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Technical Articles

Why Motor Efficiency Matters in Everyday Engineering

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Efficiency in electric motors is influenced by various factors. Internal resistance, losses in the form of heat and load required for the application, all contribute to the overall efficiency of a motor. Electric motor efficiency needs to be considered as part of the application, also known as a "Driven Unit".

An electric motor system with different components is complex, so the Policy Guidelines for Electric Motor Systems chooses to cover the entire electric motor system from the electrical input to the mechanical output. This defines the efficiency and is best suited for realising maximum energy savings. This means the Motor System includes all components within the boundary in Figure 1, which are relevant to the energy use during both start and operation:

The electrical input from several components inside the electric meter (i.e., mains cables, transformer, power factor correction, soft starter or Variable Speed Drive, switch gear, etc.),

The electric motor including all its auxiliary elements for starting,

The mechanical components (gears, transmission belts, brakes, clutches, throttles, etc.),

The application based on the torque and speed profile and its eventual use (pump, fan, compressor, mechanical process, etc.),

The net operational energy use of the application (output, i.e., flow of liquid in a pump or compressor or gaseous matter in a fan, including the energy needed to overcome the resistance and speed in ducts or pipes, heat exchangers, valves, and its operating time, etc.); this includes the operational regime with periods of idling, stand-by and operation without use.

The more practical boundary condition for regulators is defined as the Motor Driven Unit¹. It includes the three major technical components: variable speed drive, electric motor, and application.

$\eta_{\text{System}} = \eta_{\text{VFD}} * \eta_{\text{Motor}} * \eta_{\text{Gear}} * \eta_{\text{Belt}} * \eta_{\text{Driven application}}$

This article is a deep dive into these factors reveals the balance required for optimal performance, making it compulsory to address each aspect for maximum efficiency.

Energy Consumption and Cost Savings:

The main effect of motor efficiency extends to energy consumption and cost savings. Inefficient motors not only affect capacity of the wider plant but by using more electricity also contribute to higher energy bills. Calculating the energy costs associated with running motors unveils the potential for savings through the adoption of efficient motor technologies. The economic advantages of investing in energy-efficient motors and starting equipment become increasingly evident in the long run.

Environmental Impact:

Beyond financial considerations, the environmental impact of inefficient electric motor systems cannot be overstated. Carbon footprints associated with excessive energy consumption pose a threat to our planet. Prioritizing motor efficiency aligns with sustainable practices, contributing to environmental conservation efforts. The ripple effect of a global shift towards energy-efficient motors has the potential to significantly reduce carbon emissions.

Regulatory Standards and Compliance:

Governments and regulatory bodies worldwide recognize the importance of energy efficiency. Industry standards are in place to enforce compliance and drive the adoption of efficient motor technologies. Staying informed about these standards is a strategic move towards future-proofing operations against evolving regulatory landscapes as well as keeping operating costs to a minimum. By doing so, MEPS Minimum Efficiency Performance Standards, directs industrial buyers toward premium, energy-efficient products, fostering a shift toward sustainability. It is worth noting that MEPS stands for Minimum Efficiency Performance Standards, represent a crucial benchmark in the pursuit of energy efficiency. The MEPS framework in Australia and New Zealand (ANZ) aligns with international standards, notably IEC 60034-30, a synchronization that has been in effect since 2019. This alignment not only reflects a commitment to global best practices but also streamlines the transition to more energy-efficient technologies, ensuring a harmonized approach in the pursuit of a sustainable and energy-conscious future.

Technological Advances in Motor Efficiency:

The landscape of motor efficiency is continually evolving, driven by technological advancements. The advent of Variable Speed Drives (VSDs) revolutionizes the way motors operate, allowing for dynamic adjustments based on load requirements. Integrating the Internet of Things (IoT) further enhances efficiency through real-time monitoring and data-driven insights. Improved and more efficient maintenance practises and lower costs are also possible through better monitoring. Keeping abreast of these technologies is essential for those seeking to maximize motor efficiency.

Lifecycle Cost Analysis :

Optimising motor efficiency requires a pragmatic approach, considering the full lifespan of a motor. While efficient motors may entail higher upfront costs, a comprehensive lifecycle cost analysis reveals the economic viability of such investments. Balancing upfront expenditures with long-term savings ensures that decisions align with both immediate financial considerations and future cost-effectiveness. Customers looking to reduce their Carbon footprint, reduce energy use or increase capacity will also find the process instructive to understand how much energy can be saved by selecting high efficiency motors.

Risk Mitigation through Efficiency:

Efficient motors are not only about performance but also about risk mitigation. Identifying potential risks associated with inefficient motors and implementing preventative measures becomes crucial in maintaining reliability and minimizing downtime. The inherent stability of modern, more efficient motors serves everyone in the operational chain with lower operating costs, reduced environmental impact and opportunities to enhance maintenance procedures all as part of a single upgrade.

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A variable speed drive (VSD) is a power electronic controller that sets the speed of an AC motor by varying the frequency and voltage it supplies, instead of running the

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