اللائحة الفنية الكويتية

KWS XXX

المحركات الدوارة - تصنيفات الكفاءة للمحركات ذات التيار المتردد

Rotating Electrical Machines - Efficiency Classes of AC Operated Motors

الهيئة العامة للصناعة

دولة الكويت

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FOREWARD

The Standard and Metrology Department represents the National Standardization Body in the State of Kuwait, and it is a founding member of the GCC Standardization Organization, which is a regional body that its membership includes the national standardization bodies of the member states.

One of the department's tasks is to prepare Kuwaiti standards and technical regulations by specialized technical committees.

The technical sub-committee for Energy Efficiency of Rotary Electric Motors emanating from the National Committee for the Electrical and Electronic Standards Sector has prepared this Kuwaiti technical regulation within the work program of the National Committee for the Electrical and Electronic Standards Sector, in accordance with the ministerial decision issued in this regard.

This technical regulation "Rotating Electrical Machines - Efficiency Classes of AC Operated Motors" was based on IEC 60034-30-1 standard and Saudi technical regulation SASO 2893.

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Contents

1. INTRODUCTION

Electrical motors are used in different applications, such as blowers, fans, pumps, etc. This standard can be used for commissioning line operated electrical AC motors. This standard deals with all kinds of electric motors that are rated for line operation (including starting at reduced voltage). This includes single-and three-phase low voltage induction motors, as well as line-start permanent-magnet motors. The efficiency of electric motors is based on the rated power. Therefore,-KWS XXX is applied to the power range of 0.12 kW - 375 kW. All technical constructions of electric motors are covered as long as they are rated for on-line operation and not just three-phase.

The standard IEC 60034-30-1 now includes five efficiency levels IE1, IE2, IE3, IE4, and IE5. IE1 represents the lowest efficiency, and IE5 represents the current highest level of efficiency. The new class IE5 is not yet defined in detail.

In order to achieve a significant market share, it is essential for high-efficiency motors to meet Kuwait energy conservation standard code (MEW/R-6/2014) for rated powers with respect to mechanical dimensions such as frame-size and flanges. This standard defines energy-efficiency classes independent of dimensional constraints. It may not be possible in all markets to produce motors with higher efficiency classes and maintain the mechanical dimensions of the Kuwait standards. Combinations of components (such as power drive systems) will need a combined efficiency rating. That rating should not be an IE code in order to avoid confusion. The efficiency level in this standard for 50 Hz is not always entirely consistent across all numbers of poles and over the whole power range.

2. TERMINOLOGY

2.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60034-1 and following apply.

2.1.1 Single-speed motor

Motor rated for 50Hz on-line operation. Single-speed motors may be capable of frequency converter operation with variable speed.

2.1.2 Multi-speed motor

Motor rated for 50Hz on-line operation that has multiple windings or a switchable winding to provide two or more different number of poles with different synchronous speeds.

2.1.3 Variable speed motor

Motor rated for a speed range and supplied by voltage of variable amplitude and frequency

2.1.4 Brake motor

Motor equipped with an electro-mechanical brake unit operating directly on the motor shafts without couplings

2.1.5 Geared motor

Motor equipped with an integral gearbox without couplings (i.e., the first gear wheel is fixed to the motor shaft)

2.1.6 Pump motor

Motor directly attached to a pump without couplings (i.e. the impeller is fixed to the motor shaft)

2.1.7 Average efficiency

Average efficiency value for a motor population of the same design and rating.

2.1.8 Nominal efficiency

Efficiency value required to meet a certain efficiency class according to the efficiency tables in this standard.

2.1.9 Rated efficiency

Efficiency value declared by the manufacturer.

2.2 Main Symbols

η_n is the nominal efficiency, %
η is the rated efficiency, %
f_N is the rated frequency, Hz
n_N is the rated speed, min^{-1}
P_N is the rated power, kW
T_N is the rated torque, Nm
U_N is the rated voltage, V

3. SCOPE

3.1 Motors covered in KWS XXX standards

KWS XXX specifies efficiency classes for single-speed electric motors that are rated according to IEC 60034-1 and rated for operation on a sinusoidal voltage supply. The scope of the standard, as well as its exceptions, is defined in the following Table 1.

Table 1: General Motors covered in KWS XXX standards

Number of poles	2, 4, 6, 8
Power range	0.12 – 375 kW
Efficiency Level	IE1 - Standard Efficiency IE2 - High Efficiency IE3 - Premium Efficiency IE4 - Super Premium Efficiency
Voltage	< 1000 V, 50 Hz
Degree of protection	All
Operating mode	S1 (permanent operation with constant load); motors, that are designed for different operating modes but can still be operated permanently with rated output.
Degree of temperature	-20°C - +60°C
Altitude	Up to 4000 m above sea level
Geared motors	Yes
Smoke Extraction Motors with a temperature class up to 400°C	Yes

3.2 Exceptions

- Motors completely integrated into a machine (for example pump, fan and compressor) that cannot be practically tested separately from the machine even with provision of a temporary end-shield and drive-end bearing. This means the motor shall: a) share common components (apart from connectors such as bolts) with the driven unit (for example, a shaft or housing) and b) not be designed in such a way as to enable the motor to be separated from the driven unit as an entire motor that can operate independently of the driven

unit. That is, for a motor to be excluded from this standard, the process of separation shall render the motor inoperative.

- Single-speed motors with 10 or more poles, as well as motors, that are designed for variable speed.
- Motors with mechanical commutators (e.g. DC-motors).
- Motors with integrated frequency converters (compact-drives), if the motor cannot be tested separately from the converter. The efficiency-classification of compact-drives has to be based on the complete PDS (Power Drive System) and therefore has to be defined in a separate norm.
- Brake motors, if the brake is an integral component of the inner motor-construction and can be neither removed nor separately operated during the testing of motor-efficiency.
- Submersible motor, which are specifically designed to be operated completely immersed in liquid.
- Smoke Extraction Motors with a temperature-class of over 300 °C.

3.3 Assumptions & Conditions KWS XXX

1. The rated efficiency and efficiency classes are based on 25 ˚C ambient temperature according to IEC 60034-2-1.
2. This standard establishes a set of limit efficiency values based on frequency, number of poles and motor power. No distinction is made between motor technologies, supply voltage or motors with increased insulation designed specifically for converter operation even though these motor technologies may not all be capable of reaching the higher efficiency classes (See Table 1). This makes different motor technologies fully comparable with respect to their energy efficient potential.
3. Regulators should consider the above constraints when assigning national minimum energy- efficiency performance standards (MEPS) with respect to any particular type of motor.
4. The efficiency of power-drive systems is not covered by this standard. In particular, motor losses due to harmonic content of the supply voltage, losses in cables, filters and frequency-converters, are not covered. Motors with flanges, feet and/or shafts with mechanical dimensions different from IEC 60072-1 are

covered by this standard. Also geared motors are covered by this standard including those incorporating non-standard shafts and flanges.

5. Totally enclosed air-over machines (TEAO), i.e. totally enclosed frame-surface cooled machines intended for exterior cooling by a ventilating means external to the machine, are covered by this standard. Efficiency testing of such motors may be performed with the fan removed and the cooling provided by an external blower with a similar airflow rate as the original fan.
6. A motor is not excluded when the motor and frequency-converter can be separated, and the motor can be tested independently of the converter.
7. Brake motors with a brake coil that is integrated into the flange of the motor are covered as long as it is possible to test motor efficiency without the losses of the brake (for example by dismantling the brake or by energizing the brake coil from a separate power source). When the manufacturer offers a motor of the same design with and without a brake the test of motor efficiency may be done on a motor without the brake. The determined efficiency may then be used as the rating of both motor and brake motor.

4. Efficiency

4.1 Determination

4.1.1 General

This standard deals with single speed motors operated on-line. Motors operated by frequency-converters may have higher losses as compared to on-line (sinusoidal) power supply due to the harmonic voltage content (for details see (IEC/TS 60034-25). In order to make efficiency class ratings comparable between different motor technologies, all tests according to this standard shall be performed on sinusoidal voltage. Efficiency and losses shall be tested in accordance with the preferred method of the individual motor type as given in IEC 60034-2-1.

4.1.2 Rated Motor Parameters (Voltages, Frequencies and Power)

The rated efficiency shall be determined at rated power P_N, rated voltage U_N and rated frequency f_N. Motors rated for an extended voltage tolerance (415 V ± 6%) shall be assigned a single rated efficiency, i.e. the extended tolerance shall be disregarded.

Motors with rated voltage/frequency combinations of the same magnetic flux and power, 240 V / 415 V (delta-star) or 230 V/460 V (double-star/start), shall have only one rated efficiency and efficiency class (IE code). Motors with more than one rated voltage/frequency/power combination should be assigned a rated efficiency and a rated efficiency-class (IE code) for each rated voltage/frequency/power combination.
However, as a minimum the lowest efficiency value and the associated IE code (of all rated voltage/frequency/power combinations) shall always be printed on the rating plate. All efficiency values and IE codes shall be available in the product documentation (catalogue or operating instructions).

4.1.3 Motors Auxiliary Devices

Most electric motors covered by this standard may be equipped with auxiliary devices such as shaft seals, external, mechanical brakes, back-stops and unidirectional bearings, speed sensors, tacho-generators in various combinations.
However, as long as these auxiliary devices are not an integral part of the basic motor design, the determination of efficiency in all possible combinations is not practical. Tests for efficiency of such modified standard motors shall be performed on basic with original cooling without auxiliary devices installed.

The losses of a separately driven fan are to be included in the efficiency determination procedure when the external fan is an integral part of the basic motor construction. When the external fan is just an optional add-on to a mass-produced motor, which normally carried a shaft-mounted fan, the losses of the basic motor (with the shaft-mounted fan) can be used.

Angular-contact bearings (thrust bearings) for vertical mounted motors may be replaced by standard bearings during efficiency testing. Such motors may be tested horizontally.

Some types of motors (such as geared motors, pump motors and others) are equipped with shaft seals to prevent ingress of oil or water into the motor. External seals shall be removed for efficiency testing. This applies only to seals that are accessible from the outside without dismantling of the motor (dismantling of the fan-cover and the fan is accepted).

Electro mechanical brakes shall be removed during testing of motor efficiency. When the motor construction prohibits a removal of the brake, the brake-coil

shall be energized from a separate power source and the energy consumption of the brake-coil shall be disregarded in the calculation of motor efficiency.

4.2 Rating

The efficiency declared by the manufacturer on the rating plate (rated efficiency) shall be greater or equal to the tested efficiency as defined in this standard (according to the efficiency class (IE code) on the rating plate).

The full-load efficiency of any motor, when tested at rated voltage and rated frequency shall not be less than the rated-/classification efficiency minus the tolerance of the total losses in accordance with IEC 60034-1.

It is recommended to report efficiencies at 50%, 75% and full load in the product documentation. For the purpose of this standard only the efficiency at rated power applies.

Variations in materials, manufacturing process and testing result in motor-to-motor efficiency variations for a given motor design; the full-load efficiency for a large population of motors of a single design is not a unique value but rather a band of efficiency. Therefore, the energy efficiency limits given in this standard are nominal.

4.3 Classification and marking

4.3.1 General

The designation of the energy efficiency class consists of the letters “IE” (short for International Energy Efficiency class), directly followed by a numeral representing the classification according to Table 2.

4.3.2 Efficiency classification

The standard defines four IE (International Efficiency) efficiency classes for single speed electric motors that are rated according to IEC 60034-1 or IEC 60079-0 (explosive atmospheres) and designed for operation on sinusoidal voltage.

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TABLE 2 – Efficiency Classification

Designation	Definition
IE1	Motors with a rated full-load efficiency equal to or exceeding the limits listed in 5.4.1.
IE2	Motors with a rated full-load efficiency equal to or exceeding the limits listed in 5.4.2.
IE3	Motors with a rated full-load efficiency equal to or exceeding the limits listed in 5.4.3.
IE4	Motors with a rated full-load efficiency equal to or exceeding the limits listed in 5.4.4.

4.3.3 Motors below IE1 efficiency

Some motors have rated efficiencies below the limits given in Tables 3 and 4. No marking of these motors shall be required.

4.3.4 Marking

The motors shall be durably marked with the following points, which should be mentioned on the nameplate:

1. The manufacture's name or mark
2. The original country of manufacture and the manufactured year
3. The manufacture's machine code
4. The number of phases
5. The rated efficiency and the IE code
6. The class of rating of machine if designed for other than rating for continuous running duty system
7. The rated output or range of rated output in the horsepower or watt.
8. The rated voltage or range of rated voltage in volts
9. The rated frequency or range in Hz
10. The rated consumed current or range of rated current in amperes

11. The maximum power factors
12. The rated speed or range
13. The power factor
14. The maximum ambient air temperature, if other than 40 ^{o}C, Temperature rise, and Insulation class
15. The altitude for which the machine is designed if exceeding 1000 m above sea level.
16. Frame size
17. IP protection
18. Bearing details
19. Greasing intervals
20. Mounting type

4.4 Tested limits for efficiency classes IE1, IE2, IE3 and IE4

4.4.1 Tested efficiency limit for IE1

Table 3 – Tested efficiency limits (%) for 50 Hz IE1

P_N kW	Number of poles/synchronous speed min $^{-1}$			
	2/3000	4/1500	6/1000	8/750
0.12	45.0	50.0	38.3	31.0
0.18	52.8	57.0	45.5	38.0
0.20	54.6	58.5	47.6	39.7
0.25	58.2	61.5	52.1	43.4
0.37	63.9	66.0	59.7	49.7
0.40	64.9	66.8	61.1	50.9
0.55	69.0	70.0	65.8	56.1
0.75	72.1	72.1	70.0	61.2
1.1	75.0	75.0	72.9	66.5
1.5	77.2	77.2	75.2	70.2
2.2	79.7	79.7	77.7	74.2
3	81.5	81.5	79.7	77.0

4	83.1	83.1	81.4	79.2
5.5	84.7	84.7	83.1	81.4
7.5	86.0	86.0	84.7	83.1
11	87.6	87.6	86.4	85.0
15	88.7	88.7	87.7	86.2
18.5	89.3	89.3	88.6	86.9
22	89.9	89.9	89.2	87.4
30	90.7	90.7	90.2	88.3
37	91.2	91.2	90.8	88.8
45	91.7	91.7	91.4	89.2
55	92.1	92.1	91.9	89.7
75	92.7	92.7	92.6	90.3
90	93.0	93.0	92.9	90.7
110	93.3	93.3	93.3	91.1
132	93.5	93.5	93.5	91.5
160	93.8	93.8	93.8	91.9
200	94.0	94.0	94.0	92.5
250	94.0	94.0	94.0	92.5
315	94.0	94.0	94.0	92.5
355	94.0	94.0	94.0	92.5
400	94.0	94.0	94.0	92.5

4.4.2 Tested efficiency limit for IE2

Table 4 – Tested efficiency limits (%) for 50 Hz IE2

P_N kW	Number of poles/synchronous speed min $^{-1}$			
	2/3000	4/1500	6/1000	8/750
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

4.4.3 Tested efficiency limit for IE3

Table 5 – Tested efficiency limits (%) for 50 Hz IE3

P_N kW	**Number of poles/synchronous speed min $^{-1}$**			
	2/3000	4/1500	6/1000	8/750
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

18.5	82.4	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	95.6	94.3
200 up to 1000	95.8	96.0	95.8	94.6

4.4.4 Tested efficiency limit for IE4

Table 6 – Tested efficiency limits (%) for 50 Hz IE4

P_N kW	Number of poles/synchronous speed min $^{-1}$			
	2/3000	4/1500	6/1000	8/750
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
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	96.5	96.7	96.3	95.4
250	96.5	96.7	96.5	95.4
315 up to 1000	96.5	96.7	96.6	95.4

4.4.5 Interpolation of nominal efficiency limits of intermediate rated powers for 50 Hz mains supply frequency

To determine normative nominal efficiency limits of 50Hz motors with rated powers not given in the tables above within the range of 0.12 kW up to 200 kW the following formula shall be applied.

$$\eta_N = A \cdot \left[\log_{10}\left(\frac{P_N}{1\,\text{kW}}\right)\right]^3 + B \cdot \left[\log_{10}\left(\frac{P_N}{1\,\text{kW}}\right)\right]^2 + C \cdot \log_{10}\left(\frac{P_N}{1\,\text{kW}}\right) + D$$

Where A. B. C. D = interpolation coefficients (see Tables 8 and 9); P_N is given in kW

The formula and interpolation coefficients were mathematically derived to create a best fitting curve for the desired nominal efficiency limits. They do not have a physical meaning. The resulting efficiency (%) shall be rounded to the nearest tenth. i.e.. XX. X (%)

Table 7–Interpolation coefficients for 0.12 kW up to 0.74 kW

IE code	Coefficients	8-poles 750/min	6-poles 1000/min	4-poles 1500/min	2-poles 3000/min
IE1	A	5.9466	–45.9652	16.7271	11.924
	B	7.9458	–87.1474	12.7136	6.3699
	C	40.441	–8.2383	25.947	30.0509
	D	66.146	68.7303	76.174	76.6136

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IE2	**A**	6.4855	–15.9218	17.2751	22.4864
	B	9.4748	–30.258	23.978	27.7603
	C	36.852	16.6861	35.5822	37.8091
	D	70.762	79.1838	84.9935	82.458
IE3	**A**	–0.5896	–17.361	7.6356	6.8532
	B	–25.526	–44.538	4.8236	6.2006
	C	4.2884	–3.0554	21.0903	25.1317
	D	75.831	79.1318	86.0998	84.0392
IE4	**A**	–4.9735	–13.0355	8.432	–8.8538
	B	–21.453	–36.9497	2.6888	–20.3352
	C	2.6653	–4.3621	14.6236	8.9002
	D	79.055	82.0009	87.6153	85.0641

Table 8 – Interpolation coefficients for 0.75 kW up to 200 kW

IE code	**Coefficients**	**8-poles** 750/min	**6-poles** 1000/min	**4-poles** 1500/min	**2-poles** 3000/min
IE1	**A**	2.4433	0.0786	0.5234	0.5234
	B	–13.8	–3.5838	–5.0499	–5.0499
	C	30.656	17.2918	17.4180	17.4180
	D	65.238	72.2383	74.3171	74.3171
IE2	**A**	2.1311	0.0148	0.0278	0.2972
	B	–12.029	–2.4978	–1.9247	–3.3454
	C	26.719	13.2470	10.4395	13.0651
	D	69.735	77.5603	80.9761	79.077
IE3	**A**	0.7189	0.1252	0.0773	0.3569
	B	–5.1678	–2.613	–1.8951	–3.3076
	C	15.705	11.9963	9.2984	11.6108
	D	77.074	80.4769	83.7025	82.2503
IE4	**A**	0.6556	0.3598	0.2412	0.34
	B	–4.7229	–3.2107	–2.3608	–3.0479
	C	13.977	10.7933	8.446	10.293
	D	80.247	84.107	86.8321	84.8208

5. Comparison between different Efficiency classes

Table 9: Minimum efficiency values defined in KWS XXX based on test methods specified in IEC 60034-1-30:2014 for frequency of 50 Hz

output	IE1				IE2				IE3				IE4			
KW	2Pole	4Pole	6Pole	8Pole	2Pole	4Pole	6Pole	8Pole	2Pole	4Pole	6Pole	8Pole	2Pole	4Pole	6Pole	8Pole
0.12	45.0	50.0	38.3	31.0	53.6	59.1	50.6	39.8	60.8	64.8	57.7	50.7	66.5	69.8	64.9	62.3
0.18	52.8	57.0	45.5	38.0	60.4	64.7	56.6	45.9	65.9	69.9	63.9	58.7	70.8	74.7	70.1	67.2
0.20	54.6	58.5	47.6	39.7	61.9	65.9	58.2	47.4	67.2	71.1	65.4	60.6	71.9	75.8	71.4	68.4
0.25	58.2	61.5	52.1	43.4	64.8	68.5	61.6	50.6	69.7	73.5	68.6	64.1	74.3	77.9	7.1	70.8
0.37	63.9	66.0	59.7	49.7	69.5	72.7	67.6	56.1	73.8	77.3	73.5	69.3	78.1	81.1	78.0	74.3
0.40	64.9	66.8	61.1	50.9	70.4	73.5	68.8	57.2	74.6	78.0	74.4	70.1	78.9	81.7	78.7	74.9
0.55	69.0	70.0	65.8	56.1	74.1	77.1	73.1	61.7	77.8	80.8	77.2	73.0	81.5	83.9	80.9	77.0
0.75	72.1	72.1	70.0	61.2	77.4	79.6	75.9	66.2	80.7	82.5	78.9	75.0	83.5	85.7	82.7	78.4
1.1	75.0	75.0	72.9	66.5	79.6	81.4	78.1	70.8	82.7	84.1	81.0	77.7	85.2	87.2	84.5	80.8
1.5	77.2	77.2	75.2	70.2	81.3	82.8	79.8	74.1	84.2	85.3	82.5	79.7	86.5	88.2	85.9	82.6
2.2	79.7	79.7	77.7	74.2	83.2	84.3	81.8	77.6	85.9	86.7	84.3	81.9	88.0	89.5	87.4	84.5
3	81.5	81.5	79.7	77.0	84.6	85.5	83.3	80.0	87.1	87.7	85.6	83.5	89.1	90.4	88.6	85.9
4	83.1	83.1	81.4	79.2	85.8	86.6	84.6	81.9	88.1	88.6	86.8	84.8	90.0	91.1	89.5	87.1
5.5	84.7	84.7	93.1	81.4	87.0	87.7	86.0	83.8	89.2	89.6	88.0	86.2	90.9	91.9	90.5	88.3
7.5	86.0	86.0	84.7	83.1	88.1	88.7	87.2	85.3	90.1	90.4	89.1	87.3	91.7	92.6	91.3	89.3
11	87.6	87.6	86.4	85.0	89.4	89.8	88.7	86.9	91.2	91.4	90.3	88.6	92.6	93.3	92.3	90.4
15	88.7	88.7	87.7	86.2	90.3	90.6	89.7	88.0	91.9	92.1	91.2	89.6	93.3	93.9	92.9	91.2
18.5	89.3	89.3	88.6	86.9	90.9	91.2	90.4	88.6	82.4	92.6	91.7	90.1	93.7	94.2	93.4	91.7
22	89.9	89.9	89.2	87.4	91.3	91.6	90.9	89.1	92.7	93.0	92.2	90.6	94.0	94.5	93.7	92.1
30	90.7	90.7	90.2	88.3	92.0	92.3	91.7	89.8	93.3	93.6	92.9	91.3	94.5	94.9	94.2	92.7
37	91.2	91.2	90.8	88.8	92.5	92.7	92.2	90.3	93.7	93.9	93.3	91.8	94.8	95.2	94.5	93.1
45	91.7	91.7	91.4	89.2	92.9	93.1	92.7	90.7	94.0	94.2	93.7	92.2	95.0	95.4	94.8	93.4
55	92.1	92.1	91.9	89.7	93.2	93.5	93.1	91.0	94.3	94.6	94.1	92.5	95.3	95.7	95.1	93.7
75	92.7	92.7	92.6	90.3	93.8	94.0	93.7	91.6	94.7	95.0	94.6	93.1	95.6	96.0	95.4	94.2
90	93.0	93.0	92.9	92.9	90.7	94.1	94.2	94.0	91.9	95.0	95.2	94.9	93.4	95.8	96.1	94.4
110	93.3	93.3	93.3	91.1	94.3	94.5	94.3	92.3	95.2	95.4	95.1	93.7	96.0	96.3	95.8	94.7
132	93.5	93.5	93.5	91.5	94.6	94.7	94.6	92.6	95.4	95.6	95.4	94.0	96.2	96.4	96.0	94.9
160	93.8	93.8	93.8	91.9	94.8	94.9	94.8	93.0	95.6	95.8	95.6	94.3	96.3	96.6	96.2	95.1
200	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.3	95.4
250	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.5	95.4
315	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
355	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
400	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
450	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
500-1000	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4

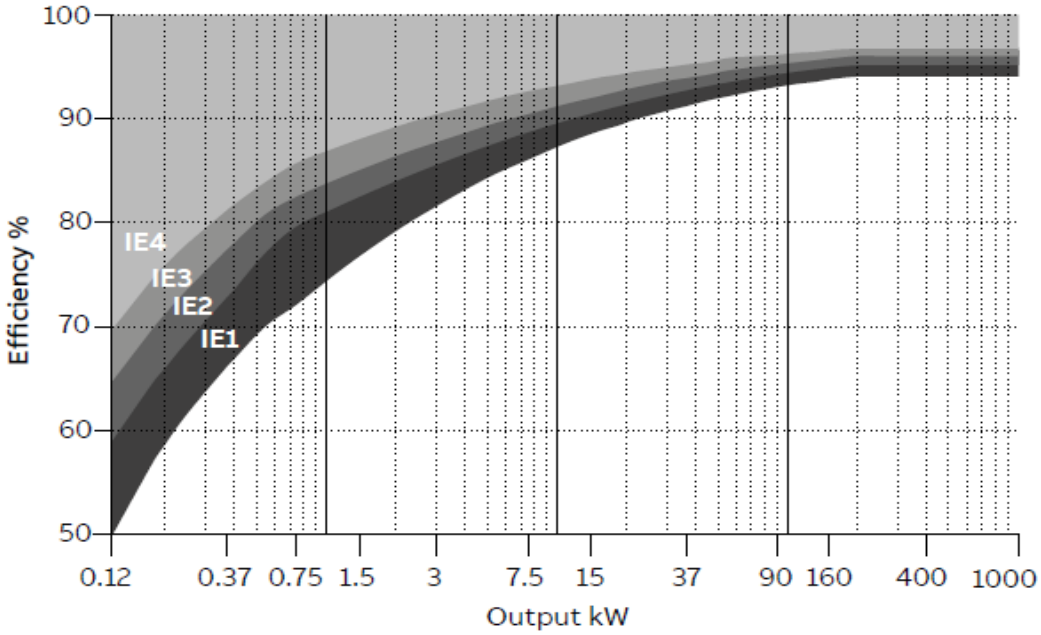

Figure 1: efficiency classes for 4 pole motors at 50 Hz (Source: ABB)

6. Registration:

6.1 General

Product registration is mandatory if motor is in the scope (including exempted motors) of the standard. whereby information about registration requirements will be available on the website of the Kuwait Public Authority for Industry. and reference shall be made to the separate registration forms and requirements.

Applications shall be submitted through energy Efficiency registration system electronically via the website.

The applications shall fulfil all updated requirements of the electronic registration system and any new requirement. procedure. and regulation required by the Public Authority for Industry.

6.2 Type of documents needed for registration under the scope of this standard for registration.

- Third party performance test report covering the submitted product as per the requirements of this KWS standard (report shall not be older than 3 years)
- Laboratory accreditation (ISO 17025) with scope of accreditation.
- Product specification data sheet.
- Product name plate design.
- Photos of the product

7. Sources

Normative References

The following documents. in whole or in part. are normatively referenced in this document and are indispensable for its application.

1. IEC 60034-1. Rotating electrical machines – Part 1: Rating and performance\
2. IEC 60034-2-1. Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles).
3. IEC/TS 60034-2-3. Rotating electrical machines – Part 23: Specific test methods for determining losses and efficiency of converter-fed AC induction motors.
4. IEC60034-6. Rotating electrical machines – Part-6: Methods of cooling (IC Code)
5. IEC/TS 60034-25. Rotating electrical machines – Part 25: Guidance for the design and performance of a.c motors specifically designed for converter supply
6. IEC 60038. IECCC standard voltages
7. IEC 60034-30-1: 2014 © IEC 2014
8. IEC 60079-0. Explosive atmospheres – Part 0: Equipment – General requirements
9. .SASO 2893 Rotating Electrical Machines Part 30-1: Efficiency classes of line operated AC motors (IE code)

Bibliography

IEC 60034-5. *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical achiness (IP code) – Classification*

IEC 60034-12. *Rotating electrical machines – Part 12: Starting performance of single-speed three-phase cage induction motors*

IEC/TS 60034-31:2010. *Rotating electrical machines – Part 31: Selection of energy-efficient motors including variable speed applications – Application guide*

IEC 60072-1. *Dimensions and output series for rotating electrical machines – Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080*

ISO 3. *preferred numbers – Series of preferred numbers.*

EN 12101-3. *Smoke and heat control system – Part 3: Specification for powered smoke and heat exhaust ventilators.*

EN 50347. *General purpose three-phase induction motors having standard dimensions and outputs – Frame numbers 56 to 315 and flange numbers 65 to 740*

EN 52800. *Energy efficiency for power drive systems. motor starters. power electronics and their driven applications*

JIS C 4212 (Japanese Industrial Standard). *Low voltage three-phase squirrel-cage high efficiency induction motors*

NBR 17094-1. *Rotating electrical machines – Induction motors – Specification*

NEMA MG1. *Motors and Generators*
SANS 1804-1 (South African Standard). *Induction motors – Part 1: IEC requirements.*

Saudi Standards. Metrology and Quality Organization (SASO)