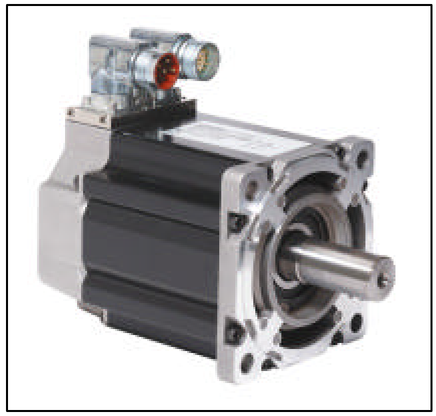
Turning to Energy Efficient Motors

Design improvements lead to higher performance and lower cost.



Considering that more than half of the electrical energy used in the U.S. is consumed by electric motors, it's clear that using energy efficient motors can help reduce operating costs as well as the drain on natural resources required by generating electric power.

Sometimes referred to as high-efficiency or NEMA Premium motors, energy efficient motors owe their higher performance to design improvements coupled with more accurate manufacturing tolerances. According to Jay Schultz, rotary and linear product manager for Parker's Electromechanical Automation Division, several technology factors lead to reduced electrical losses. "Traditionally, AC induction motors replace the iron bars with copper material," he says. "Also, much of the added efficiency comes from the drives. However, the highest efficiencies are generated by using permanent magnet AC motor technology. They inherently have a much higher efficiency – 93 percent or more. In addition, torque density is improved by 250 percent. Weight is decreased 80 percent for the same output power."

Choosing the right material for a permanent magnet is critical to making the motor energy efficient because the density of the magnetic field greatly affects performance. Recycled material, for example, is typically not used due to a reduction in material quality for the laminations. Because energy efficient motors are designed and manufactured with higher-quality materials and techniques, they usually have higher service factors and bearing lives, less heat output and less vibration, and these all increase reliability. (Of course, like all motors, energy efficient motors must be properly engineered and maintained to yield maximum savings.)

Defining "Efficiency"

Motor efficiency is the ratio of mechanical power output to the electrical power input, usually expressed as a percentage. Energy efficient motors use less energy, and we can illustrate this in several ways, including:

$$\text{Efficiency, \%} = \frac{\text{746 x Horsepower (output)}}{\text{Watts (input)}} \text{ x 100}$$

or

$$\text{Efficiency, \%} = \frac{\text{Watts (output)}}{\text{Watts (input)}} \text{ x 100}$$

But it's the energy generated *inside* the motor that ultimately defines its efficiency, and that can be expressed through these equations:

$$\text{Efficiency, \%} = \frac{\text{Watts (output)}}{\text{Watts (output)} + \text{Watts (Losses)}} \times 100$$

or

$$\text{Efficiency, \%} = \frac{\text{Watts (Input) - Watts (Losses)}}{\text{Watts (Input)}} \times 100$$

(In these two equations, "Losses" stands for the energy lost while the motor makes its electrical-to-mechanical energy conversion.)

Because efficiencies of AC induction motors hover around 50 to 70 percent, the cost difference in energy is significant – especially for continuous and high dynamic application. "With premium-efficiency AC induction motors, the efficiency can reach 90 percent, making them somewhat comparable to a permanent magnet AC motor," says Schultz. "So the energy costs really add up when frequent starting and stopping are part of the application. The large rotors cause even the most efficient AC induction motors to consume a larger amount of energy. However, I consider physical size a serious part of efficiency, because fewer natural resources are consumed when making PMAC motors and fewer are used in the product itself. This 'efficiency' isn't part of the motor power loss calculations, but it influences the overall consumption of energy."

Save Money – and the Planet

When considering energy efficient motors in discrete manufacturing applications, OEMs and machine builders should remember that variable-speed applications using an induction motor greatly reduce the efficiency – whether general purpose or high efficiency. "There is a higher initial cost when using a PMAC motor, but over time, electricity costs replace the added up-front costs," explains Schultz. "In addition, the drive technology can further improve the efficiency of these PM motors. Furthermore, as we attempt to create a more environmentally friendly product, using fewer natural resources in the manufacturing process and in the product themselves helps reduce the overall impact of business on our environment."

In line with Parker's agenda to create more efficient products is our MaxPlusPlus (MPP) family of brushless servo motors. These highly efficient motors feature segmented lamination technology, which can yield up to 40% higher torque per unit size than conventionally wound servo motors. "Potted" stators improve heat transfer for better thermal efficiency, resulting in increased torque at the motor shaft. High-performance neodymium magnets are employed for higher acceleration rates. MPP motors are ideal for such forward-thinking markets as hybrid cars, fully electric cars, electric-propelled submarines and geothermal energy.

As industries across the country create responsible corporate energy policies and seek ways to become environmentally friendly, more and more are turning to high-efficiency motors. It's good for the Earth and it's good for a company's bottom line. To learn more about Parker's energy efficient motors and drives, please call Jay Schultz at 707-584-2417, or email him at jschultz@parker.com.

www.parkermotion.com/motors