor has been damaged by heat, or if the costs of rewinding the motor are more than half of the cost of a new energy efficient motor.

Energy efficient motors

Compared to standard efficiency motors, energy efficient motors put out more mechanical energy per unit of electrical energy. Energy efficient motors are generally made of higher quality materials, using better manufacturing techniques and a better design. These improvements lead to longer working lives, less waste heat and less noise from energy efficient motors during operation. However, the same improvements also result in increased purchase cost.

The main things to examine when deciding whether to purchase a new standard efficiency model or a new efficient model, or to rewind the old motor are:

- Facility utility rates;
- Motor efficiency;
- Motor power factor;
- Initial motor cost;
- Motor RPM;
- Motor size;
- Annual operating hours of motor;
- Maintenance and installation costs; and
- Utility rebates.

Motors are one of the largest contributors to energy consumption. Because of this, any energy management or efficiency program should take these machines into heavy consideration. A motor management program that includes an assessment for efficiency measures, a comprehensive maintenance program, and a purchasing policy for motors that takes energy efficiency into consideration will greatly contribute to reduced overall facility energy use.

Resources

Motor Resource Center: Advanced Energy and Washington State University Cooperative Extension Program
http://www.motorresourcecenter.net

Department of Energy Office of Industrial Technologies - Energy Efficiency and Renewable Energy Network (EREN) and U.S. Department of Energy
http://www.oit.doe.gov

MotorMaster+ 4.0 - Developed by the Office of Industrial Technology, Department of Energy
http://mm3.energy.wsu.edu/mmplus

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