

EFFICIENCY OF ELECTRIC MOTORS

COMMISSION REGULATION (EU) 2019/1781

Having regard to Directive **2009/125/EC** of the European Parliament establishing a framework for the setting of ecodesign requirements for energy-related products, it specifies the time and the efficiency levels that motors sold in the European market will have to comply.

This Regulation shall apply to:

- (1) This Regulation applies to the following products:
- (a) induction electric motors without brushes, commutators, slip rings or electrical connections to the rotor, rated for operation on a 50 Hz, 60 Hz or 50/60 Hz sinusoidal voltage, that:
- (i) have two, four, six or eight poles;
 - (ii) have a rated voltage UN above 50 V and up to and including 1 000 V;
 - (iii) have a rated power output PN from 0,12 kW up to and including 1 000 kW;
 - (iv) are rated on the basis of continuous duty operation; and
 - (v) are rated for direct on-line operation;
- (b) variable speed drives with 3 phases input that:
- (i) are rated for operating with one motor referred to in point (a), within the 0,12 kW-1 000 kW motor rated output range;
 - (ii) have a rated voltage above 100 V and up to and including 1 000 V AC;
 - (iii) have only one AC voltage output.



This Regulation shall not apply to:

- (a) motors completely integrated into a product (for example into a gear, pump, fan or compressor) and whose energy performance cannot be tested independently from the product, even with the provision of a temporary end-shield and drive-end bearing; the motor must share common components (apart from connectors such as bolts) with the driven unit (for example, a shaft or housing) and shall not be designed in such a way that the motor can be separated in its entirety from the driven unit and operate independently. The process of separation shall have the consequence of rendering the motor inoperative;
- (b) motors with an integrated variable speed drive (compact drives) whose energy performance cannot be tested independently from the variable speed drive; d) brake motors.
- (c) motors with an integrated brake which forms an integral part of the inner motor construction and can neither be removed nor powered by a separate power source during the testing of the motor efficiency;
- (d) motors specifically designed and specified to operate exclusively:
- (i) at altitudes exceeding 4 000 metres above sea-level;
 - (ii) where ambient air temperatures exceed 60 °C;
 - (iii) in maximum operating temperature above 400 °C;
 - (iv) where ambient air temperatures are less than – 30 °C; or
 - (v) where the water coolant temperature at the inlet to a product is below 0 °C or above 32 °C;
- (e) motors specifically designed and specified to operate wholly immersed in a liquid;
- (f) motors specifically qualified for the safety of nuclear installations, as defined in Article 3 of Council Directive 2009/71/Euratom (8);
- (g) explosion-protected motors specifically designed and certified for mining, as defined in Annex I, point 1 of Directive 2014/34/EU of the European Parliament and of the Council (9);
- (h) motors in cordless or battery-operated equipment;
- (i) motors in hand-held equipment whose weight is supported by hand during operation;
- (j) motors in hand-guided mobile equipment moved while in operation;
- (k) motors with mechanical commutators;
- (l) Totally Enclosed Non-Ventilated (TENV) motors;
- (m) motors placed on the market before 1 July 2029 as substitutes for identical motors integrated in products placed on the market before 1 July 2022, and specifically marketed as such;
- (n) multi-speed motors, i.e. motors with multiple windings or with a switchable winding, providing a different number of poles and speeds;
- (o) motors designed specifically for the traction of electric vehicles.

VSDs integrated:

- (a) VSDs integrated into a product and whose energy performance cannot be tested independently from the product, that is to say that an attempt to do so would render the VSD or the product inoperative;
- (b) VSDs qualified specifically for the safety of nuclear installations, as defined Article 3 of Directive 2009/71/ Euratom;
- (c) regenerative drives; (d) drives with sinusoidal input current.

Each ecodesign requirement shall apply in accordance with the following timetable:

1. ENERGY EFFICIENCY REQUIREMENTS FOR MOTORS

Energy efficiency requirements for motors shall apply according to the following timetable:

- (a) from 1 July 2021:
- (i) the energy efficiency of three-phase motors with a rated output equal to or above 0,75 kW and equal to or below 1 000 kW, with 2, 4, 6 or 8 poles, which are not Ex eb increased safety motors, shall correspond to at least the IE3 efficiency level set out in Table 2 of Directive 2019/1781/ Euratom;
 - (ii) the energy efficiency of three-phase motors with a rated output equal to or above 0,12 kW and below 0,75 kW, with 2, 4, 6 or 8 poles, which are not Ex eb increased safety motors, shall correspond to at least the IE2 efficiency level set out in Table 1 of Directive 2019/1781/ Euratom;
- (b) from 1 July 2023:
- (i) the energy efficiency of Ex eb increased safety motors with a rated output equal to or above 0,12 kW and equal to or below 1 000 kW, with 2, 4, 6 or 8 poles, and single-phase motors with a rated output equal to or above 0,12 kW shall correspond to at least the IE2 efficiency level set out in Table 1 of Directive 2019/1781/ Euratom;
 - (ii) the energy efficiency of three-phase motors which are not brake motors, Ex eb increased safety motors, or other explosion-protected motors, with a rated output equal to or above 75 kW and equal to or below 200 kW, with 2, 4, or 6 poles, shall correspond to at least the IE4 efficiency level set out in Table 3 of Directive 2019/1781/ Euratom.

2. EFFICIENCY REQUIREMENTS FOR VARIABLE SPEED DRIVES

Efficiency requirements for variable speed drives shall apply as follows:

From 1 July 2021, the power losses of variable speed drives rated for operating with motors with a rated output power equal to or above 0,12 kW and equal to or below 1 000 kW shall not exceed the maximum power losses corresponding to the IE2 efficiency level.

Energy efficiency for VSDs, expressed in International Energy efficiency classes (IE), is determined based on the power losses as follows:

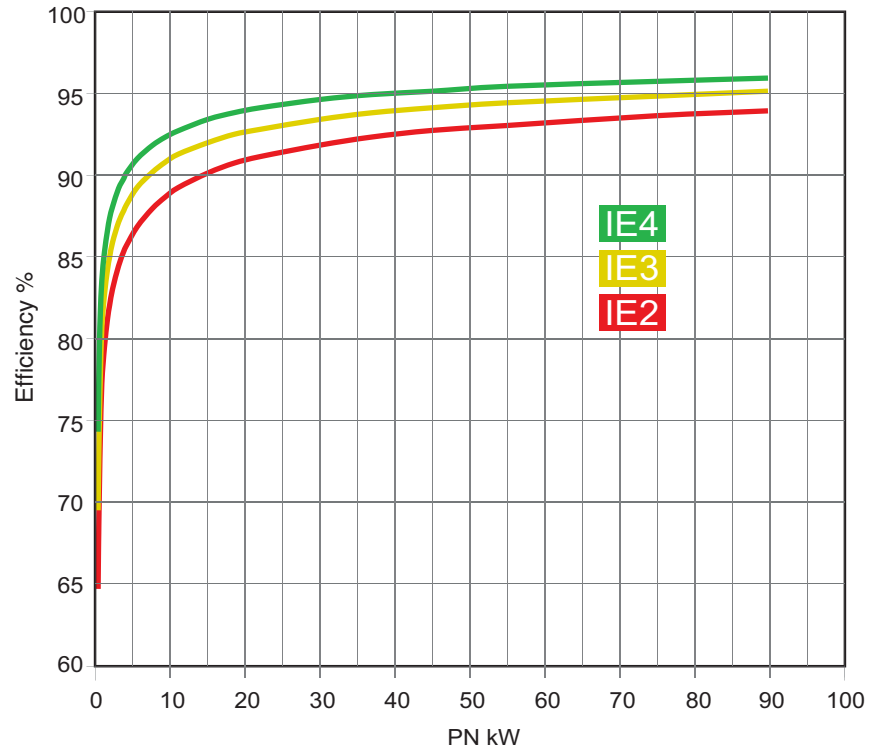
The maximum power losses of the IE2 class are 25 % lower than the reference value referred to in Table 6 of Directive 2019/1781/ Euratom.

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Summary table of the levels of efficiency as expected in IEC 60034-30-1

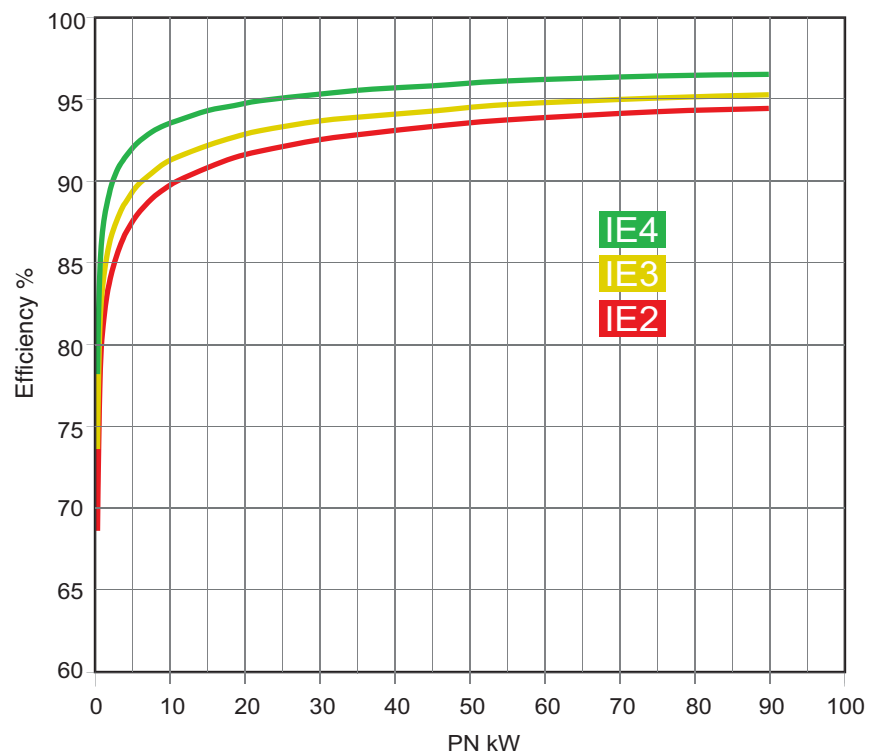
Rated power output kW	Efficiency %		
	IE2	IE3	IE4
0,25	64,8	69,7	74,3
0,3	67,1	71,6	76,1
0,33	68,2	72,6	77,1
0,37	69,5	73,8	78,1
0,45	71,7	75,8	79,9
0,55	74,1	77,8	81,5
0,75	77,4	80,7	83,5
1,1	79,6	82,7	85,2
1,5	81,3	84,2	86,5
1,8	82,2	85	87,3
2,2	83,2	85,9	88
3	84,6	87,1	89,1
3,7	85,5	87,8	89,7
4	85,8	88,1	90
5,5	87	89,2	90,9
7,5	88,1	90,1	91,7
9,2	88,8	90,7	92,2
11	89,4	91,2	92,6
15	90,3	91,9	93,3
18,5	90,9	92,4	93,7
22	91,3	92,7	94
30	92	93,3	94,5
37	92,5	93,7	94,8
45	92,9	94	95
55	93,2	94,3	95,3
75	93,8	94,7	95,6
90	94,1	95	95,8

2-pole



Rated power output kW	Efficiency %		
	IE2	IE3	IE4
0,25	68,5	73,5	77,9
0,3	70,5	75,3	79,5
0,33	71,5	76,2	80,3
0,37	72,7	77,3	81,1
0,45	74,8	79	82,5
0,55	77,1	80,8	83,9
0,75	79,6	82,5	85,7
1,1	81,4	84,1	87,2
1,5	82,8	85,3	88,2
1,8	83,5	86	88,8
2,2	84,3	86,7	89,5
3	85,5	87,7	90,4
3,7	86,3	88,4	90,9
4	86,6	88,6	91,1
5,5	87,7	89,6	91,9
7,5	88,7	90,4	92,6
9,2	89,3	91	93
11	89,8	91,4	93,3
15	90,6	92,1	93,9
18,5	91,2	92,6	94,2
22	91,6	93	94,5
30	92,3	93,6	94,9
37	92,7	93,9	95,2
45	93,1	94,2	95,4
55	93,5	94,6	95,7
75	94	95	96
90	94,2	95,2	96,1

4-pole



EFFICIENCY OF WATER PUMPS

Directive of the European Parliament COMMISSION REGULATION (EC) No 547/2012

With the Eco-design Directive of Energy Using Products (**ErP Directive – Energy-related Products**) the European Union wants to improve the design of equipment that “consume” significant energy (e.g. televisions, refrigerators, washing machines, boilers, pumps, motors etc.) to improve eco-design providing environmental sustainability, reducing negative environmental impact as the consequence of production, use and disposal of products.

The objective of the Directive is to force manufacturers and importers to produce and distribute products with high energy efficiency, and reduced carbon output.

The criteria for eco-design will be an integral part of the declaration of conformity (**CE**), which is a necessary requirement/mark for products being sold in the EU.



This Regulation shall apply to:

The Regulation 547/2012/EC defines the eco-design requirements for marketing centrifugal water pumps in the European market, even if they are integrated in other products (OEM). The Regulation provides the introduction and the calculation of a minimum efficiency index (MEI).

The pumps involved in the Regulation are:

- End suction own bearing water pumps (ESOB) designed for pressures up to 16 bar, a maximum shaft power of 150 kW, a maximum head of 90 m at nominal speed of 1450 rpm and a maximum head of 140 m at nominal speed of 2900 rpm;
- End suction close coupled water pumps (ESCC) designed for pressures up to 16 bar, a maximum shaft power of 150 kW, a maximum head of 90 m at nominal speed of 1450 rpm and a maximum head of 140 m at nominal speed of 2900 rpm;
- End suction close coupled in-line water pumps (ESCCi) designed for pressures up to 16 bar, a maximum shaft power of 150 kW, a maximum head of 90 m at nominal speed of 1450 rpm and a maximum head of 140 m at nominal speed of 2900 rpm;
- Vertical multistage water pumps (MS-V) designed for pressures up to 25 bar, with a nominal speed of 2900 rpm and a maximum flow of 100 m³/h (27,78·10⁻³ m³/s);
- Submersible multistage water pumps (MSS) with a nominal outer diameter of 4" (10,16 cm) or 6" (15,24 cm) designed to operate in a borehole at nominal speed of 2 900 rpm, at operating temperatures within a range of 0 °C and 90 °C;

This Regulation shall not apply to:

- a) Water pumps designed specifically for pumping clean water at temperatures below – 10 °C or above 120 °C.
- b) Water pumps designed only for fire-fighting applications.
- c) Displacement water pumps.
- d) Self-priming water pumps.

This regulation shall apply in accordance with the following timetable:

- 1) From 1 January 2013, water pumps shall have: at the best efficiency point (BEP), at part load (PL), at over load (OL) a minimum efficiency index MEI $\geq 0,10$.
- 2) From 1 January 2015, water pumps shall have: at the best efficiency point (BEP), at part load (PL), at over load (OL) a minimum efficiency index MEI $\geq 0,40$.

The information on benchmark efficiency is available on the web site www.europump.org/efficiencycharts

The MEI value of Calpeda pumps is available on the web site www.calpeda.com

Regulation (EU) No 547/2012

- The benchmark for most efficient water pumps is MEI $\geq 0,70$.
- The efficiency of a pump with a trimmed impeller is usually lower than that of a pump with the full impeller diameter. The trimming of the impeller will adapt the pump to a fixed duty point, leading to reduced energy consumption. The minimum efficiency index (MEI) is based on the full impeller diameter.
- The operation of this water pump with variable duty points may be more efficient and economic when controlled, for example, by the use of a variable speed drive that matches the pump duty to the system.

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