Understanding Your Motor Options

If you think "industrial" when you heard the word Motors, you're not alone. After all, motors – in fans, pumps, robots and assembly lines – are the heart of any modern manufacturing plant.

But motors are critical to the equipment running commercial facilities as well. Efforts you make to ensure the motors used in your building are efficient, and that they are operating efficiently, can make a big bottom-line difference in operational expenses.

In other words, there's more to energy efficiency in your building then switching out the lighting.

60% of power use

What's more, the omnipresence of motors in our everyday lives is drawing new attention from efficiency advocates seeking to reduce both energy use and related greenhouse gas emissions. The U.S. Energy Department now estimates that motors use more than 60% of all electricity generated in this country.

To understand this staggering figure, you need to think beyond industrial plants and just take a look around your office and home. The break-room refrigerator, HVAC-system fan, photocopy machine, vacuum cleaner and, even, your desktop computer all depend on motors to do their jobs.

Interest has been building over the last decade to boost motor efficiency in a range of applications, and federal regulations have begun to enforce that goal.

You'll have to become efficient

Since 2003, facility managers have had the option to choose between standard- and premium-efficiency motors when shopping for new or replacement models. That choice is, as of this writing, scheduled to disappear.

Why? In an effort to cut the nation's electricity demand, federal regulations are phasing out less-efficient motors beginning in December 2010. Passed in 2007, "EISA" (the Energy Independence and Security Act) mandates that a large category of motors manufactured after Dec. 19, 2010, meet the requirements of the National Electrical Manufacturers Association's (NEMA) MG-1 standard, often called "NEMA Premium."

Developed in 2003 and revised in 2006, this standard applies to most electric motors with ratings from 1 to 500 hp. It covers motors re-sold to original equipment manufacturers for use in the products they assemble as well as to motors sold on a standalone basis.

Efficiency standards will reach down to smaller motors, sized between ¼ to 3 hp, beginning in February 2015.

What you get with a 'premium' motor

Motor efficiency is expressed in percentages, indicating the proportion of electricity supplying a motor that is translated into actual work. For example, a standard-efficiency 1-hp motor might have an efficiency rating of 78%, while a premium rating would climb to 82.5%. For 10-hp motors, the same numbers would climb to 84% for standard and 91.1% for premium.

Why are premium-efficiency motors more expensive than their standard-efficiency predecessors? In their manufacture, suppliers use higher-grade copper and steel – and more of it. These materials help create the incremental improvements that help new motors produce the same amount of work with less electricity.

Worried about that extra initial cost? It almost certainly will be offset quickly by resulting electricity savings. In every analysis, energy use makes up a far bigger percentage of any motor's lifecycle cost than the initial purchase price.

Beyond cost, the new models may force designers to make adjustments in some manufacturing and product-design applications. Added material used to improve motor performance may lead to a gain in the motor enclosure size – meaning that added room may be needed to accommodate these slightly larger models.

Create a motor plan

New efficiency requirements will mean new decisions for facility managers. In an industrial plant, for example, after an existing motor fails (perhaps due to winding failure) – *does it make more sense to rewind or buy new?*

What about currently serviceable motors – does it make sense to start considering upgrade options? It just might, especially with many utilities offering incentives to owners for just such efforts.

Deciding which option makes the most sense for your facility requires managers to first understand their overall motor needs and inventory. This is done via creation of a motor management plan. For help in developing such a plan, contact your electrical contractor.

Begin creating the plan with a thorough survey of the motors currently operating in your facility (collect data on age, horsepower, and ratings). For your highest and most critical loads, a power logger can help identify the amount of power drawn to provide a general idea of overall energy consumption.

Identify the power losses

This first step likely will identify some motors that obviously require replacement or repair. Deciding which move makes more sense can be made easier using software that helps calculate motor efficiency and takes your current utility rates into account. "MotorMaster+" software, available (free download) from the U.S. Energy Department might be useful; see accompanying information.

Additionally, you'll want your electrical contractor to inspect all motors to check other potential efficiency-robbing issues. These include voltage unbalance, current unbalance, and power factor; all can have a big impact on your electricity bill.

Power factor is especially important for industrial plants running a large number of motors, because utilities add a charge to their monthly bills when power factor exceeds a stated level. So, correcting power factor problems can result in immediate savings.

Segment your equipment

During your inventory, it's useful to categorize existing motors into one of three categories:

- *Replace immediately.* Replacing these motors now would provide rapid payback, because of resulting energy savings, improved reliability or applicable utility rebates. The biggest targets are motors that run continuously – 8,000 or more hours per year – are inefficient or unreliable, and may be covered by rebates.
- *Replace at failure.* These units are still doing the job, but will be good candidates for replacement, instead of repair, when they fail. It might be a good time to start pricing new models and considering whether it makes sense to buy them now, to have on hand for immediate use, should need arise.
- *Leave in place.* Motors that are already reasonably efficient or that are used less than 2,000 hours a year may be just fine where they are. Rewinding may be more economical than replacement in these cases.

Your operating decisions matter

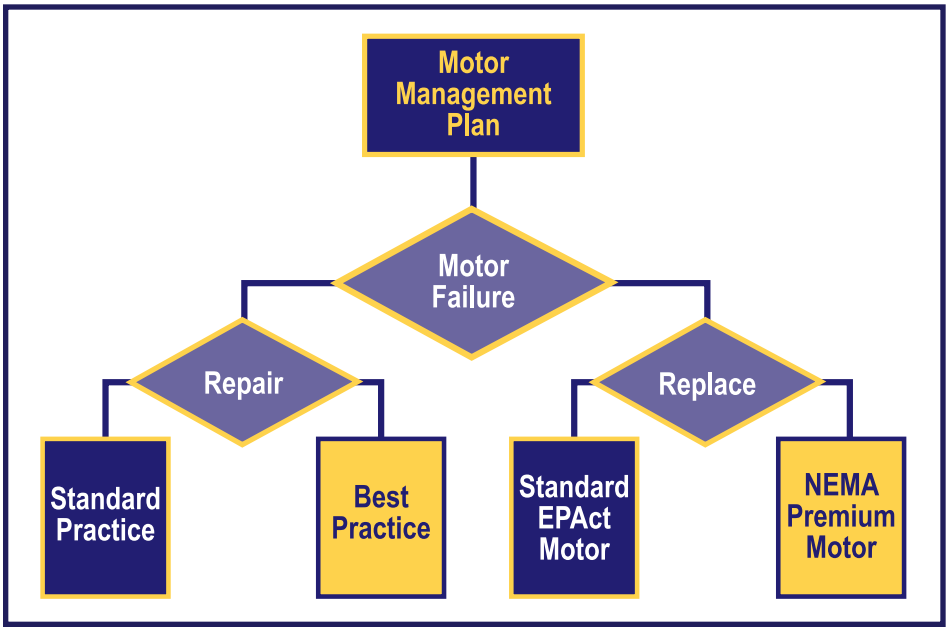
Installing an efficient motor is only the beginning. How you operate that motor also has a big impact on its electricity use (and your facility's energy efficiency).

Motors should be specified with an understanding of the real loads they'll be handling. They run most efficiently at between 75% and 100% of their full-load rating. In many instances, motors are oversized for their application; as a result, they spend much of their operating lives running at substantially less than their stated efficiency rating.

Do you have variable loads – such as pumps, hydraulic systems, and fans – in your building(s)? These are especially likely to be running at less-than-optimal loads. Why is that? Typically, they are sized to address peak needs, even though predominant demand may be much less.

Electronic variable speed drives (VSDs) are a good option in these applications. VSDs vary the frequency and voltage of electricity going to the motor to control speed and torque, replacing less-efficient controls (including belts and pulleys, throttle valves, and clutches).

VSDs are becoming common components of higher-efficiency HVAC systems. They enable instant motor-speed control, and a single unit can control several motors at a time. Additionally, they can help minimize equipment wear and tear by allowing gradual startups and slowdowns, an advantage that also can mean fewer of the electricity-demand spikes that can occur when systems are brought online at the beginning of a work day.



Note that these spikes have a direct impact on how your utility bills your building during the year. As a result, eliminating those spikes (or reducing them) can lead to significant savings.

Calculated Decisions

First cost is the first factor most of us consider when making purchasing decisions – after all, what could be easier than looking at two price tags side by side, when both options appear to perform the same function.

However, this logic will end up costing you – at least, when it comes to choosing motors. The real cost (the biggest $ figures) for you from a motor are in the utility bills, year after year. MotorMaster+ is a software program developed by the U.S. Energy Dept. to help facility managers consider all costs when making motor-purchase decisions.

The software is free to use and download:

http://www1.eere.energy.gov/industry/bestpractices/software_motormaster.html

Included with the software: A database that contains list prices and performance information – including full-and part-load efficiencies, power factor, rpm and service factor – for more than 20,000 motors from 14 manufacturers, in sizes ranging from 1 hp to 600 hp.

Use the software to obtain estimates of energy consumption in specific applications, (along with electricity costs based on your facility's rates). Utility rebate values also can be incorporated into its output.

Maintain your equipment

Ongoing maintenance also is critical to maintaining motor efficiency. The U.S. Department of Energy recommends daily visual inspections of accessible motors to ensure the surrounding area isn't harboring dirt or dust that could get drawn into housings and lead to overheating.

Recommended monthly service includes checking lubrication, packing, alignment, mounting, and terminal tightness. Annual check-ups should include inspecting bearings and drive belts for wear and using vibration analysis to check on overall motor condition. Again a contractor can help here.

Additional tests should be run to rule out unbalanced power conditions or over- or under-voltage situations.

There's more to come. While premium-efficiency motors will soon be the "standard" everywhere, researchers are working to boost performance ratings even further. For example, Japanese researchers have developed a direct current motor capable of operating at better than 96% efficiency, holding a rating between 93% and 96% as its output changes between 50 and 200 watts. While the motor currently would be too expensive for commercial adoption, it does point toward a more efficient future.

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