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Motor efficiency rating reflects performance

Motor efficiency rating reflects motor performance

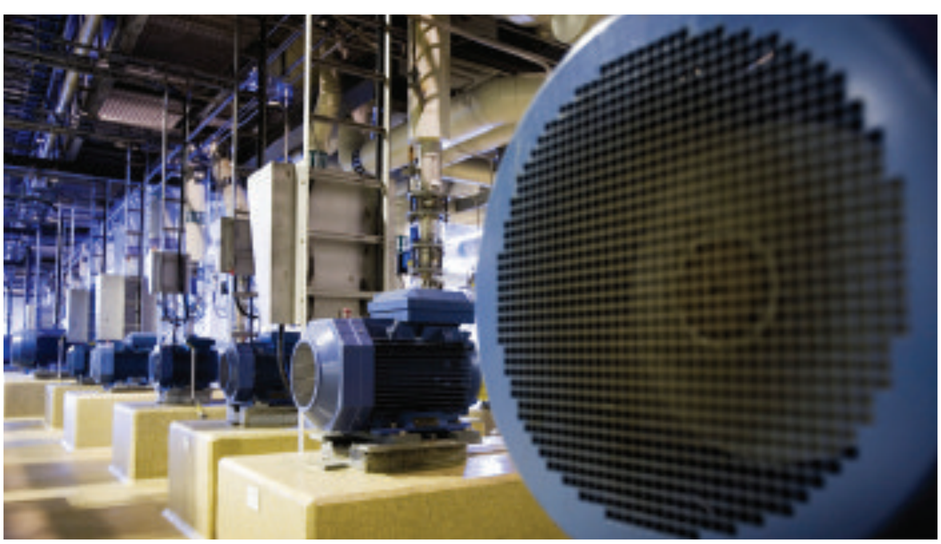
The introduction of Minimum Energy Performance Standard (MEPS) has re-focused attention on the energy use of electric motors, but the age-old habit of over specifying motors persists. If the motor is oversized, efficiency gains achieved by using energy efficient motors are not as relevant, as the motor runs less efficiently at partial load. However, there will soon be a regulation to address this type of wastage too, says *Ian Allan* of ABB.

Many motors in industrial applications, such as pump and fan systems, are significantly oversized. Frequently, they are dimensioned for a worst-case scenario which rarely, if ever, materialises, plus a safety margin of perhaps 15%. In addition, other components in the drive chain may also be oversized and the motor is then dimensioned to drive the whole oversized load, plus some.

While this approach results in a system that definitely works and keeps the system designer out of trouble, at least in the short term, it becomes unnecessarily expensive and wasteful of energy. Attention has been drawn to the efficiency of motors through the recently introduced energy efficiency labelling scheme, but this only helps users choose between two otherwise equivalent motors. If the chosen motor size is wrong, the energy labelling will not help produce an energy efficient system.

Motors run most efficiently at around 80-85% load. But if several people are involved in specifying different components and everyone is allowed to do their own thing, this system load is difficult to achieve.

This is the reason why mandatory efficiency levels on systems are now coming into force – first fans, next year, then pumps, because these are the two biggest application areas for motors.



The Energy Related Products (ERP) directive will stipulate mandatory efficiency levels, starting with fan systems in 2013, to be followed by other products. Eventually, more than 30 different product combinations will be covered. However, while this will ensure that fan systems, pump systems and other equipment provided by OEMs will be built to energy efficient standards; there is nothing to stop anyone from assembling inappropriately specified systems in their own back yard.

Old habits die hard

Over specifying is often down to old habits and outdated practices, such as a company policy stipulating that motor driven systems need to be specified with 15% margin, or individuals wanting to err on the side of caution.

What it really boils down to is to make sure the entire system is as efficient as possible, not just to focus on the efficiency of individual components. From the input of electrical energy to the output of air, water or whatever flow the system is designed to produce, the overall system efficiency needs to be optimised. Power transmission components such as gearboxes, belts and pulleys must be dimensioned for the duty and the same goes for the driven equipment. If a variable-speed drive is used, the drive train may also include harmonic and power factor correction on the network side, as well as output filters and other equipment, which all need to be optimised. If the rest of the components operate efficiently, it may be possible to select a smaller motor, further improving the energy efficiency of the system.

Designing an efficient system

Assuming that we are putting together a system of optimised components, the first thing to ask is whether the system will have fixed or variable output. If the output is variable, consider a variable-speed drive to match the speed of the motor to the driven machine. While this adds to the cost of the system, the additional outlay will quickly be repaid by the energy savings. Varying the speed of output also gives better process control, compared to, for example, throttling of the flow.

If the output of the system is fixed, ask whether the load will be running at the same speed as the motor. If not, again consider a variable-speed drive, which may provide a cost-effective and flexible alternative to a gearbox.

Providing that the load will be running at a fixed-speed synchronous with the motor, a fixed-speed application is most appropriate. A standard efficiency motor may be considered if the expected duty is less than 2,000 hours per year, otherwise a premium efficiency motor should be selected. Any price difference will quickly be recouped by the energy savings.

For variable-speed applications, a premium efficiency motor should always be selected. A motor with poor efficiency cannot be improved by the addition of a variable-speed drive. On the contrary, the difference between the high and the low efficiency motors becomes even greater in variable-speed operation.

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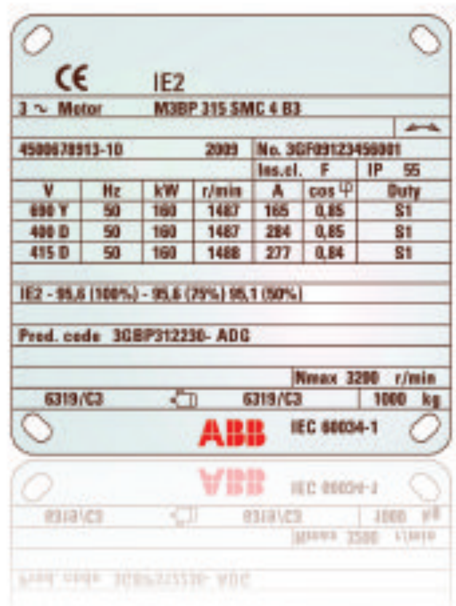
New motors more efficient

Motor technology has improved significantly over the years. A modern 110 kW four-pole motor, for instance, has 30% lower losses than an equivalent motor from 1980, although the two motors will look very similar on the outside.

Higher efficiency motors cost more to purchase because of the more costly materials and production techniques used. However, the saving in operating costs can offset the initial outlay relatively quickly. At 8,000 operating hours per year, the additional cost of a premium efficiency motor is paid back in less than two years. Even at a modest 2,000 operating hours per year, the energy savings pay back the difference in less than half the expected 15-year life span.



Information that must be shown on the motor rating plate includes lowest nominal efficiency at 100% rated load; efficiency level (IE2 or IE3); and year of manufacture

Motors come in three efficiency bands - IE1 for standard efficiency; IE2 for high efficiency; or IE3 for premium efficiency. Since June 2011, only motors in classes IE2 and higher can be sold. When these efficiency classes for motors were introduced, the intention was to make motor selection easier for the user, and also to make it easy to check that manufacturers were meeting their obligations.

While the new efficiency labelling scheme is more accurate than the scheme it replaced, it has one major drawback – it measures efficiency at 100% load, which is a condition that will never be encountered under normal operation; accurately dimensioned systems are designed for 80-85% duty. For most fixed-speed applications, this is of little consequence as the efficiency curve is fairly flat between 70 and 100%. However, in variable-speed operation, the efficiency curve is a lot more complicated. A new EU standard to cover drive efficiency is now underway. This will measure the efficiency at 90% speed. While this is a long way from showing efficiency across the entire speed range, at least it is a step in the right direction.

If you want to get an accurate picture of energy efficiency, it is necessary to measure the efficiency of the whole chain, from electricity supply to output. In the end, it is the efficiency of the whole system that impacts on the bottom line.

Realistically, only OEMs will be able to provide such figures, by which the true cost of ownership can be estimated. As energy costs are often far more important to lifecycle cost than the purchase price, it is always wise to also ask for the annual operating cost when requesting a quote. A lower purchase cost may result in higher energy bills and greater life cycle costs. And, while it is difficult to make an accurate measurement on equipment you already own, bearing the concept of system efficiency in mind when selecting motors goes a long way. *www.abb.com/motors*

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On an average industrial site, motor systems account for two-thirds of the total electricity used; they are responsible for 40% of the UK’s total electricity consumption. Motors are used in a wide variety of applications, dominated by pumps (32% of industrial motor energy consumption) and fans (22%). The average electric motor will consume its capital cost in energy in less than two months; typically, a motor costing £500 will consume over £50,000 worth of energy in its lifetime. This means that a single percentage point increase in efficiency will save lifetime energy costs generally equivalent to the purchase price of the motor.