

# The efficiency of asynchronous motors and permanent magnet motors

*Motor energy efficiency has become a subject of critical importance. This article aims to explain in simple terms the differences in efficiency between conventional asynchronous motors and permanent magnet motors.*

## New efficiency classes



The IEC has published the new 60034-30 standard which defines efficiency classes for 2-, 4- and 6-pole asynchronous motors, with power ratings from 0.75 to 375 kW (1 to 500 HP). Broadly speaking, these efficiency classes (IE1 to IE3 by increasing level of efficiency) correspond to the former eff2, eff1 and premium categories, with the recent addition of IE4, or super premium. Currently provided for information purposes only, IE4 may include solutions built for example around magnet motors driven by a variable speed drive. Its

introduction was recognition that asynchronous motors in the standard power ratings and frame sizes would not be able to deliver these efficiencies while meeting the conditions for economic viability.

## Asynchronous motors

Asynchronous motors are induction motors. This term conceals the fact that the magnetic flux is created by the stator currents and, by extension, the power supply. The motor therefore draws current even with no load, without supplying power. This is known as the magnetising current, or more commonly the no-load current – a purely reactive current that is necessary regardless of the load. It thus pushes down the power factor to values significantly below 1, decreasing still further as the number of poles increase. To put this into perspective, it is easy to obtain a power factor greater than 0.9 for a 2-pole motor; however, it is relatively difficult to exceed 0.7 using an 8-pole motor.

## Permanent magnet motors

However, in the case of permanent magnet motors, the magnetic flux is produced by the magnets without generating any losses. Consequently, at the same torque, the current drawn by magnet motors is significantly lower than for asynchronous motors. As Joule losses of the stator are proportional

to the square of the motor current, generally representing the largest source of loss, the difference in efficiency is considerable.

Another well known disadvantage of asynchronous motors is that an amount of slip is required for operation. This slip results in unavoidable losses in the rotor cage, which increase as the slip increases with the torque. Such losses do not occur in magnet motors.

## Exceptional efficiencies

Magnet motors inherently deliver exceptional energy performance. This performance is further increased when the motor is paired up with an electronic drive. Indeed, the vector control strategies that may be used are significantly more effective than their standard counterparts. In particular, the flux level (and therefore iron losses), power factor and even optimum efficiency can be obtained by controlling all load points, once no longer at the voltage and/or current limit, an extremely important - if rarely mentioned - point. For implementation to be truly effective, the drive must "recognise" the motor. Which makes the global solution more attractive than ever before.

Already fully compatible with class IE4 and beyond, the Dyneo motor range is Leroy-Somer's answer to the new energy constraints.

