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

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CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 6
3 Terms and definitions 7
4 Symbols 8
5 Designation 9
5.1 General 9
5.2 Design N 9
5.3 Design NE 9
5.4 Designs NY and NEY 9
5.5 Design H 9
5.6 Design HE 9
5.7 Designs HY and HEY 10
6 Design N requirements 10
6.1 Torque characteristics 10
6.2 Locked rotor current and apparent power 10
6.3 Starting requirements 10
7 Design NE starting requirements 11
8 Designs NY and NEY starting requirements 11
9 Design H requirements 11
9.1 Starting torque 11
9.2 Locked rotor current and apparent power 11
9.3 Starting requirements 11
10 Design HE starting requirements 12
11 Designs HY and HEY starting requirements 12
12 Determination of current and torque from measurement 12
12.1 Locked-rotor current and locked-rotor torque 12
12.2 Breakdown torque 12
12.3 Torque-speed curve and current-speed curve 13
12.3.1 General 13
12.3.2 Torque-speed and current-speed curves from direct measurement (method a) 13
12.3.3 Torque-speed and current-speed curves from acceleration (method b) 13
12.3.4 Torque-speed and current-speed curves from measured input power (method c) 14
12.4 Correction of data for tests performed at reduced voltage and/or other than rated frequency 14
Annex A (informative) Current and torque characteristics with locked rotor 20
Annex B (informative) Correction method for test done on reduced voltage 24
Bibliography 25

Figure A.1 – Locked-rotor current in multiples of rated current versus time 20
Figure A.2 – Locked-rotor torque in multiples of rated torque versus time 21
Figure A.3 – Locked-rotor torque in cNm versus rotor position in °; left: preferable number of rotor slots, right: less preferable number of rotor slots 21

Figure A.4 – Locked-rotor torque in cNm versus rotor position in ° 22
Figure A.5 – Time -courses (in s) of rotational speed (upper left), torque (lower left), phase voltage (upper right) and phase current (lower right) during a star-delta start-up 23

Table 1 – Minimum values of torques for design N 15
Table 2 – Maximum values of locked rotor apparent power for designs N and H 16
Table 3 – Maximum values of locked rotor apparent power for designs NE and HE 16
Table 4 – External moment of inertia (J) 17
Table 5 – Minimum values of torques for design H 18
Table 6 – Minimum values of torques for design N motors with type of protection 'Ex eb – increased safety' 18
Table 7 – External moment of inertia (J) for motors with type of protection 'Ex eb – increased safety' 19

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.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60034-12:2016. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

This fourth edition cancels and replaces the third edition published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

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 International Standard is based on the following documents:

Draft	Report on voting
2/2132/CDV	2/2150A/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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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~~ can be necessary for particular applications.

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

NOTE 4 The values tabled for locked rotor apparent power are based on RMS symmetrical steady state locked rotor currents.~~; at motor switch on there will be a one-half cycle asymmetrical instantaneous~~ The start of the motor leads to transient asymmetrical currents in the whole supply, so called inrush currents, the peak ~~current~~ value of which ~~may~~ can 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.

The application of the test methods described in Clause 12 can be applied to cage induction motors outside the scope of this document. However, special care shall 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 60034-1:2022, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-5:2020, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*

IEC 60034-30-1:2014, *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"*
IEC 60079-7:2015/AMD1:2017

ISO 80000-4:2019, *Quantities and units – Part 4: Mechanics*

3 Terms and definitions

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

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://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

[SOURCE: IEC 60050-411:1996, 411-48-42, modified – The notes 1 and 2 to entry have been modified.]

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~~ can 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

[SOURCE: IEC 60050-411:1996, 411-48-43, modified – The notes 1 and 2 to entry have been modified.]

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 power included in the rating

Note 1 to entry: The terms rated value and rating are defined in IEC 60034-1:2022, 3.1 and 3.2 (see also IEC 60050-411:1996, 411-51-23 and 411-51-24).

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

Note 1 to entry: The terms rated value and rating are defined in IEC 60034-1:2022, 3.1 and 3.2 (see also IEC 60050-411:1996, 411-51-23 and 411-51-24).

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

[SOURCE: IEC 60050-411:1996, 411-48-49, modified – "after the inrush currents have decayed to a symmetrical system of current" has been added.]

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

IEC 60034-12

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

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



IEC 60034-12:2024-05(en-fr)

CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 6
3 Terms and definitions 7
4 Symbols 8
5 Designation 9
5.1 General 9
5.2 Design N 9
5.3 Design NE 9
5.4 Designs NY and NEY 9
5.5 Design H 9
5.6 Design HE 9
5.7 Designs HY and HEY 10
6 Design N requirements 10
6.1 Torque characteristics 10
6.2 Locked rotor current and apparent power 10
6.3 Starting requirements 10
7 Design NE starting requirements 11
8 Designs NY and NEY starting requirements 11
9 Design H requirements 11
9.1 Starting torque 11
9.2 Locked rotor current and apparent power 11
9.3 Starting requirements 11
10 Design HE starting requirements 12
11 Designs HY and HEY starting requirements 12
12 Determination of current and torque from measurement 12
12.1 Locked-rotor current and locked-rotor torque 12
12.2 Breakdown torque 12
12.3 Torque-speed curve and current-speed curve 13
12.3.1 General 13
12.3.2 Torque-speed and current-speed curves from direct measurement (method a) 13
12.3.3 Torque-speed and current-speed curves from acceleration (method b) 13
12.3.4 Torque-speed and current-speed curves from measured input power (method c) 14
12.4 Correction of data for tests performed at reduced voltage and/or other than rated frequency 14
Annex A (informative) Current and torque characteristics with locked rotor 20
Annex B (informative) Correction method for test done on reduced voltage 24
Bibliography 25

Figure A.1 – Locked-rotor current in multiples of rated current versus time 20
Figure A.2 – Locked-rotor torque in multiples of rated torque versus time 21
Figure A.3 – Locked-rotor torque in cNm versus rotor position in °; left: preferable number of rotor slots, right: less preferable number of rotor slots 21

Figure A.4 – Locked-rotor torque in cNm versus rotor position in ° 22
Figure A.5 – Time -courses (in s) of rotational speed (upper left), torque (lower left), phase voltage (upper right) and phase current (lower right) during a star-delta start-up 23

Table 1 – Minimum values of torques for design N 15
Table 2 – Maximum values of locked rotor apparent power for designs N and H 16
Table 3 – Maximum values of locked rotor apparent power for designs NE and HE 16
Table 4 – External moment of inertia (J) 17
Table 5 – Minimum values of torques for design H 18
Table 6 – Minimum values of torques for design N motors with type of protection 'Ex eb – increased safety' 18
Table 7 – External moment of inertia (J) for motors with type of protection 'Ex eb – increased safety' 19

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ROTATING ELECTRICAL MACHINES –

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

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ISO 80000-4:2019, *Quantities and units – Part 4: Mechanics*

SOMMAIRE

AVANT-PROPOS 28
1 Domaine d'application 30
2 Références normatives 30
3 Termes et definitions 31
4 Symboles 32
5 Désignation 33
5.1 Généralités 33
5.2 Moteurs de conception N 33
5.3 Moteurs de conception NE 33
5.4 Moteurs de conception NY et NEY 33
5.5 Moteurs de conception H 33
5.6 Moteurs de conception HE 34
5.7 Moteurs de conception HY et HEY 34
6 Exigences pour les moteurs de conception N 34
6.1 Caractéristiques de couple 34
6.2 Courant et puissance apparente à rotor bloqué 34
6.3 Exigences de démarrage 35
7 Exigences de démarrage pour les moteurs de conception NE 35
8 Exigences de démarrage pour les moteurs de conception NY et NEY 35
9 Exigences pour les moteurs de conception H 35
9.1 Couple de démarrage 35
9.2 Courant et puissance apparente à rotor bloqué 35
9.3 Exigences de démarrage 35
10 Exigences de démarrage pour les moteurs de conception HE 36
11 Exigences de démarrage pour les moteurs de conception HY et HEY 36
12 Détermination du courant et du couple par mesurage 36
12.1 Courant à rotor bloqué et couple à rotor bloqué 36
12.2 Couple de décrochage 36
12.3 Courbe couple-vitesse et courbe courant-vitesse 37
12.3.1 Généralités 37
12.3.2 Courbes couple-vitesse et courant-vitesse déterminées par mesurage direct (méthode a) 37
12.3.3 Courbes couple-vitesse et courant-vitesse déterminées à partir de l'accélération (méthode b) 38
12.3.4 Courbes couple-vitesse et courant-vitesse déterminées à partir de la puissance d'entrée mesurée (méthode c) 38
12.4 Correction des données pour les essais réalisés à tension réduite et/ou autre que la fréquence assignée 39
Annexe A (informative) Caractéristiques de courant et de couple avec rotor bloqué 45
Annexe B (informative) Méthode de correction pour essai réalisé sur tension réduite 49
Bibliographie 50

Figure A.1 – Courant à rotor bloqué dans des multiples de courant assigné en fonction du temps 45
Figure A.2 – Couple à rotor bloqué dans des multiples de couple assigné en fonction du temps 46

Figure A.3 – Couple à rotor bloqué en cNm en fonction de la position du rotor en °; gauche: nombre choisi d'encoches rotoriques, droite: mauvais choix du nombre d'encoches rotoriques 46

Figure A.4 – Couple à rotor bloqué en cNm en fonction de la position du rotor en ° 47

Figure A.5 – Allures temporelles (en s) de la vitesse de rotation (en haut à gauche), du couple (en bas à gauche), de la tension de phase (en haut à droite) et du courant de phase (en bas à droite) pendant un démarrage étoile-triangle 48

Tableau 1 – Valeurs minimales des couples pour les moteurs de conception N 40

Tableau 2 – Valeurs maximales de la puissance apparente à rotor bloqué pour les moteurs de conception N et H 40

Tableau 3 – Valeurs maximales de la puissance apparente à rotor bloqué pour les moteurs de conception NE et HE 41

Tableau 4 – Moment d'inertie extérieur (J) 42

Tableau 5 – Valeurs minimales des couples pour les moteurs de conception H 43

Tableau 6 – Valeurs minimales des couples pour les moteurs de conception N à type de protection 'Ex eb – sécurité augmentée' 43

Tableau 7 – Moment d'inertie extérieur (J) pour les moteurs à type de protection 'Ex eb – sécurité augmentée' 44

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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MACHINES ÉLECTRIQUES TOURNANTES –

Partie 12: Caractéristiques de démarrage des moteurs triphasés à induction à cage à une seule vitesse

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L'IEC 60034-12 a été établie par le comité d'études 2 de l'IEC: Machines tournantes. Il s'agit d'une Norme internationale.

Cette quatrième édition annule et remplace la troisième édition parue en 2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

Article ou paragraphe	Modification
Tableau 6	Aligné sur les exigences du CE 31, GT 27, concernant les moteurs antidéflagrants
12	Nouvel article relatif aux méthodes de mesure du courant et du couple à rotor bloqué
Annexe A	Nouvelle annexe informative relative aux caractéristiques générales de courant et de couple à rotor bloqué
Annexe B	Nouvelle annexe informative relative à la correction de la tension et de la fréquence

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
2/2132/CDV	2/2150A/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications/.

Une liste de toutes les parties de la série IEC 60034, publiées sous le titre général *Machines électriques tournantes*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

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MACHINES ÉLECTRIQUES TOURNANTES –

Partie 12: Caractéristiques de démarrage des moteurs triphasés à induction à cage à une seule vitesse

1 Domaine d'application

La présente partie de l'IEC 60034 spécifie les paramètres de huit conceptions de caractéristiques de démarrage de moteurs triphasés à induction à cage à une seule vitesse fonctionnant à 50 Hz ou 60 Hz conformes à l'IEC 60034-1, qui:

– ont des tensions assignées jusqu'à 1 000 V;
– sont prévus pour démarrage direct ou étoile-triangle;
– sont dimensionnés pour le service type S1;
– peuvent avoir n'importe quel degré de protection tel qu'il est défini dans l'IEC 60034-5 et incluant les protections contre les explosions.

Ce document s'applique également aux moteurs bitension à condition que le niveau de saturation du flux soit le même aux deux tensions.

Les valeurs de couple, de puissance apparente et de courant données dans le présent document sont des valeurs limites (c'est-à-dire minimales ou maximales sans tolérance).

NOTE 1 Les constructeurs ne sont pas tenus de fabriquer des machines correspondant à ces huit conceptions. Le choix d'une conception spécifique répondant au présent document fera l'objet d'un accord entre le constructeur et son client.

NOTE 2 Des conceptions autres que les huit spécifiées peuvent s'avérer nécessaires pour des applications particulières.

NOTE 3 Les valeurs données dans les catalogues des constructeurs peuvent inclure des tolérances conformes à l'IEC 60034-1.

NOTE 4 Les valeurs calculées pour la puissance apparente à rotor bloqué sont fondées sur les courants à rotor bloqué en régime établi symétriques en valeur efficace. Le démarrage du moteur entraîne des pics de courants asymétriques transitoires dans toute l'alimentation, appelés courants d'appel, dont la valeur peut fluctuer entre 1,8 et 2,8 fois la valeur à rotor bloqué en régime établi. La crête de courant et le temps de descente dépendent de la conception du moteur et de l'angle de commutation. Des effets semblables peuvent se produire lors du passage du fonctionnement en étoile au fonctionnement en triangle. Une description plus détaillée est fournie à l'Annexe A.

Les méthodes d'essai décrites à l'Article 12 peuvent également être appliquées aux moteurs à induction à cage qui n'entrent pas dans le domaine d'application du présent document. Toutefois, des précautions particulières doivent être prises dans de tels cas afin d'empêcher la surchauffe du stator ou de l'enroulement du rotor, selon la méthode concrète et les paramètres choisis.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60034-1:2022, *Machines électriques tournantes – Partie 1: Caractéristiques assignées et caractéristiques de fonctionnement*

IEC 60034-5:2020, *Machines électriques tournantes – Partie 5: Degrés de protection procurés par la conception intégrale de machines électriques tournantes (code IP) – Classification*

IEC 60034-30-1:2014, *Machines électriques tournantes – Partie 30-1: Classes de rendement pour les moteurs à courant alternatif alimentés par le réseau (code IE)*

IEC 60079-7:2015, *Atmosphères explosives – Partie 7: Protection du matériel par sécurité augmentée "e"*
IEC 60079-7:2015/AMD1:2017

ISO 80000-4:2019, *Grandeurs et unités – Partie 4: Mécanique*