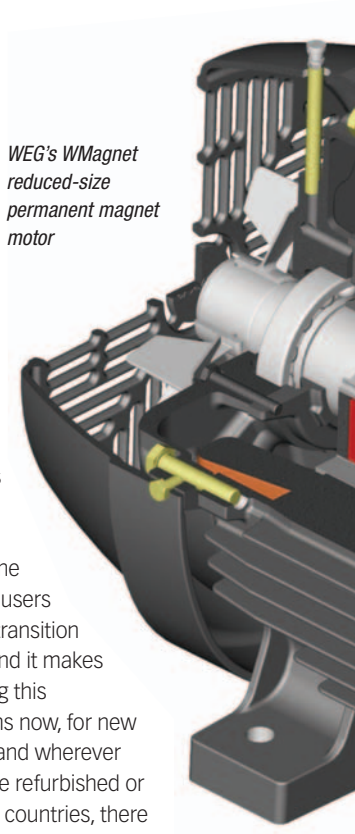
Motors move beyond IE2

Regulations demanding that motors conform to the IE2 standard may not come in until next year, but the technology is already well ahead of that, as Paul Fanning reports.



WEG's WMagnet reduced-size permanent magnet motor

Beginning in June next year, all electric motors will be required to meet the IE2 standard of energy efficiency. The motor efficiency ratings will be based on the efficiency classes defined in the IEC 60034-30 standard published by the International Electrotechnical Commission (IEC). These range from IE1 (low efficiency) to IE4 (super-premium efficiency). It will supersede the voluntary scheme based on the Eff efficiency classifications which has been running in Europe since 1998. Under the scheme, all single-speed, three-phase squirrel-cage induction motors with output ratings from 0.75 to 375kW sold in the EU will have to achieve at least the IE2 efficiency level by 16 June 2011. The scheme applies to motors with two, four or six poles.

In the second phase, which comes into force on 1 January 2015, motors rated from 7.5 to 375kW will either have to achieve the higher IE3 efficiency level, or meet the IE2 level and be equipped with a variable speed drive (VSD). Finally, two years later, the same regulations will be extended to apply to motors as small as 750W. There are no plans to make IE4 motors mandatory – efficiency values have yet to be defined for this class, which will cover 'super-premium' technologies such as permanent magnet (PM) motors.

When these new classifications were announced in March 2009, there was widespread criticism from Government, environmental campaigners and motor manufacturers that they did not go far enough and that the deadlines being set were too lax. And it must be said that the regulations compare less than favourably with other parts of the world. The US, for instance, will make the use of IE3-equivalent motors mandatory at the end of this year.

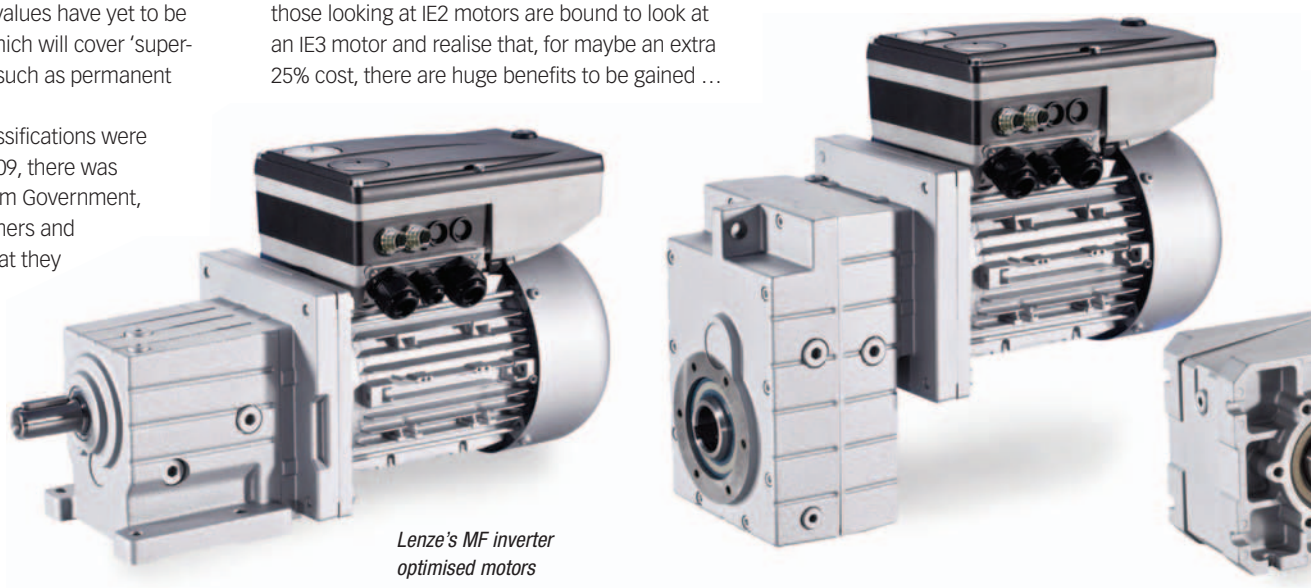
It is perhaps not surprising then, that many motor manufacturers already offer products that far exceed the IE2 requirements, even in some cases believed to reach the IE4 standard. The technology available is some distance ahead of the legislation.

Baldor UK's Robin Cowley is scathing about the IEC's standards, having described as 'criminal' the extent to which the EU is trailing the rest of the world in this respect. Perhaps unsurprisingly, then, he is keen to persuade end users to make the move to higher-efficiency motors sooner rather than later. He also describes take-up of high-efficiency motors as 'poor' and blames poor education, particularly by the Carbon Trust.

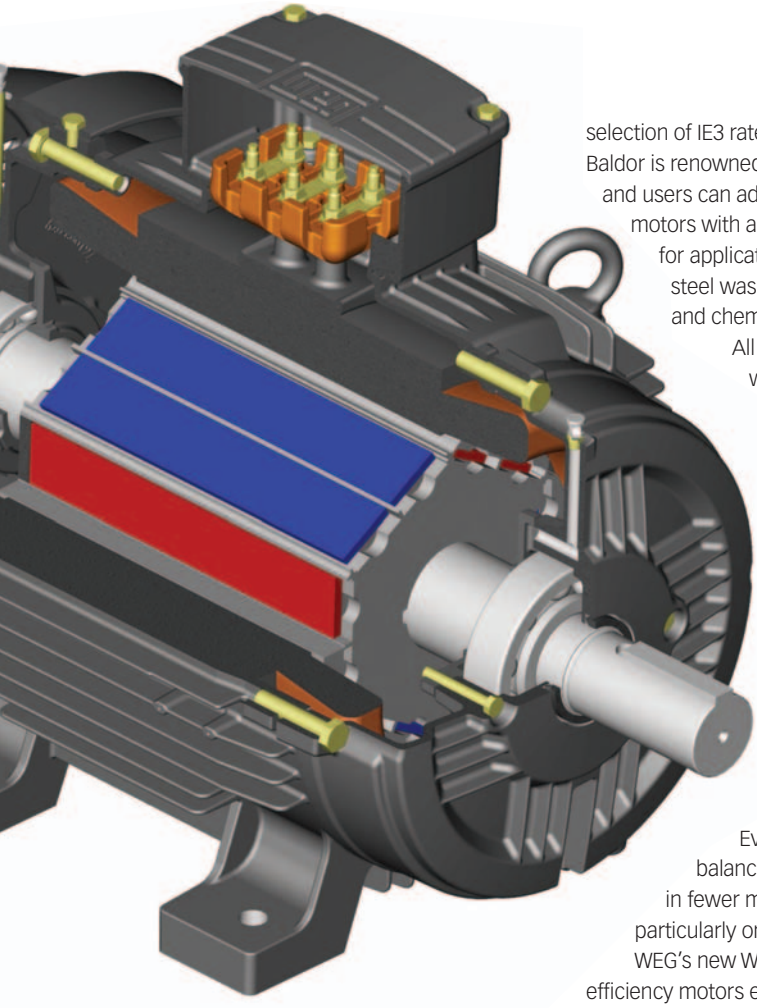
He does, however, believe that the introduction of the standard will concentrate the minds of those installing motors and will encourage them to think beyond it. "Once IE2 becomes mandatory," he says, "education will ramp up very quickly. Word will get round and those looking at IE2 motors are bound to look at an IE3 motor and realise that, for maybe an extra 25% cost, there are huge benefits to be gained … after all, energy costs are only going one way."

"Sooner or later," he continues, "all motor users are going to have to transition to higher efficiency and it makes sense to start building this requirement into plans now, for new equipment projects, and wherever motors are likely to be refurbished or replaced. In some EU countries, there are also tax incentives when installing these motors, such as the Enhanced Capital Allowance (ECA) scheme in the UK. Such actions not only make economic sense, they can play an enormous role in helping corporations to meet their environmental care goals."

Baldor's standard IEC frame IE3 range of AC motors – called Super-E Metric – spans 22 power ratings from 4 to 375 kW, with a choice of three speed options at each rating. Maximum efficiencies at full load start at 89.9% for a 4 kW 4-pole motor, and go up to more than 96.3% for



Lenze's MF inverter optimised motors



high power motors. Baldor also offers higher voltage, ultra high efficiency motors for higher power applications up to 10 MW.

All the standard motors feature cast iron frames for durability, and will run from 50Hz, 380 to 415 V three-phase supplies. They are additionally rated for use at 60 Hz/460 V, also making them suitable for use in the US. Baldor complements this range with an even broader selection of IE3 rated motors in NEMA frames. Baldor is renowned for its customisation ability, and users can additionally specify IE3 rated motors with a range of protection options for applications including all-stainless-steel washdown duty types, severe duty and chemical duty (IEEE 841 compliant).

All Super-E Metric motors are wound with Baldor's ISR (Inverter Spike Resistant) magnet wire, making them up to 100 times more resistant to transient voltage spikes, high frequencies, and short rise-time pulses commonly produced by inverters. This results in all Super-Es being 'inverter ready'. These motors, with improved insulation materials, can withstand peak voltages up to 1600 V peak for extended reliability.

Every Super-E motor is also balanced to a high standard, resulting in fewer mechanical stresses, particularly on motor bearings.

WEG's new WQuattro line of super premium efficiency motors employs a hybrid design to achieve the highest efficiency in the market, exceeding the requirements of the impending IE4 Super Premium Efficiency classification across its entire output range.

The WQuattro is a hybrid motor integrating a conventional three-phase distributed winding, and a rotor with an aluminium cage and internal high energy magnets. This combination makes the WQuattro ideal for direct on-line starting and acceleration up to synchronous speed. With this type of operation the motor speed does not vary with load, despite overload variations, or cases of voltage drop, as long as the mains frequency is kept constant. In addition, there is no requirement for positioning/speed sensors, or special protection relays, and the low bearing temperatures that result from synchronous operation also ensure longer life and reduced maintenance for the motors.

Where the speed of the motor needs to be adjustable, the WQuattro can be used with inverters (V/F and Vector types), offering an extended speed range with constant torque. In addition inverter control also offers the key benefit of multi-motor operation – several motors can operate in synchronism fed by the same inverter.

Importantly, the WQuattro line offers interchangeability with existing installations. It employs the same frame size for output as standard induction motors, and so it is easy to retrofit into existing applications.

WEG also offers reduced-size permanent magnet motors for for applications where constant torque, low vibration and low noise levels are required. WMagnet motors are manufactured with high energy magnets (NdFeB) in their rotors; these deliver a significant reduction in energy losses compared to an induction motor, resulting in a lower temperature rise of the motor, generally, and increased operating life. In addition, as these energy (Joule) losses (RI2) account for a significant portion of total losses in induction motors, the PM motor, the company claims, attains IE4.

Lenze, meanwhile, has introduced its MF inverter optimised motors positioned in this gap between standard AC motors (low cost, moderate efficiency and suit mains or frequency inverter operation) and servo motors with rare earth permanent magnet technology (more efficient but much more expensive). MF motors can not only yield around 5% saving on energy, but also additional advantages of smaller dimensions and a purchase cost that is actually lower than standard AC motors. The energy saving of 5% is significant (at similar powers changing from IE1 standard to IE2 high efficiency motors will only deliver about 3%) leading to long term savings and reduction in greenhouse gas emissions.

The company has taken standard 4 pole motor designs and optimised them for use at 120Hz, equivalent to a speed of about 3500 rpm. The efficiency of these 120Hz optimised MF motors increases by typically 5 or 6% compared to a standard 4 pole motor. For example at 0.75kW the efficiency is practically 80% and close to the IE3 efficiency level which becomes compulsory in 2015. The higher speed increases power leading to a 1 or 2 frame size reduction, and this reduces physical size which leads in turn to reduced costs. A 1.5kW MF motor is 71 frame compared to a standard 1.5kW pole motor which is 90 frame. Moreover the smaller size means lower inertia and more dynamic drives. The performance takes a step towards servo levels with high acceleration and deceleration. Full torque is available over a 1:24 speed range.

www.baldor.co.uk
www.weg.net
www.lenze.co.uk