

This is a preview - click here to buy the full publication



IEC 60034-12

Edition 4.0 2024-05
REDLINE VERSION

INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.160.01

ISBN 978-2-8322-8990-7

Warning! Make sure that you obtained this publication from an authorized distributor.

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.
- 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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

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.

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.

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

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**

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.
- 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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

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.

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.

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

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 can be necessary for particular applications.

NOTE 3 Values given in manufacturers' catalogues 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. The start of the motor leads to transient asymmetrical currents in the whole supply, so called inrush currents, the peak value of which 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 60034-12:2024 © IEC 2024

– 7 –

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*

SOMMAIRE

AVANT-PROPOS	28
1 Domaine d'application	30
2 Références normatives	30
3 Termes et définitions	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

MACHINES ÉLECTRIQUES TOURNANTES –

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

AVANT-PROPOS

- 1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
- 3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
- 4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 9) L'IEC attire l'attention sur le fait que la mise en application du présent document peut entraîner l'utilisation d'un ou de plusieurs brevets. L'IEC ne prend pas position quant à la preuve, à la validité et à l'applicabilité de tout droit de brevet revendiqué à cet égard. À la date de publication du présent document, l'IEC n'a pas reçu notification qu'un ou plusieurs brevets pouvaient être nécessaires à sa mise en application. Toutefois, il y a lieu d'avertir les responsables de la mise en application du présent document que des informations plus récentes sont susceptibles de figurer dans la base de données de brevets, disponible à l'adresse <https://patents.iec.ch>. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié tout ou partie de tels droits de propriété.

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

- reconduit,
- supprimé, ou
- révisé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de ce document indique qu'il contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer ce document en utilisant une imprimante couleur.

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*