

DRAFT COMMUNIQUE ON ECODESIGN REQUIREMENTS FOR ELECTRIC MOTORS AND VARIABLE SPEED DRIVES (SGM:2021/16)(2019/1781/EU)

Object

ARTICLE 1 – (1) The purpose of this Communique is to establish ecodesign requirements for the placing on the market or the putting into service of electric motors and variable speed drives, including where they are integrated in other products, related to the implementation of the Regulation on the Ecodesign of Energy-Related Products which was put into effect with the Cabinet Decree dated 23/6/2010 and numbered 2010/643.

Scope

ARTICLE 2 – (1) This Communique 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:

- 1) have two, four, six or eight poles;
- 2) have a rated voltage U_N above 50 V and up to and including 1 000 V;
- 3) have a rated power output P_N from 0,12 kW up to and including 1 000 kW;
- 4) are rated on the basis of continuous duty operation; and
- 5) are rated for direct on-line operation;

b) variable speed drives with 3 phases input that:

1) are rated for operating with one motor referred to in point 1(a) of this article, within the 0,12 kW-1 000 kW motor rated output range;

2) have a rated voltage above 100 V and up to and including 1 000 V AC;

3) have only one AC voltage output.

(2) The requirements in section 1, and points (a), (b), (d), (e), (f), (g), (ğ), (h), (ı) section 2, and (13) of section 3 (a) of Annex I shall not apply to the following motors:

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;

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;

ç) motors specifically designed and specified to operate exclusively:

- 1) at altitudes exceeding 4 000 metres above sea-level;
- 2) where ambient air temperatures exceed 60 °C;
- 3) in maximum operating temperature above 400 °C;
- 4) where ambient air temperatures are less than – 30 °C; or
- 5) where the water coolant temperature at the inlet to a product is below 0 °C or above 32 °C;

d) motors specifically designed and specified to operate wholly immersed in a liquid;

e) motors specifically qualified for the safety of nuclear installations,

f) explosion-protected motors specifically designed and certified for mining, as defined in section 1 of Annex I of Regulation on the Equipment and Protective Systems Intended for Use In Potentially Explosive Atmospheres (2014/34/EU) published in the Official Gazette dated 30/06/2016 and numbered 29758.

g) motors in cordless or battery-operated equipment;

ğ) motors in hand-held equipment whose weight is supported by hand during operation;

h) motors in hand-guided mobile equipment moved while in operation;

ı) motors with mechanical commutators;

i) Totally Enclosed Non-Ventilated (TENV) motors;

j) motors placed on the market before 1 July 2029 as substitutes for identical motors integrated in products placed on the market before 1 July 2021 for motors referred to in Annex I. Part 1 (1)(a) and before 1 July 2023 for motors referred to in Annex I. Part 1 (1)(b) , and specifically marketed as such;

k) multi-speed motors, i.e. motors with multiple windings or with a switchable winding, providing a different number of poles and speeds;

l) motors designed specifically for the traction of electric vehicles.

(3) The requirements in section 3, and points (1), (2), (5), (6), (7), (8), (9) and (10) of section 4 and section 3 of Annex I shall not apply to the following VSDs:

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 defined in Directive on Nuclear Safety Controls and Sanctions published in the Official Gazette dated 13/10/2007 and numbered 26642,

c) regenerative drives;

ç) drives with sinusoidal input current.

d) VSDs consisting of a single cabinet, comprising VSDs which are all in conformity with this Communiqué.

Legal Basis

ARTICLE 3 – (1) This Communiqué has been prepared on the basis of the Law No. 4703 of 29/6/2001 on the Preparation and Implementation of Technical Legislation on Products and Presidential Decree No. 1 on the Presidency Organization published in the Official Gazette No. 30474 dated 10/7/2018

Compliance with the European Union Legislation

ARTICLE 4 – (1) This Communiqué has been prepared based on Commission Regulation No 2019/1781/EU laying down ecodesign requirements for electric motors and variable speed drives pursuant to Directive 2009/125/EC of the European Parliament and of the Council, repealing Commission Regulation (EC) No 640/2009 in the framework of alignment with the European Union legislation.

Definitions

ARTICLE 5 – (1) For the purposes of this Communiqué the following definitions shall apply:

a) ‘EU’ means European Union

b) ‘ministry’ means Ministry of Industry and Technology,

c) ‘declared values’ means the values provided by the manufacturer, importer or authorised representative for the stated, calculated or measured technical parameters in accordance with Article 7, for the verification of compliance by the Ministry.’;

ç) ‘variable speed drive’ (‘VSD’) means an electronic power converter that continuously adapts the electrical power supplied to a single motor to control the motor’s mechanical power output according to the torque-speed characteristic of the load driven by the motor, by adjusting the power supply to a variable frequency and voltage supplied to the motor. It includes all protection devices and auxiliaries which are integrated in the VSD.’;

d) ‘test load’ of a VSD means the electrical device used for testing purposes that determines the output current and the output displacement factor $\cos \phi$;

e) 'other explosion-protected motor' means a motor intended for use in explosive atmospheres and certified 'Ex ec', 'Ex tb', 'Ex tc', 'Ex db', or 'Ex dc' as defined in standards;

f) 'hand-held equipment' means a portable appliance intended to be held in the hand during normal use;

g) 'mains' or 'electric mains' means the electricity supply from the grid;

ğ) 'equivalent model' means a model which has the same technical characteristics relevant for the technical information to be provided, but which is placed on the market or put into service by the same manufacturer, importer or authorised representative as another model with a different model identifier;

h) 'Ex eb increased safety motor' means a motor intended for use in explosive atmospheres and certified 'Ex eb', as defined in standards;

ı) 'factory acceptance test' means a test on an ordered product where the customer uses witnessed testing to verify the product's full accordance with contractual requirements, before they are accepted or put into service.

i) 'phase' means the type of configuration of the mains;

j) 'brake motor' means a motor equipped with an electromechanical brake unit operating directly on the motor shaft without couplings;

k) 'cordless or battery operated equipment' means an appliance deriving its energy from batteries enabling the appliance to perform its intended function without a supply connection;

l) 'pole' means a north or a south pole produced by the rotating magnetic field of the motor, whose total number of poles determines its base speed;

m) 'motor with mechanical commutators' means a motor in which a mechanical device reverses the direction of the current;

n) 'model identifier' means the code, usually alphanumeric, which distinguishes a specific product model from other models with the same trade mark or the same manufacturer's, importer's or authorised representative's name;

o) 'electric motor' or 'motor' means a device that converts electrical input power into mechanical output power in the form of a rotation with a rotational speed and torque that depends on factors including the frequency of the supply voltage and number of poles of the motor;

ö) 'energy efficiency' of a motor means the ratio of its mechanical output power to the electrical active input power;

p) 'hand-guided equipment' means a non-road mobile appliance that is moved and guided by the user during normal use;

r) 'regenerative drive' means a VSD that is able to regenerate energy from the load to the mains, i.e. that induces a $180^\circ \pm 20^\circ$ phase shift of the input current to the input voltage when the load motor is braking;

s) 'drive with sinusoidal input current' means a VSD with a sinusoidal waveform of the input current, characterised by a Total Harmonic Content below 10 %;

§) 'continuous duty operation' means capable of continuous operation at rated power with a temperature rise within the specified insulation temperature class, specified as specific duty types S1, S3 $\geq 80\%$ or S6 $\geq 80\%$ as defined in standards;

t) 'witnessed testing' means actively observing the physical testing of the product under investigation by another party, to draw conclusions on the validity of the test and the test results. This may include conclusions on the compliance of testing and calculations methods used with applicable standards and legislation;

u) 'totally enclosed non-ventilated (TENV) motor' means a motor designed and specified to operate without a fan, and which dissipates heat predominantly through natural ventilation or radiation on the totally enclosed motor surface;

Ecodesign requirements

ARTICLE 6 – (1) The ecodesign requirements for electric motors and variable speed drives and the dates of entry into force of these requirements are set out in Annex I of this Communique.

Conformity assessment

ARTICLE 7 – (1) The conformity assessment procedure referred to in Article 11 of Regulation on Ecodesign Requirements for Energy-Related Products (2009/125/EC) published in the Official Gazette No. 27722 dated 07/10/2010 shall be the internal design control system set out in Annex IV to that Regulation or the management system set out in Annex V to that Regulation.

(2) For the purposes of the conformity assessment pursuant to Article 11 of Regulation on Ecodesign Requirements for Energy-Related Products (2009/125/EC), the technical documentation of motors shall contain a copy of the product information provided in accordance with point 2 of Annex I to this Communique, and the details and results of calculations set out in Annex II to this Communique, and where applicable Annex I.1.

(3) For the purposes of the conformity assessment pursuant to Article 11 of Regulation on Ecodesign Requirements for Energy-Related Products the technical documentation of VSDs shall contain a copy of the product information provided in accordance with point 4 of Annex I to this Communique, and the details and results of calculations set out in Annex II to this Communique, and where applicable Annex I.3.

(4) Where the information included in the technical documentation for a particular model has been obtained using either or both of the methods below, the technical documentation shall include the details of such calculation, the assessment undertaken by the manufacturer to verify the accuracy of the calculation and, where appropriate, the declaration of identity between the models of different manufacturers. The technical documentation shall include a list of all equivalent models, including the model identifiers.

- a) from a model that has the same technical characteristics relevant for the technical information to be provided but is produced by a different manufacturer; or
- b) by calculation on the basis of design or extrapolation from another model of the same or a different manufacturer, or both,

Verification procedure for market surveillance purposes

ARTICLE 8 – (1) The Ministry shall apply the verification procedure laid down in Annex III when performing the market surveillance checks referred to in Article 5, point 2 of the Regulation on Ecodesign Requirements for Energy-Related Products (2009/125/EC).

Circumvention

ARTICLE 9– (1) The manufacturer, importer or authorised representative shall not place on the market products designed to be able to detect they are being tested (e.g. by recognising the test conditions or test cycle), and to react specifically by automatically altering their performance during the test with the aim of reaching a more favourable level for any of the parameters specified in this Regulation or declared by the manufacturer, importer or authorised representative in the technical documentation or included in any of the documentation provided.

(2) The energy consumption of the product and any of the other declared parameters shall not deteriorate after a software or firmware update when measured with the same test standard originally used for the declaration of conformity, except with explicit consent of the end-user prior to the update. No deterioration of performance shall occur as result of rejecting the update.

(3) A software update shall never have the effect of changing the product’s performance in a way that makes it non-compliant with the ecodesign requirements applicable for the declaration of conformity.

Benchmarks

ARTICLE 11 – (1) The benchmarks for the best-performing motors and variable speed drives available at the time of adopting this Communique are set out in Annex IV.

Consultation forum

ARTICLE 12 – (1) The Ministry shall participate in meetings of the Consultaion Forum with respect to this Communique established by the European Commission to carry out studies in the light of technical progress on setting additional resource efficiency requirements for products in accordance with the objectives of the circular economy, including identification and reuse of rare earth in permanent magnet motors; the level of verification tolerances; setting stricter requirements for motors and variable speed drives; setting minimum energy efficiency requirements for motors with a rated voltage above 1000 V; setting requirements for combinations of motors and VSDs placed on the market together, as well as integrated variable speed drives (compact drives); the exemptions set out in this Communique adding other types of motors to the scope, including permanent magnet motors.

Repeal

ARTICLE 12 – (1) The Communique on Ecodesign Requirements for Electric Motors (SGM: 2012/2) published in the Official Gazette dated 7/2/2012 and numbered 28197 has been repealed.

Entry into Force

ARTICLE 13– (1) Paragraph 1 of Article 9 of this Communiqué shall enter into force on the date of its publication and other provisions shall enter into force on 01/07/2021.

Enforcement

ARTICLE 14 – (1) The provisions of this Communiqué shall be enforced by the Minister of Industry and Technology.

ECODESIGN REQUIREMENTS FOR MOTORS AND VARIABLE SPEED DRIVES

1. ENERGY EFFICIENCY REQUIREMENTS FOR MOTORS

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

a) from 1 July 2021:

1) 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 or in Table 3b as appropriate.

2) 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 or in Table 3a as appropriate;

b) from 1 July 2023:

1) 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 or in Table 3a as appropriate;

2) 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 or in Table 3c as appropriate..

c) Energy efficiency of motors, expressed in International Energy efficiency classes (IE), is set out in Tables 1 to 3c for different values of the motor rated output power P_N , at 50 Hz or 60 Hz. IE classes are determined at rated output power (P_N), rated voltage (U_N), and based on 25 °C ambient reference temperature.

1) For 50/60 Hz motors, the requirements above shall be met at both 50 Hz and 60 Hz at the rated output power specified for 50 Hz.

2) For 50Hz or 60Hz motors the requirements above shall be met at respectively 50Hz or 60Hz at the rated output power specified respectively for 50 Hz or 60 Hz.

Table 1
Minimum efficiencies η_n for IE2 efficiency level at 50 Hz [%]

Rated output power P_N (kW)	Number of poles			
	2	4	6	8
0,12	53,6	59,1	50,6	39,8
0,18	60,4	64,7	56,6	45,9

0,20	61,9	65,9	58,2	47,4
0,25	64,8	68,5	61,6	50,6
0,37	69,5	72,7	67,6	56,1
0,40	70,4	73,5	68,8	57,2
0,55	74,1	77,1	73,1	61,7
0,75	77,4	79,6	75,9	66,2
1,1	79,6	81,4	78,1	70,8
1,5	81,3	82,8	79,8	74,1
2,2	83,2	84,3	81,8	77,6
3	84,6	85,5	83,3	80,0
4	85,8	86,6	84,6	81,9
5,5	87,0	87,7	86,0	83,8
7,5	88,1	88,7	87,2	85,3
11	89,4	89,8	88,7	86,9
15	90,3	90,6	89,7	88,0
18,5	90,9	91,2	90,4	88,6
22	91,3	91,6	90,9	89,1
30	92,0	92,3	91,7	89,8
37	92,5	92,7	92,2	90,3
45	92,9	93,1	92,7	90,7
55	93,2	93,5	93,1	91,0
75	93,8	94,0	93,7	91,6
90	94,1	94,2	94,0	91,9
110	94,3	94,5	94,3	92,3
132	94,6	94,7	94,6	92,6
160	94,8	94,9	94,8	93,0
200 up to 1000	95,0	95,1	95,0	93,5

Table 2
Minimum efficiencies η_n for IE3 efficiency level at 50 Hz (%)

Rated output power P_N (kW)	Number of poles			
	2	4	6	8
0,12	60,8	64,8	57,7	50,7
0,18	65,9	69,9	63,9	58,7
0,20	67,2	71,1	65,4	60,6
0,25	69,7	73,5	68,6	64,1
0,37	73,8	77,3	73,5	69,3
0,40	74,6	78,0	74,4	70,1
0,55	77,8	80,8	77,2	73,0
0,75	80,7	82,5	78,9	75,0
1,1	82,7	84,1	81,0	77,7
1,5	84,2	85,3	82,5	79,7
2,2	85,9	86,7	84,3	81,9
3	87,1	87,7	85,6	83,5
4	88,1	88,6	86,8	84,8
5,5	89,2	89,6	88,0	86,2

7,5	90,1	90,4	89,1	87,3
11	91,2	91,4	90,3	88,6
15	91,9	92,1	91,2	89,6
Rated output power P_N (kW)	Number of poles			
	2	4	6	8
18,5	92,4	92,6	91,7	90,1
22	92,7	93,0	92,2	90,6
30	93,3	93,6	92,9	91,3
37	93,7	93,9	93,3	91,8
45	94,0	94,2	93,7	92,2
55	94,3	94,6	94,1	92,5
75	94,7	95,0	94,6	93,1
90	95,0	95,2	94,9	93,4
110	95,2	95,4	95,1	93,7
132	95,4	95,6	95,4	94,0
160	95,6	95,8	96,6	94,3
200 up to 1000	95,8	96,0	95,8	94,6

Table 3
Minimum efficiencies η_n for IE4 efficiency level 50 Hz (%)

Rated output power P_N (kW)	Number of poles			
	2	4	6	8
0,12	66,5	69,8	64,9	62,3
0,18	70,8	74,7	70,1	67,2
0,20	71,9	75,8	71,4	68,4
0,25	74,3	77,9	74,1	70,8
0,37	78,1	81,1	78,0	74,3
0,40	78,9	81,7	78,7	74,9
0,55	81,5	83,9	80,9	77,0
0,75	83,5	85,7	82,7	78,4
1,1	85,2	87,2	84,5	80,8
1,5	86,5	88,2	85,9	82,6
2,2	88,0	89,5	87,4	84,5
3	89,1	90,4	88,6	85,9
4	90,0	91,1	89,5	87,1
5,5	90,9	91,9	90,5	88,3
7,5	91,7	92,6	91,3	89,3
11	92,6	93,3	92,3	90,4
15	93,3	93,9	92,9	91,2
18,5	93,7	94,2	93,4	91,7
22	94,0	94,5	93,7	92,1
30	94,5	94,9	94,2	92,7
37	94,8	95,2	94,5	93,1
45	95,0	95,4	94,8	93,4

55	95,3	95,7	95,1	93,7
75	95,6	96,0	95,4	94,2
90	95,8	96,1	95,6	94,4
Rated output power P_N (kW)	Number of poles			
	2	4	6	8
110	96,0	96,3	95,8	94,7
132	96,2	96,4	96,0	94,9
160	96,3	96,6	96,2	95,1
200 up to 249	96,1	96,7	96,3	95,4
250 up to 314	96,5	96,7	96,5	95,4
315 up to 1000	96,5	96,7	96,6	95,4

Table 3a
Minimum efficiencies η_n for IE2 efficiency level at 60 Hz (%)

Rated output power P_N [kW]	Number of poles			
	2	4	6	8
0,12	59,5	64,0	50,5	40,0
0,18	64,0	68,0	55,0	46,0
0,25	68,0	70,0	59,5	52,0
0,37	72,0	72,0	64,0	58,0
0,55	74,0	75,5	68,0	62,0
0,75	75,5	78,0	73,0	66,0
1,1	82,5	84,0	85,5	75,5
1,5	84,0	84,0	86,5	82,5
2,2	85,5	87,5	87,5	84,0
3,7	87,5	87,5	87,5	85,5
5,5	88,5	89,5	89,5	85,5
7,5	89,5	89,5	89,5	88,5
11	90,2	91,0	90,2	88,5
15	90,2	91,0	90,2	89,5
18,5	91,0	92,4	91,7	89,5
22	91,0	92,4	91,7	91,0
30	91,7	93,0	93,0	91,0
37	92,4	93,0	93,0	91,7
45	93,0	93,6	93,6	91,7
55	93,0	94,1	93,6	93,0
75	93,6	94,5	94,1	93,0
90	94,5	94,5	94,1	93,6
110	94,5	95,0	95,0	93,6
150	95,0	95,0	95,0	93,6
185	95,4	95,4	95,0	93,6
220	95,4	95,4	95,0	93,6
250	95,4	95,4	95,0	93,6
300	95,4	95,4	95,0	93,6

335	95,4	95,4	95,0	93,6
375 'ten 1000'e kadar	95,4	95,8	95,0	94,1

Table 3b
Minimum efficiencies η_n for IE3 efficiency level at 60 Hz (%)

Rated output power P_N [kW]	Number of poles			
	2	4	6	8
0,12	62,0	66,0	64,0	59,5
0,18	65,6	69,5	67,5	64,0
0,25	69,5	73,4	71,4	68,0
0,37	73,4	78,2	75,3	72,0
0,55	76,8	81,1	81,7	74,0
0,75	77,0	83,5	82,5	75,5
1,1	84,0	86,5	87,5	78,5
1,5	85,5	86,5	88,5	84,0
2,2	86,5	89,5	89,5	85,5
3,7	88,5	89,5	89,5	86,5
5,5	89,5	91,7	91,0	86,5
7,5	90,2	91,7	91,0	89,5
11	91,0	92,4	91,7	89,5
15	91,0	93,0	91,7	90,2
18,5	91,7	93,6	93,0	90,2
22	91,7	93,6	93,0	91,7
30	92,4	94,1	94,1	91,7
37	93,0	94,5	94,1	92,4
45	93,6	95,0	94,5	92,4
55	93,6	95,4	94,5	93,6
75	94,1	95,4	95,0	93,6
90	95,0	95,4	95,0	94,1
110	95,0	95,8	95,8	94,1
150	95,4	96,2	95,8	94,5
185	95,8	96,2	95,8	95,0
220	95,8	96,2	95,8	95,0
250	95,8	96,2	95,8	95,0
300	95,8	96,2	95,8	95,0
335	95,8	96,2	95,8	95,0
375 'ten 1000'e kadar	95,8	96,2	95,8	95,0

Table 3c
Minimum efficiencies η_n for IE4 efficiency level at 60 Hz (%)

Rated output power P_N [kW]	Number of poles			
	2	4	6	8
0,12	66,0	70,0	68,0	64,0
0,18	70,0	74,0	72,0	68,0
0,25	74,0	77,0	75,5	72,0
0,37	77,0	81,5	78,5	75,5
0,55	80,0	84,0	82,5	77,0
0,75	82,5	85,5	84,0	78,5
1,1	85,5	87,5	88,5	81,5
1,5	86,5	88,5	89,5	85,5
2,2	88,5	91,0	90,2	87,5
3,7	89,5	91,0	90,2	88,5
5,5	90,2	92,4	91,7	88,5
7,5	91,7	92,4	92,4	91,0
11	92,4	93,6	93,0	91,0
15	92,4	94,1	93,0	91,7
18,5	93,0	94,5	94,1	91,7
22	93,0	94,5	94,1	93,0
30	93,6	95,0	95,0	93,0
37	94,1	95,4	95,0	93,6
45	94,5	95,4	95,4	93,6
55	94,5	95,8	95,4	94,5
75	95,0	96,2	95,8	94,5
90	95,4	96,2	95,8	95,0
110	95,4	96,2	96,2	95,0
150	95,8	96,5	96,2	95,4
185	96,2	96,5	96,2	95,4
220	96,2	96,8	96,5	95,4
250	96,2	96,8	96,5	95,8
300	96,2	96,8	96,5	95,8
335	96,2	96,8	96,5	95,8
375'ten 1000'e kadar	96,2	96,8	96,5	95,8

ç) To determine the minimum efficiency of 50 Hz motors with rated power outputs P_N of between 0,12 and 200 kW not provided in Tables 1, 2 and 3, the following formula shall be used:

$$\eta_n: A \times [\log_{10}(P_n/1kW)]^3 + B \times [\log_{10}(P_n/1kW)]^2 + C \times \log_{10}(P_n/1kW) + D$$

5. - A, B, C and D are interpolation coefficients to be determined according to Tables 4 and 5.

Table 4
Interpolation coefficients for motors with rated power output P from 0,12 kW up to 0,55 kW

IE code	Coefficients	2 poles	4 poles	6 poles	8 poles
IE2	A	22,4864	17,2751	-15,9218	6,4855
	B	27,7603	23,978	-30,258	9,4748
	C	37,8091	35,5822	16,6861	36,852
	D	82,458	84,9935	79,1838	70,762
IE3	A	6,8532	7,6356	17,361	-0,5896
	B	6,2006	4,8236	-44,538	-25,526
	C	25,1317	21,0903	-3,0554	4,2884
	D	84,0392	86,0998	79,1318	75,831
IE4	A	-8,8538	8,432	-13,0355	-4,9735
	B	-20,3352	2,6888	-36,9497	-21,453
	C	8,9002	14,6236	-4,3621	2,6653
	D	85,0641	87,6153	82,0009	79,055

d) Between 0,55 kW and 0,75 kW, a linear interpolation shall be performed on the obtained minimum efficiencies for 0,55 kW and 0,75 kW.

Table 5

Interpolation coefficients for motors with rated power output P from 0,75 kW up to 200 kW

IE code	Coefficients	2 poles	4 poles	6 poles	8 poles
IE2	A	0,2972	0,0278	0,0148	2,1311
	B	-3,3454	-1,9247	-2,4978	-12,029
	C	13,0651	10,4395	13,247	26,719
	D	79,077	80,9761	77,5603	69,735
IE3	A	0,3569	0,0773	0,1252	0,7189
	B	-3,3076	-1,8951	-2,613	-5,1678
	C	11,6108	9,2984	11,9963	15,705
	D	82,2503	83,7025	80,4769	77,074
IE4	A	0,34	0,2412	0,3598	0,6556
	B	-3,0479	-2,3608	-3,2107	-4,7229
	C	10,293	8,446	10,7933	13,977
	D	84,8208	86,8321	84,107	80,247

e) To determine the minimum efficiency of 60 Hz motors at a rated power not provided in Tables 3a, 3b and 3c, the following rule shall be used:

- 1) The efficiency of a rated power at or above the midpoint between 2 consecutive values from the tables shall be the highest of the two efficiencies.
- 2) The efficiency of a rated power below the midpoint between 2 consecutive values from the tables shall be the lowest of the two efficiencies.

f) Losses are determined in accordance with Annex II.

2. PRODUCT INFORMATION REQUIREMENTS FOR MOTORS

(1) The product information requirements set out in points (2)(1) to (3)(a) below shall be visibly displayed on:

a) the technical data sheet or user manual supplied with the motor, unless an internet link to that information is supplied with the product. A QR code may in addition be supplied with a link to the information;

b) the technical documentation for the purposes of conformity assessment pursuant to Article 5;

c) free access websites of the manufacturer of the motor, its authorised representative or the importer, and;

ç) the technical data sheet supplied with products in which the motor is incorporated.

d) As regards to the technical documentation, the information shall be provided in the order as set out in paragraph (2) and point (3)(a). The exact wording used in the list does not need to be repeated. The information may be displayed using clearly understandable graphs figures or symbols rather than text.

(2) 'From 1 July 2021 for motors referred to in Annex I. Section 1 (1)(a), and from 1 July 2023 for motors referred to in Annex I. Section 1 (1)(b) (1):

1) rated efficiency (η_N) at the full, 75 % and 50 % rated load, and rated voltage(s) (U_N), determined based on 25 °C ambient reference temperature, rounded to one decimal place;

2) efficiency level: 'IE2' 'IE3' or 'IE4', as determined in the first section of this Annex;

3) manufacturer's name or trade mark, commercial registration number and address;

4) product's model identifier;

5) number of poles of the motor;

6) the rated power output(s) P_N or range of rated power output (kW);

7) the rated input frequency(s) of the motor (Hz);

8) the rated voltage(s) or range of rated voltage (V);

9) the rated speed(s) or range of rated speed (rpm);

10) whether single-phase or three-phase;

11) information on the range of operating conditions for which the motor is designed:

(i) altitudes above sea-level;

(ii) minimum and maximum ambient air temperatures including for motors with air cooling;

(iii) water coolant temperature at the inlet to the product, where applicable,;

(iv) maximum operating temperature;

(v) potentially explosive atmospheres;

12) if the motor is considered exempt from efficiency requirement in accordance with Article 2(2) of this Regulation, the specific reason why it is considered exempt.

(3) From 1 July 2022::

a) The power losses expressed in percentage (%) of the rated output power at the following different operating points for speed versus torque: (25;25) (25;100) (50;25) (50;50) (50;100) (90;50) (90;100) determined based on 25 °C ambient reference temperature, rounded to one decimal place; if the motor is not suited for operation at any of the operating points for speed versus torque above, then 'N.A.' or 'Not Applicable' should be indicated for such points.

(4) The information referred to in points 1 and 2 as well as the year of manufacture shall be durably marked on or near the rating plate of the motor. Where the size of the rating plate makes it impossible to mark all the information referred to in point 1 only the rated efficiency at full rated load and voltage shall be marked.

(5) The information listed in paragraph (2) and point (3)(a) does not need to be published on free access websites for tailor-made motors with a special mechanical and electrical design manufactured on the basis of a specific client request if this information is included in the commercial offers provided to the clients.

(6) Manufacturers shall provide information in the technical data sheet or user manual supplied with the motor on any specific precautions that must be taken when motors are assembled, installed, maintained or used with variable speed drives.

e) For motors exempt from the efficiency requirements in accordance with point 2(j) of Article 2 of this Communiqué, the motor or its packaging and the documentation must clearly indicate ‘Motor to be used exclusively as spare part for’ and the unique model identification or serial number of the product(s) for which it is intended.

f) For 50 Hz and 60 Hz motors, the data set out above is provided at the applicable frequency, while for 50/60 Hz motors it is sufficient to provide the data at 50 Hz, except for the rated efficiency at full load, which shall be specified at both 50Hz and 60Hz.

g) Losses are determined in accordance with Annex II.

3. EFFICIENCY REQUIREMENTS FOR VARIABLE SPEED DRIVES

(1) From 1 July 2021;

a) 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.

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

c) The maximum power losses of the IE2 class are 25 % lower than the reference value referred to in Table 6.

Table 6
Reference VSD losses and test load displacement factor for the IE class determination of VSDs

Apparent output power of VSD (kVA)	Rated power of Motor (kW) (indicative)	Reference power losses (kW), at 90 % rated motor stator frequency and 100 % rated torque-producing current	Test load displacement factor cos phi (+/- 0,08)
0,278	0,12	0,100	0,73
0,381	0,18	0,104	0,73

0,500	0,25	0,109	0,73
0,697	0,37	0,117	0,73
0,977	0,55	0,129	0,73
1,29	0,75	0,142	0,79
1,71	1,1	0,163	0,79
2,29	1,5	0,188	0,79
3,3	2,2	0,237	0,79
4,44	3	0,299	0,79
5,85	4	0,374	0,79
7,94	5,5	0,477	0,85
Apparent output power of VSD (kVA)	Rated power of Motor (kW) (indicative)	Reference power losses (kW), at 90 % rated motor stator frequency and 100 % rated torque-producing current	Test load displacement factor cos phi (+/- 0,08)
9,95	7,5	0,581	0,85
14,4	11	0,781	0,85
19,5	15	1,01	0,85
23,9	18,5	1,21	0,85
28,3	22	1,41	0,85
38,2	30	1,86	0,85
47	37	2,25	0,85
56,9	45	2,70	0,86
68,4	55	3,24	0,86
92,8	75	4,35	0,86
111	90	5,17	0,86
135	110	5,55	0,86
162	132	6,65	0,86
196	160	8,02	0,86
245	200	10,0	0,87
302	250	12,4	0,87
381	315	15,6	0,87
429	355	17,5	0,87
483	400	19,8	0,87
604	500	24,7	0,87
677	560	27,6	0,87
761	630	31,1	0,87
858	710	35,0	0,87
967	800	39,4	0,87
1088	900	44,3	0,87
1209	1000	49,3	0,87

c) If the apparent output power of a VSD is between two values in Table 6, the higher power loss value and the lower value of the test load displacement factor shall be used for the IE class determination.

d) Losses are determined in accordance with Annex II.

4. PRODUCT INFORMATION REQUIREMENTS FOR VARIABLE SPEED DRIVES

(1) From 1 July 2021;

a) the product information on variable speed drives set out in points (b) shall be visibly displayed on:

1) the technical data sheet or user manual supplied with the VSD, unless an internet link to that information is supplied with the product. A QR code may in addition be supplied with a link to the information;

2) the technical documentation for the purposes of conformity assessment pursuant to Article 7;

3) free access websites of the manufacturer, its authorised representative or the importer and;

4) the technical data sheet supplied with products in which the VSD is incorporated.

b) As regards to the technical documentation, the information shall be provided in the order as listed in points. The exact wording used in the list does not need to be repeated. It may be displayed using clearly understandable graphs figures or symbols rather than text.:

1) power losses in % of the rated apparent output power at the following different operating points for relative motor stator frequency versus relative torque-producing current (0;25) (0;50) (0;100) (50;25) (50;50) (50;100) (90;50) (90;100), as well as standby losses, generated when the VSD is powered up but is not providing current to the load, rounded to one decimal place;

2) efficiency level: 'IE2' as determined in the third section of this annex;

3) manufacturer's name or trade mark, commercial registration number and address;

4) product's model identifier;

5) apparent output power or range of apparent output power (kVA);),

6) indicative motor rated power output(s) PN or range of rated power output (kW);

7) rated output current (A);

8) maximum operating temperature (°C);

9) rated supply frequency(s) (Hz);

10) rated supply voltage(s) or range of rated supply voltage (V);

11) if the VSD is considered exempt from the efficiency requirements in accordance with Article 2(3) of this Communiqué the specific reason why it is considered exempt.

c) The information listed above in points (1) to (11) does not need to be published on free access websites for tailor-made VSDs with special electrical design manufactured on the basis of a specific client request if this information is included in the commercial offers provided to the clients.

ç) The information referred to in points (b) (1) and (2) as well as the year of manufacture shall be durably marked on or near the rating plate of the VSD. Where the size of the rating plate makes it impossible to mark all the information referred to in point (1) only the power losses in % of the rated apparent output power at (90;100), rounded to one decimal place, shall be marked.

d) Losses are determined in accordance with Annex II.

MEASUREMENT METHODS AND CALCULATIONS

1. For the purposes of compliance and verification of compliance with the requirements of this Communique, measurements and calculations shall be made using harmonised standards the reference numbers of which have been published for this purpose in the Official Journal of the European Union, or other reliable, accurate and reproducible methods, which take into account the generally recognised state-of-the-art, and in line with the following provisions:

2. FOR MOTORS

a) The difference between the output mechanical power and the input electrical power is due to losses occurring in the motor.

b) Total losses shall be determined using the following methods, based on a 25 °C reference ambient temperature::

- Single-phase motors: Direct measurement: Input-Output;
- Three-phase motors: Summation of losses: Residual losses.

c) However, for the seven operating points according to Annex I. Part 2 (3)(a), the losses shall be determined by either direct input-output measurement or by calculation.

3. FOR VARIABLE SPEED DRIVES

a) For the determination of the IE class, the power losses of VSDs shall be determined at 100 % rated torque-producing current and 90 % rated motor stator frequency..

b) The losses shall be determined according to one of the following methods:

- the input-output method; or
- the calorimetric method.

c) The test switching frequency shall be 4 kHz until 111 kVA (90 kW) and 2 kHz above, or at the default factory settings as defined by the manufacturer.

ç) It is acceptable to measure VSD losses at a frequency of up to 12 Hz instead of zero.

d) Manufacturers or their authorised representatives can also use the single loss determination method. Calculations have to be performed with respect to component manufacturer's data with typical values of power semiconductors at the actual VSD operating temperature or at the maximum operating temperature specified in the datasheet. When no component manufacturer data is available, losses shall be determined by measurement. Combination of calculated and measured losses are allowed. The different individual losses are calculated or measured separately and the total losses are determined as the sum of all individual losses.

VERIFICATION PROCEDURE FOR MARKET SURVEILLANCE PURPOSES

1. The verification tolerances defined in this Annex relate only to the verification by the Ministry of the declared values and shall not be used by the manufacturer, importer or authorised representative as an allowed tolerance to establish the values in the technical documentation or in interpreting these values with a view to achieving compliance or to communicate better performance by any means.

2. Where a model has been designed to be able to detect it is being tested (e.g. by recognising the test conditions or test cycle), and to react specifically by automatically altering its performance during the test with the objective of reaching a more favourable level for any of the parameters specified in this Communique or included in the technical documentation or included in any of the documentation provided, the model and all equivalent models shall be considered not compliant.

3. As part of verifying that a product model complies with the requirements laid down in this Communique pursuant to Article 5(2) of the Regulation on Ecodesign Requirements for Energy-Related Products (2009/125/EC) of the Ministry shall apply the following procedure for the requirements referred to in Annex I.:

(a) the Ministry shall verify one single unit of the model;

(b) the model shall be considered to comply with the applicable requirements if:

1) the values given in the technical documentation pursuant to Article 2 of Annex IV of the Regulation on Ecodesign Requirements for Energy-Related Products (2009/125/EC) (declared values), and, where applicable, the values used to calculate these values, are not more favourable for the manufacturer, importer or authorised representative than the results of the corresponding measurements carried out pursuant to paragraph (f) thereof; and

2) the declared values meet any requirements laid down in this Communique and any required product information published by the manufacturer, importer or authorised representative does not contain values that are more favourable for the manufacturer, importer or authorised representative than the declared values; and

3) when the Ministry tests the unit of the model, the determined values (the values of the relevant parameters as measured in testing and the values calculated from these measurements) comply with the respective verification tolerances as set out in Table 7.

(c) If the results referred to in points (b)(1) or (b)(2) are not achieved the model and all equivalent models shall be considered not to comply with this Communique.

(ç) If the result referred to in point (b)(3) is not achieved;

1) for models that are produced in quantities of less than five per year including equivalent models, the model and all equivalent models shall be considered not to comply with this Communiqué;

2) for models that are produced in quantities of five or more per year including equivalent models, the Ministry shall select three additional units of the same model for testing. As an alternative, the three additional units selected may be one or more of equivalent models.

(d) The model shall be considered to comply with the applicable requirements if for these three units the arithmetical mean of the determined values complies with the respective verification tolerances given in Table 7.

(e) If the result referred to in point (d) is not achieved the model and all equivalent models shall be considered not to comply with this Communiqué.

(f) The Ministry shall provide all relevant information to the authorities of the other Member States and to the Commission without delay after a decision being taken on the non-compliance of the model according to points (c), (e) or the second paragraph of this Annex.

4. The Ministry shall use the measurement and calculation methods set out in Annex II.

5. Given the weight and size limitations for the transportation of motors with a rated power output of 375 to 1 000 kW the Ministry may decide to undertake the verification procedure at the premises of manufacturers, authorised representatives or importers before the products are put into service. The Ministry can do this verification using its own testing equipment.

6. If factory acceptance tests are planned for such motors, which will test parameters laid down in Annex I of this Communiqué, the Ministry may decide to use witnessed testing during these factory acceptance tests to gather test results which can be used to verify compliance of the motor under investigation. The authorities may request a manufacturer, authorised representative or importer to disclose information on any planned factory acceptance tests relevant for witnessed testing.

7. In the cases mentioned in the two paragraphs above, the Ministry only needs to verify one single unit of the model. If the result referred to in point 3(b)(3) is not achieved, the model and all equivalent models shall be considered not to comply with this Communiqué.

8. The Ministry shall only apply the tolerances set out in Table 7 and shall only use the procedure described in point 3 for the requirements referred to in this Annex. For the parameters in Table 7, no other tolerances such as those set out in harmonised standards or in any other measurement method shall be applied.

Tablo 7
Doğrulama toleransları

Parameters	Verification tolerances
Total losses (1- η) for motors with a rated output equal to or above 0,12 kW and equal to or below 150 kW.	The determined value (*) shall not exceed the value (1- η) calculated based on the declared η by more than 15 %.

Total losses (1- η) for motors with a rated output of above 150 kW and equal to or below 1 000 kW.	The determined value (*) shall not exceed the value (1- η) calculated based on the declared η by more than 10 %.
Total losses for variable speed drives.	The determined value (*) shall not exceed the declared value by more than 10 %..
(*) In the case of three additional units tested as prescribed in point 3(ç)(2), the determined value means the arithmetical mean of the values determined for these three additional units.	

BENCHMARKS

1. At the time of adoption of this Communique the best available technology on the market for the environmental aspects that were considered significant and are quantifiable is indicated below..

a) For motors the IE4 level was identified as the best available technology. Motors with losses that are 20 % lower exist but within limited availability and not in all power ranges covered by this Communique and not in the form of induction motors.

b) For variable speed drives, the best available technology on the market corresponds to 20 % of the reference power losses referred to in Table 6. By utilising silicon carbide technologies (SiC MOFSET), semiconductor losses could be further reduced by about 50 % compared to a conventional solution.