ETHIOPIAN STANDARD

ES 6892:2021

Minimum Energy Performance Standard (MEPS) For 0.75 kW – 375 kW Three Phase 50Hz); AC Induction Squirrel Cage Motors

ICS:

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FOREWORD

It is the policy of the country to promote all round development driven by green energy and efficient use of energy. Even though the primary source of power generation in the country is green however, end use efficiency across all economic sectors including industrial sector is generally law. In the country's industrial sector motors have significant share from the total industrial electrical energy consumption. Recent study indicated that use of low grade electric motors is on the high side. It is therefore evident that there is huge potential to reduce energy waste through the use of energy efficient industrial motors, for this to happen appropriate policy intervention is necessary. To cope up with this and based on the mandate given to EEA by virtue of the Energy proclamation and the Energy regulation, EEA along with the stakeholders has set itself to define Minimum Energy Performance standard (MEPS) for three phase line operated AC induction motors with capacity ranging from 0.75 kW to 375 kW. This document lays out Minimum Energy Performance Standard (MEPS) to be equally complied by the local manufacturers and/or importers of electric AC motors to get their product qualified.

As evidenced elsewhere the defined MEOPS for electric motors This activity will lend services to gradually reduce the level of energy intensity in the industrial sector and facilitate development of market for efficient motors thereby contributing greatly towards energy conservation in the country and achieving the reality of tomorrow's "GREEN ETHIOPIAN".

(Mr. Getahun EEA)

Minimum Energy Performance Standard (MEPS) For 0.75 kW – 375KW Three Phase 50Hz AC Induction Squirrel Motors

1. Scope:

This Ethiopian Standard applies to single-speed three-phase cage induction motors with ratings from 0.75 kW and up to 375 kW rated for operation on a sinusoidal voltage supply and:

- have rated voltage U_N above 50 V up to 1 kV;
- have 2, 4 or 6 poles;
- are capable of continuous operation at their rated power with a temperature rise within the specified insulation temperature class;

NOTE 1: Most motors covered by this standard are rated for duty type S1 (continuous duty). However, some motors that are rated for other duty cycles are still capable of continuous operation at their rated power and these motors are also covered.

- are marked with any ambient temperature within the range of –20 °C to + 60 °C;

NOTE 2: The rated efficiency and efficiency classes are based on 25 °C ambient temperature according to IEC 60034-2-1.

NOTE 3: Motors rated for temperatures outside the range – 20 °C and + 60 °C are considered to be of special construction and are consequently excluded from this standard.

NOTE 4: Smoke extraction motors with a temperature class of up to and including 400 °C are covered by this standard.

- are marked with an altitude up to 4 000 m above sea level.

NOTE 5: The rated efficiency and efficiency class are based on a rating for altitudes up to 1000 m above sea level.

- Motors with flanges, feet and/or shafts with mechanical dimensions different from IEC 60072-1 are covered by this standard.
- Geared motors are covered by this standard including those incorporating non-standard shafts and flanges.
- (TEAO, IC418) Totally enclosed air-over machines, 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.

The MEPS requirements of this standard do not apply to the following:

- Single-speed motors with 8 or more poles or multi-speed motors.
- Motors with mechanical commutators (such as DC motors).
- 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.

- 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 integrated frequency-converters (compact drives) when the motor cannot be tested separately from the converter. Energy efficiency classification of compact drives shall be based on the complete product (PDS : Power Drive System) and will be defined in a separate standard.

NOTE 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.

- Brake motors when the brake is an integral part of the inner motor construction and can neither be removed nor supplied by a separate power source during the testing of motor efficiency.

NOTE 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.

- Submersible motors specifically designed to operate wholly immersed in a liquid.
- Smoke extraction motors with a temperature class above 400 °C.

2. Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ES IEC : 60034-1; Rotating electrical machines Part 1: Rating and Performance;

ES IEC : 60034-30-1 ; Efficiency classes of line operated AC motors;

ES IEC : 60034-2-I; Part2-1:Standard methods for determining losses and efficiency of rotating electrical machines from tests;

ES IEC: 60034-12; Starting performance of single-speed cage induction motors.

3. Terms & Definitions:

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

3.1.

Single-speed motor

motor rated for 50 Hz on-line operation

Note 1 to entry: Single-speed motors may be capable of frequency converter operation with variable speed.

3.2.

Multi-speed motor

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

3.3.

Variable speed motor

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

3.4.

Brake motor

Motor equipped with an electro-mechanical brake unit operating directly on the motor shaft Without couplings

3.5.

Geared motor

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

3.6.

Pump motor

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

3.7.

Average efficiency

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

3.8.

Nominal efficiency

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

3.9.

Rated efficiency

Efficiency value assigned by the manufacturer, equal to the nominal efficiency value or higher

3.10. Symbols

ηn is the nominal efficiency, %

ηN 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

*U*N is the rated voltage, V

4. Labeling and Marking

4.1. General

The manufacturers or suppliers shall declare the energy efficiency Class of their product on nameplate as per the requirement of ES IEC 60034-30-1standard and the test results.

4.2. Determination of claims of efficiency

The rated motor efficiency marked on a nameplate claimed shall not be less than the value obtained by a test undertaken by or for the supplier.

5. Minimum Energy Performance Standard (MEPS)

A motor does not comply with this standard if its measured efficiency is less than the value determined in **Clause 8.**

6. Testing

Efficiency and losses shall be tested in accordance with the preferred method of the individual motor type as given in ES IEC 60034-2-1.

7. Efficiency classification

The energy efficiency classification and corresponding nominal efficiency value as per ES IEC: 60034-30-1 shall be given in Table 1 and Table 2, 3 4 below respectively.

Table 1 : Efficiency classification

Designation	Definition
IE2	Motors with a rated full-load efficiency equal to or exceeding the limits listed Table 2
IE3	Motors with a rated full-load efficiency equal to or exceeding the limits listed in Table 3
IE4	Motors with a rated full-load efficiency equal to or exceeding the limits listed in Table 4
IE5	Envisaged for a future edition of this standard.

Table 2 – Nominal efficiency limits (%) for 50 Hz IE2

***P*N** kW	**Number of poles/synchronous speed** min–1		
	2/3000	**4/1500**	**6/1000**
0,75	77,4	79,6	75,9
1,1	79,6	81,4	78,1
1,5	81,3	82,8	79,8
2,2	83,2	84,3	81,8
3	84,6	85,5	83,3
4	85,8	86,6	84,6
5,5	87,0	87,7	86,0
7,5	88,1	88,7	87,2
11	89,4	89,8	88,7
15	90,3	90,6	89,7
18,5	90,9	91,2	90,4
22	91,3	91,6	90,9
30	92,0	92,3	91,7
37	92,5	92,7	92,2
45	92,9	93,1	92,7
55	93,2	93,5	93,1
75	93,8	94,0	93,7
90	94,1	94,2	94,0
110	94,3	94,5	94,3
132	94,6	94,7	94,6
160	94,8	94,9	94,8
200 up to 375	95,0	95,1	95,0

Table 3 – Nominal efficiency limits (%) for 50 Hz IE3

***P*N** kW	**Number of poles/synchronous speed** min–1		
	2/3000	**4/1500**	**6/1000**
0,75	80,7	82,5	78,9
1,1	82,7	84,1	81,0
1,5	84,2	85,3	82,5
2,2	85,9	86,7	84,3
3	87,1	87,7	85,6
4	88,1	88,6	86,8
5,5	89,2	89,6	88,0
7,5	90,1	90,4	89,1
11	91,2	91,4	90,3
15	91,9	92,1	91,2
18,5	92,4	92,6	91,7
22	92,7	93,0	92,2
30	93,3	93,6	92,9
37	93,7	93,9	93,3
45	94,0	94,2	93,7
55	94,3	94,6	94,1
75	94,7	95,0	94,6
90	95,0	95,2	94,9
110	95,2	95,4	95,1
132	95,4	95,6	95,4
160	95,6	95,8	95,6
200 up to 375	95,8	96,0	95,8

Table 3 – Nominal efficiency limits (%) for 50 Hz IE4

***P*N** kW	**Number of poles/synchronous speed** min–1		
	2/3000	**4/1500**	**6/1000**
0,75	83,5	85,7	82,7
1,1	85,2	87,2	84,5
1,5	86,5	88,2	85,9
2,2	88,0	89,5	87,4
3	89,1	90,4	88,6
4	90,0	91,1	89,5
5,5	90,9	91,9	90,5
7,5	91,7	92,6	91,3
11	92,6	93,3	92,3
15	93,3	93,9	92,9
18,5	93,7	94,2	93,4
22	94,0	94,5	93,7
30	94,5	94,9	94,2
37	94,8	95,2	94,5
45	95,0	95,4	94,8
55	95,3	95,7	95,1
75	95,6	96,0	95,4
90	95,8	96,1	95,6
110	96,0	96,3	95,8
132	96,2	96,4	96,0
160	96,3	96,6	96,2
200	96,5	96,7	96,3
250	96,5	96,7	96,5
315 up to 375	96,5	96,7	96,6

8. Minimum Energy Performance Standard (MEPS)

The minimum allowable values of energy efficiency for motor categories under this Ethiopian standard shall not be less than those specified for class IE2 requirements as defined in above **Table-2** at a rated full load.

9. Motors Repair, Maintenance and Replacement

During maintenance and replacement the minimum energy efficiency class (IE2) shall be maintained.

Annex A
Informative

Commercial Levels of Motor Energy Efficiency as defined in ES IEC-60034-30

This parameter for evaluating the efficacy level of subject motors is defined in the back drop of the above mentioned standard as follows;

Premium Efficiency	IE3
High Efficiency	IE2 Comparable to Eff1
Standard Efficiency	IE1 Comparable to Eff2.

The above standard also introduces IE4 (Super Premium Efficiency), however the products falling under this category are yet to be commercialized.