SLOVENSKI STANDARD
oSIST prEN IEC 60034-12:2023

01-junij-2023

Električni rotacijski stroji - 12. del: Zagonska zmogljivost indukcijskih motorjev s trifazno kletko z eno hitrostjo

Rotating electrical machines - Part 12: Starting performance of single-speed three-phase cage induction motors

Drehende elektrische Maschinen - Teil 12: Anlaufverhalten von Drehstrommotoren mit Käfigläufer ausgenommen polumschaltbare Motoren

Machines électriques tournantes - Partie 12: Caractéristiques de démarrage des moteurs triphasés à induction à cage à une seule vitesse

Ta slovenski standard je istoveten z: **prEN IEC 60034-12:2023**

ICS:

29.160.30 Motorji Motors

oSIST prEN IEC 60034-12:2023 **en,fr,de**

IEC

2/2132/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 60034-12 ED4**	
DATE OF CIRCULATION: **2023-04-28**	CLOSING DATE FOR VOTING: **2023-07-21**
SUPERSEDES DOCUMENTS: **2/2107/CD, 2/2130/CC**	

IEC TC 2 : ROTATING MACHINERY

SECRETARIAT: United Kingdom	SECRETARY: Mr Charles Whitlock
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 9	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING

☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of

- any relevant patent rights of which they are aware and to provide supporting documentation,
- any relevant “in some countries” clauses to be included should this proposal proceed. Recipients are reminded that the enquiry stage is the final stage for submitting "in some countries" clauses. See AC/22/2007.

TITLE:

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

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES –

Part 12: Starting performance of single-speed three-phase cage induction motors

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60034-12 has been prepared by IEC technical committee 2: Rotating machinery.

This fourth edition cancels and replaces the second edition, published in 2016. It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

Clause or subclause	Change
Table 6	Aligned with the requirements for explosion protected motors from TC31 WG27
12	New clause on methods for measuring locked-rotor current and torque
Annex A	New informative annex on the general current and torque characteristics with locked rotor
Annex B	New informative annex on correction of voltage and frequency

The text of this standard is based on the following documents:

CDV	Report on voting
2/1789/CDV	2/1821A/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60034 series, published under the general title *Rotating electrical machines,* can be found on the IEC website.

NOTE A table of cross-references of all IEC TC 2 publications can be found in the IEC TC 2 dashboard on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

ROTATING ELECTRICAL MACHINES –

Part 12: Starting performance of single-speed three-phase cage induction motors

1 Scope

This part of IEC 60034 specifies the parameters for eight designs of starting performance of single-speed three-phase 50 Hz or 60 Hz cage induction motors in accordance with IEC 60034-1 that:

– have a rated voltage up to 1 000 V;
– are intended for direct-on-line or star-delta starting;
– are rated on the basis of duty type S1;
– are constructed to any degree of protection as defined in IEC 60034-5 and explosion protection.

This document also applies to dual voltage motors provided that the flux saturation level is the same for both voltages.

The values of torque, apparent power and current given in this document are limiting values (that is, minimum or maximum without tolerance).

NOTE 1 It is not expected that all manufacturers will produce machines for all eight designs. The selection of any specific design in accordance with this document will be a matter of agreement between the manufacturer and the purchaser.

NOTE 2 Designs other than the eight specified may be necessary for particular applications.

NOTE 3 It should be noted that values given in manufacturers' catalogues may include tolerances in accordance with IEC 60034-1.

NOTE 4 The values tabled for locked rotor apparent power are based on r.m.s. symmetrical steady state locked rotor currents. The start of the motor leads to transient asymmetrical currents in the whole supply, so called inrush currents, which may range from 1,8 to 2,8 times the steady state locked rotor value. The current peak and decay time are a function of the motor design and switching angle. Similar effects can occur during the switchover from star to delta operation. A more detailed description is provided in Annex A.

NOTE 5 The application of the test methods described in clause 12 of this standard may be applied to cage induction motors outside the scope of this standard, as well. However, special care must be taken in such cases to prevent overheating of the stator or the rotor winding depending on the concrete method and parameters chosen.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line-operated AC motors (IE-code)*

IEC 60079-7:2015, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
rated torque
T_N
torque the motor develops at its shaft end at rated output and speed

[SOURCE: IEC 60050-411:1996, 411-48-05]

3.2
locked-rotor torque
T_l
smallest measured torque the motor develops at its shaft end with the rotor locked, over all its angular positions, at rated voltage and frequency

[SOURCE: IEC 60050-411:1996, 411-48-06]

3.3
pull-up torque
T_u
smallest steady-state asynchronous torque which the motor develops between zero speed and the speed which corresponds to the breakdown torque, when the motor is supplied at the rated voltage and frequency

Note 1 to entry: This definition does not apply to those motors whose torque continually decreases with increase in speed.

Note 2 to entry: In addition to the steady-state asynchronous torques, harmonic synchronous torques, which are a function of rotor load angle, will be present at specific speeds. At such speeds, the accelerating torque may be negative for some rotor load angles. Experience and calculation show this to be an unstable operating condition and therefore harmonic synchronous torques do not prevent motor acceleration and are excluded from this definition.

3.4
breakdown torque
T_b
maximum steady-state asynchronous torque which the motor develops without an abrupt drop in speed, when the motor is supplied at the rated voltage and frequency

Note 1 to entry: This definition does not apply to those motors whose torque continually decreases with increase in speed.

3.5
rated output
P_N
value of the output included in the rating

3.6
rated voltage
U_N
value of the voltage included in the rating

3.7
locked rotor apparent power
S_l
apparent power input with the motor held at rest at rated voltage and frequency after the inrush currents have decayed to a symmetrical system of current

3.8
locked rotor current
I_l
current with the motor held at rest at rated voltage and frequency after the inrush currents have decayed to a symmetrical system of current

4 Symbols

Symbol	Quantity
I_l	Locked rotor current
J	External moment of inertia
J_M	Moment of inertia of motor under test
n	Rotational speed
p	Number of pole pairs
P_1	Power at the motor terminals during test method c)
$P_{1,g}$	Power at the generator terminals during test method a)
P_{Fe}	Motor iron losses during test method c)
P_L	Motor I²R losses during test method c)
$P_{T,g}$	Total losses of the generator during test method a)
P_N	Rated output
S_l	Locked rotor apparent power
T_N	Rated torque
T_l	Locked rotor torque
T_u	Pull-up torque
T_b	Breakdown torque
T_{fw}	Motor friction and windage torque during test method c)
U_N	Rated voltage

5 Designation

5.1 General

Motors designed according to this document are classified according to 5.2 to 5.7. The letters used to specify the different designs stand for:

N: normal starting torque

H: high starting torque

Y: star-delta starting

E: motors utilizing extended / higher locked rotor apparent power and current to achieve efficiency classes of IE3 or higher according to IEC 60034-30-1

5.2 Design N

Normal starting torque three-phase cage induction motors, intended for direct-on-line starting, having 2, 4, 6 or 8 poles, rated from 0,12 kW to 1 600 kW.

5.3 Design NE

Normal starting torque three-phase cage induction motors having higher locked rotor apparent power than design N, intended for direct-on-line starting, having 2, 4, 6 or 8 poles, rated from 0,12 kW to 1 600 kW. ‘

5.4 Designs NY and NEY

Motors similar to designs N or NE, respectively, but intended for star-delta starting. For these motors in star-connection, minimum values for T_l and T_u are 25 % of the values of design N or NE, respectively, see Table 1.

5.5 Design H

High starting torque three-phase cage induction motors with 4, 6 or 8 poles, intended for direct-online starting, rated from 0,12 kW to 160 kW at a frequency of 60 Hz.

5.6 Design HE

High starting torque three-phase cage induction motors having higher locked rotor apparent power than design H, with 4, 6 or 8 poles, intended for direct-online starting, rated from 0,12 kW to 160 kW at a frequency of 60 Hz.

5.7 Designs HY and HEY

Motors similar to designs H or HE, respectively, but intended for star-delta starting. For these motors in star-connection, minimum values for T_l and T_u are 25 % of the values of design H or HE, respectively, see Table 5.

6 Design N requirements

6.1 Torque characteristics

The starting torque is represented by three characteristic features. These features shall be in accordance with the appropriate values given in Table 1 or Table 6. The values in Table 1 and Table 6 are minimum values at rated voltage. Higher values are allowed.

The motor torque at any speed between zero and that at which breakdown torque occurs shall be not less than 1,3 times the torque obtained from a curve varying as the square of the speed and being equal to rated torque at rated speed. However, for 2-pole motors with type of protection 'Ex eb – increased safety' having a rated output greater than 100 kW, the motor torque at any speed between zero and that at which breakdown torque occurs shall not be less than 1,3 times the torque obtained from a curve varying as the square of the speed and being equal to 70 % rated torque at rated speed. For motors with type of protection 'Ex eb', the three characteristic torques shall be in accordance with the appropriate values given in Table 6.

NOTE The factor 1,3 has been chosen with regard to an undervoltage of 10 % in relation to the rated voltage at the motor terminals during the acceleration period.

6.2 Locked rotor current and apparent power

The locked rotor apparent power shall be not greater than the appropriate value given in Table 2. The values given in Table 2 are independent of the number of poles and are maximum values at rated voltage. For motors with type of protection 'e', locked rotor apparent power shall be in accordance with the appropriate values specified in IEC 60079-7.

The locked rotor current is calculated from the locked rotor apparent power according to:

$$I_{\mathrm{l}} = \frac{S_{\mathrm{l}}}{P_{\mathrm{N}}} \times \frac{P_{\mathrm{N}}}{\sqrt{3}U_{\mathrm{N}}} \quad (1)$$

NOTE The advantage of specifying $S_{\mathrm{l}}/P_{\mathrm{N}}$ instead of $I_{\mathrm{l}}/I_{\mathrm{N}}$ is that the locked rotor current can be calculated from rated power and rated voltage only, not requiring to know the rated current which depends on quantities such as power factor and efficiency that are usually not known in early stages of a project.

6.3 Starting requirements

Motors shall be capable of withstanding two starts in succession (coasting to rest between starts) from cold conditions and one start from hot after running at rated conditions. The retarding torque due to the driven load will be in each case proportional to the square of the speed and equal to the rated torque at rated speed with the external moment of inertia given in Table 4 or Table 7.

In each case, a further start is permissible only if the motor temperature before starting does not exceed the steady temperature at rated load. However, for 2-pole motors with type of protection 'Ex eb – increased safety' having a rated output greater than 100 kW, the retarding torque due to the driven load is proportional to the square of the speed and equal to 70 % rated torque at rated speed, with the external moment of inertia given in Table 7. After this starting, load with rated torque is possible.

NOTE It should be recognized that the number of starts should be minimized since these affect the life of the motor.

7 Design NE starting requirements

The starting requirements are as for design N, except that the limits for locked rotor apparent power in Table 3 apply, as increasing efficiency values require physically increasing values for locked rotor apparent power.

8 Designs NY and NEY starting requirements

The starting requirements are as for designs N or NE, respectively. In addition, however, a reduced retarding torque is necessary as the starting torque in ‘star connection’ may be insufficient to accelerate some loads to an acceptable speed.

NOTE It should be recognized that the number of starts should be minimized since these affect the life of the motor.

9 Design H requirements

9.1 Starting torque

The starting torque is represented by three characteristic features. These features shall be in accordance with the appropriate values given in Table 5. These values are minimum values at rated voltage. Higher values are allowed.

9.2 Locked rotor current and apparent power

The locked rotor apparent power shall be not greater than the appropriate value given in Table 2. The values in Table 2 are independent of the number of poles and are maximum values at rated voltage.