xylem
Let's Solve Water

May 2017

Understanding EU Pump Efficiency Regulations

The latest standards in the European Union's Energy-related Products Directive set stringent efficiency requirements for motors, pumps and HVAC system circulators

Presented by: Giorgio Sabbatini

Energy efficiency is a major focus in building design worldwide and in the European Union (EU). The reason is clear: 40 percent of EU energy demand is consumed in buildings, and 50 percent of that is used in commercial buildings, accounting for more energy than transport and industry combined.[1] Furthermore, green buildings have become more the rule than the exception, and energy efficiency is important to earning green building certification.

The focus on energy efficiency extends to commercial building equipment, including motors, pumps and HVAC system circulator pumps. EU governments have set progressively stringent efficiency standards for these items under the ErP (Energy-related Products) Directive. Only products that comply are allowed to carry the Conformité Européenne (CE) mark and to be sold within the EU. Building designers and owners using these products stand to help reduce their energy usage and their carbon footprint.

Evolving directive

The EU aims through domestic action to become the most climate friendly region in the world and so gain energy security, green jobs, and competitive edge for European companies in key sectors of the future economy. The EU also aspires to transition to a low-carbon economy by 2050. As part of this, the EU has committed by 2020 to:

- 20 percent emissions reduction from 1990 levels, moving to 30 percent reduction if conditions are right.
- 20 percent greater energy efficiency.
- 20 percent renewables in the energy mix.[2]

In 2005, the EU approved the 2005/32/EC Directive, spelling our requirements for the environmental design of energy-using products (EuP). This has been known as the EuP or Ecodesign Directive. In 2009, that directive was replaced by the 2009/125/EC Directive. The most significant change was expansion of the scope to include both energy-using products (such as computers and washing machines) and energy-related products (ErP) that do not directly use energy (such as water-saving faucets and showerheads).

EEI AND MEI: WHAT THEY MEAN

In working to reduce demand for energy in buildings and improve energy efficiency, it's important to be able to forecast how much energy a given building will consume based on the equipment used inside it. This in turn requires some uniform criteria that enable accurate forecasts and comparisons.

Various methods have been offered for measuring and monitoring energy performance. Of course, many factors affect building energy consumption, from weather, to building materials, to the efficiency of HVAC and other equipment, to the kinds of activities that take place in the building.

The European Union's Energy-related Products (ErP) Directive is part of a larger initiative to improve building efficiency. Its provisions apply to a range of products, including water pumps and HVAC circulator pumps. Under the directive, two specific indices are used to rate efficiency in these products.

ENERGY EFFICIENCY INDEX (EEI)

The EEI applies to circulators. It specifies by how much the power input of a pump lies below a predefined reference power input. For example, an EEI of 0.27 means that the circulator requires only 27 per cent of the power input that has been defined as the critical threshold. Therefore, the lower the EEI, the less energy the circulator uses. The EEI is calculated by comparing the average power consumption of the circulator being measured across a load profile against the reference power input of a current standard circulator.

MINIMUM EFFICIENCY INDEX (MEI)

The MEI applies specifically to water pumps. It indicates the percentage of pumps that have efficiency inferior to the one being measured. For example, if a pump has an MEI of 0.4, that means 40 percent of the pumps available on the market are less efficient than that pump. Thus, the higher the MEI, the greater the pump's efficiency. Pumps are ranked by way of a mathematical calculation based on efficiencies at the Best Efficiency Point (BEP), 75 percent of the BEP (part load), and 110 percent of the BEP (overload).

The essential point to remember is that only products that comply with the EEI or MEI requirements of the ErP directive are allowed to carry the Conformité Européenne (CE) mark conferring eligibility to be sold within the EU.

Under this set of rules, generally called the ErP Directive, the objective is to reduce energy consumption and other negative environmental impacts. Specifically, the target of these ecodesign provisions by 2020 is to reduce energy consumption by 12 percent from the 2007 consumption level, meaning a total saving of 341 terawatt-hours (trillion watt-hours), or 341 billion kilowatt-hours.

Motor and pump provisions

With this directive, the EU regulators laid the groundwork for specific measures affecting a broad range of energy-using and energy-related products. The goal is to reduce energy consumption along the supply chain, from design through production, transport, packaging and actual application. Three provisions of the ErP Directive relate specifically to the pump industry:

- 640/2009 and 4/2014: Ecodesign requirements for electric motors.
- 641/2009 and 622/2012: Ecodesign requirements for glandless stand-alone circulators and glandless circulators integrated in products.
- 547/2012: Ecodesign requirements for water pumps.

640/2009 and 4/2014: Ecodesign requirements for electric motors

This regulation was first issued in July 2009. The European Commission identified electric motors as the most significant electric load in industries where motors are used in production processes. In these applications, cost-saving potential of 20 to 30 percent has been identified, mainly through the adoption of high-efficiency motors. Electric motor systems include a number of energy-using products, such as motors, drives, pumps and fans.

The regulation was changed in 2014, expanding the scope of motors affected. The regulation establishes ecodesign requirements for placing motors on the market and putting them into service; it covers motors integrated into products, including pumps. Products covered include electric, single-speed, three-phase 50 Hz or 50/60 Hz, squirrel cage induction motors that:

- Have two to six poles
- Have rated voltage of up to 1,000 V
- Have rated output between 0.75 kW and 375 kW
- Are rated based on continuous duty operation

Under this provision, as of January 1, 2017, all motors with a rated output of 0.75 to 375 kW must meet at least the IE3 energy efficiency level, or must meet the IE2 energy efficiency level and be equipped with a variable-speed drive (see the accompanying table). The energy efficiency rating is the ratio of mechanical output power to electrical input power.

Examples of nominal motor efficiencies for IE3 (50 Hz)

Rated Output Power	2 poles	4 poles	6 poles
15 kW	91.9 (90.3)	92.1 (90.6)	91.2 (89.7)
30 kW	93.3 (9 20)	93.6 (92.3)	92.9 (91.7)
45 kW	94.0 (92.9)	94.2 (93.1)	93.7 (92.7)
75 kW	94.7 (93.8)	95.0 (94.0)	94.6 (93.7)
110 kW	95.2 (94.3)	95.4 (94.5)	95.1 (94.3)
160 kW	95.6 (94.8)	95.8 (94.9)	95.6 (94.8)
200-375 kW	95.8 (95.0)	96.0 (95.1)	95.8 (95.0)

As of January 1, 2017, motors must meet the IE3 efficiency levels listed here to secure the CE mark. The figures in parentheses are the less efficient IE2 levels that are compliant for motors equipped with variable-speed drives.

641/2009 and 622/2012: Ecodesign requirements circulators

The European Commission determined that circulators consume much of the energy used in building heating systems. For that reason, and because most standard circulators operate continuously regardless of heating needs, circulators became a priority for setting ecodesign requirements. One 2005 study showed that 14 million circulators were placed in the EU market per year, consuming 50 terawatt-hours and accounting for 23 million tons of CO_2 emissions.

This regulation sets ecodesign requirements for the placing on the market of glandless stand-alone circulators and glandless circulators integrated in products. A circulator is defined as an impeller pump with rated hydraulic output of 1 watt to 2,500 watts and designed for use in heating systems or in secondary circuits of cooling distribution systems. A glandless circulator is a circulator with the shaft of the motor directly coupled to the impeller and the motor immersed in the pumped medium. A stand-alone circulator means a circulator designed to operate independently from the product.

Under the regulation, as of August 1, 2015, the affected circulators must have an energy efficiency index (EEI) no higher than 0.23. The accompanying sidebar provides a simplified explanation of the EEI.

547/2012: Ecodesign requirements for water pumps

Studies have identified potential to improve energy efficiency in electric pumping systems by 20 to 30 percent. Even though the main savings result from applying high-efficiency motors, energy-efficient pumps also contribute. A 2005 study estimated annual electricity consumption from pumps at 109 terawatt-hours, corresponding to 50 million tons of CO_2 emissions. Without efficiency measures, consumption was projected to increase to 136 terawatt-hours in 2020.

This regulation applies to rotodynamic water pumps for pumping clean water, including those integrated with other products. Specifically, it covers:

- End suction pumps with their own bearings (ESOB).
- End suction close-coupled (ESCC) pumps (in which the motor shaft is extended to also become the pump shaft).
- End suction close-coupled inline (ESCCi) pumps (in which the inlet is on the same axis as the outlet).
- Vertical multistage (MS-V) pumps (in which the impellers are assembled on a vertical rotating shaft designed for pressures up to 25 bar, with a nominal speed of 2,900 rpm and a maximum flow of 100 m^3/hr).
- Submersible multistage (MSS) pumps (with a nominal outer diameter of 4 or 6 inches, designed to operate in a borehole at a nominal 2,900 rpm at operating temperatures from 0° to 90°C).

Under the regulation, as of January 1, 2015, these water pumps must have specified minimum efficiency at the best efficiency point and at part load and overload conditions, with a Minimum Efficiency Index (MEI) of at least 0.4. The accompanying sidebar provides a simplified explanation of the MEI.

More with less

Energy efficiency has come to the forefront in building design and equipment specification, with an increasing focus on whole-life owning and operating cost. Motors and pumps able to deliver the required output with lower electric energy input will save building owners money and reduce carbon emissions.

Pump manufacturers' latest products reflect this industry shift. In line with the ErP Directive, manufacturers can help building owners and designers choose products that fit the application and meet the latest efficiency requirements, while reducing lifecycle cost in the equipment and the overall building.

Giorgio Sabbatini is global director of the HVAC and Commercial Buildings Services (CBS) business unit, and Market Segment Manager, Industry & Agriculture at Xylem, a company dedicated to solving the most challenging water problems and to setting industry standards for fluid technology applications and water solutions. He can be reached at giorgio.sabbatini@xyleminc.com

[1]http://ebtc.eu/pdf/Green_buildings_in_the_EU.pdf
[2]http://ebtc.eu/pdf/Green_buildings_in_the_EU.pdf