
Električni rotacijski stroji - 18-41. del: Kvalificiranje in preskusi pri obvladovanju kakovosti električnih izolacijskih sistemov brez delne razelektritve (tip I) v električnih rotacijskih strojih, ki jih napajajo napetostni pretvorniki (IEC 60034-18-41:2014)

Rotating electrical machines - Part 18-41: Qualification and quality control tests for partial discharge free (Type I) electrical insulation systems used in rotating electrical machines fed from voltage converters (IEC 60034-18-41:2014)

iTeh STANDARD PREVIEW

(standardizirani)
Drehende elektrische Maschinen - Teil 18-41: Qualifizierung und Qualitätsprüfungen für teilentladungsfreie elektrische Isoliersysteme (Typ I) in drehenden elektrischen Maschinen, die von Spannungsumrichtern gespeist werden (IEC 60034-18-41:2014)

<https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014>

Machines électriques tournantes - Partie 18-41: Qualification et essais de contrôle qualité pour des systèmes d'isolation électrique sans décharge partielle (Type I) utilisés dans des machines électriques tournantes alimentées par des convertisseurs de tension (CIE 60034-18-41:2014)

Ta slovenski standard je istoveten z: EN 60034-18-41:2014

ICS:

29.080.30	Izolacijski sistemi	Insulation systems
29.160.01	Rotacijski stroji na splošno	Rotating machinery in general

SIST EN 60034-18-41:2014 en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 60034-18-41:2014](#)

<https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014>

EUROPEAN STANDARD

EN 60034-18-41

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2014

ICS 29.160

English Version

Rotating electrical machines - Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters - Qualification and quality control tests
(IEC 60034-18-41:2014)

Machines électriques tournantes - Partie 18-41: Systèmes d'isolation électrique sans décharge partielle (Type I) utilisés dans des machines électriques tournantes alimentées par des convertisseurs de tension - Essais de qualification et de contrôle qualité
(CEI 60034-18-41:2014)

Drehende elektrische Maschinen - Teil 18-41: Qualifizierung und Qualitätsprüfungen für teilentladungsfreie elektrische Isoliersysteme (Typ I) in drehenden elektrischen Maschinen, die von Spannungsumrichtern gespeist werden
(IEC 60034-18-41:2014)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

This European Standard was approved by CENELEC on 2014-04-10. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

<https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-36df3449-7e69-4808-a067>

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 2/1728/FDIS, future edition 1 of IEC 60034-18-41, prepared by IEC/TC 2 "Rotating machinery" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60034-18-41:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-01-10
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-04-10

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

iTeh STANDARD PREVIEW
Endorsement notice
(standards.iteh.ai)

The text of the International Standard IEC 60034-18-41:2014 was approved by CENELEC as a European Standard without any modification.

SIST EN 60034-18-41:2014
<https://standards.iteh.ai/catalog/standards/sist/36d13449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014>

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60034-18-1	2010	Rotating electrical machines Part 18-1: Functional evaluation of insulation systems - General guidelines	EN 60034-18-1	2010
IEC 60034-18-21	-	Rotating electrical machines Part 18-21: Functional evaluation of insulation systems - Test procedures for wire-wound windings - Thermal evaluation and classification	EN 60034-18-21	-
IEC 60034-18-31	-	Rotating electrical machines Part 18-31: Functional evaluation of insulation systems - Test procedures for form-wound windings - Thermal evaluation and classification	EN 60034-18-31	-
IEC 60172	-	Test procedure for the determination of the temperature index of enamelled winding wires	EN 60172	-
IEC 60664-1	-	Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests	EN 60664-1	-
IEC/TS 60034-18-42	-	Rotating electrical machines Part 18-42: Qualification and acceptance tests for partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters	CLC/TS 60034-18-42	-
IEC/TS 60034-25	2007	Rotating electrical machines Part 25: Guidance for the design and performance of a.c. motors specifically designed for converter supply	CLC/TS 60034-25	2008

IEC/TS 60034-27	-	Rotating electrical machines Part 27: Off-line partial discharge measurements on the stator winding insulation of rotating electrical machines	CLC/TS 60034-27	-
IEC/TS 61800-8	-	Adjustable speed electrical power drive systems Part 8: Specification of voltage on the power interface	-	-
IEC/TS 61934	-	Electrical insulating materials and systems - Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses	-	-

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 60034-18-41:2014](https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014)

<https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014>



IEC 60034-18-41

Edition 1.0 2014-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Rotating electrical machines –
Part 18-41: Partial discharge free electrical insulation systems (Type I) used in
rotating electrical machines fed from voltage converters – Qualification and
quality control tests**

[SIST EN 60034-18-41:2014](https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-77201126430/sist-en-60034-18-41-2014)

[https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-](https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-77201126430/sist-en-60034-18-41-2014)

[77201126430/sist-en-60034-18-41-2014](https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-77201126430/sist-en-60034-18-41-2014)

**Machines électriques tournantes –
Partie 18-41: Systèmes d'isolation électrique sans décharge partielle (Type I)
utilisés dans des machines électriques tournantes alimentées par des
convertisseurs de tension – Essais de qualification et de contrôle qualité**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX



ICS 29.160

ISBN 978-2-8322-1416-9

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	10
4 Machine terminal voltages arising from converter operation.....	13
5 Electrical stresses in the insulation system of machine windings	17
5.1 General.....	17
5.2 Voltages stressing the phase/phase insulation	18
5.3 Voltages stressing the phase/ground insulation.....	18
5.4 Voltages stressing the turn and strand insulation	18
5.5 Mechanisms of insulation degradation	19
6 Types of machine insulation	20
7 Stress categories for Type I insulation systems used in converter fed machines	20
8 Design qualification and type tests for Type I insulation systems	22
8.1 General.....	22
8.2 Design qualification test.....	22
8.3 Type test.....	22
9 Test equipment.....	22
9.1 PD measurement at power frequency.....	22
9.2 PD measurement during voltage impulses.....	22
9.3 Voltage impulse generators.....	23
9.4 Sensitivity	23
9.5 PD tests.....	23
9.5.1 Power frequency voltage	23
9.5.2 Impulse excitation.....	23
10 Qualification of the design of Type I insulation systems	23
10.1 General.....	23
10.2 Approach	24
10.2.1 General	24
10.2.2 Twisted pair or equivalent arrangement	24
10.2.3 Motorette (random wound) or formette (form-wound)	24
10.2.4 Complete windings	24
10.3 Preparation of test objects	25
10.3.1 General	25
10.3.2 Turn/turn insulation samples.....	25
10.3.3 Motorette/formette test samples or complete windings	25
10.4 Design qualification tests	26
10.4.1 General	26
10.4.2 Pre-diagnostic tests.....	26
10.4.3 Diagnostic tests.....	26
10.4.4 Ageing cycle	26
10.4.5 PD tests	26
10.5 Pass criterion for the design qualification test	27
11 Type test procedure for Type I insulation systems	27
11.1 General.....	27

11.2	Power frequency PD tests.....	27
11.3	Impulse PD tests.....	28
12	Routine tests.....	28
13	Analysis, reporting and classification.....	28
Annex A (informative) Derivation of possible terminal voltages in service for a converter-fed machine.....		29
A.1	Calculation of d.c. bus voltage.....	29
A.2	Calculation of maximum peak voltages for a 2-level converter.....	30
Annex B (normative) Derivation of test voltages for Type I insulation systems.....		32
B.1	Stress categories.....	32
B.2	Requirements for the applied impulse voltage.....	32
B.3	Enhancement factors for PD tests.....	33
B.4	Voltage for design qualification and type tests.....	34
B.5	Examples of maximum peak/peak operating voltages.....	37
B.6	Calculation of test voltages.....	37
Annex C (normative) Derivation of allowable voltages in service.....		39
C.1	Impulse voltage insulation class (IVIC) of the machine.....	39
C.2	Impulse voltage insulation class assigned in special designs.....	39
Bibliography.....		41

iTeh STANDARD PREVIEW

Figure 1 – Voltage impulse waveshape parameters.....	13
Figure 2 – Five step phase to phase voltage at the terminals of a machine fed by a 3-level converter.....	15
Figure 3 – Jump voltage (U_j) at the machine terminals associated with a converter drive.....	15
Figure 4 – Voltage enhancement at the terminals of a motor due to reflection as a function of cable length for various impulse rise times.....	17
Figure 5 – Example of a random wound design.....	18
Figure 6 – Example of a form-wound design.....	18
Figure 7 – Worst case voltage stressing the turn/turn insulation in a variety of random wound stators as a function of the rise time of the impulse.....	19
Figure A.1 – Circuit diagram for a converter/machine system.....	29
Figure B.1 – Forbidden zone (shaded) for impulse tests.....	33
Figure B.2 – Examples of test waveforms.....	33
Figure B.3 – Comparison of phase/phase, phase/ground, and turn/turn voltages for a 2-level converter.....	35
Figure B.4 – Impulse test voltage waveforms and the levels for applying the same peak/peak voltage of $2aU_j$ on the turn/turn insulation (schematic representation).....	36
Figure B.5 – Test voltages for phase/ground and turn/turn impulse tests using a unipolar impulse.....	38
Table 1 – Common ranges of characteristics of the terminal voltages of converter fed machines.....	14
Table 2 – Definition of symbols.....	14
Table 3 – Influence of features of the machine terminal voltage on components of Type I insulation systems.....	21
Table 4 – Stress categories for Type I insulation systems based on a 2-level converter.....	21
Table 5 – Allowable voltage waveforms for testing system components.....	25

Table A.1 – Examples of maximum peak voltages.....	31
Table B.1 – Summary of stress categories.....	32
Table B.2 – Summary of enhancement factors to be applied to the operating voltages.....	34
Table B.3 – Maximum peak/peak operating voltages related to U_{dc} for a 2-level converter according to the stress categories of Table 4	36
Table B.4 – Examples of maximum peak/peak operating voltage for a 500 V r.m.s. rated winding fed from a 2-level converter, according to the stress categories of Table 4.....	37
Table B.5 – Examples of maximum peak/peak test voltage for a 500 V rated winding fed from a 2-level converter, according to the stress categories of Table 4 and with EF 1,25	37
Table B.6 – Turn/turn PD test levels for special windings and twisted pairs.....	38
Table C.1 – Maximum allowable operating voltage at the machine terminals in units of U_N ...	39

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 60034-18-41:2014](https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014)

<https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES –

**Part 18-41: Partial discharge free electrical insulation systems (Type I)
used in rotating electrical machines fed from voltage converters –
Qualification and quality control tests**

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 60034-18-41 has been prepared by IEC technical committee 2: Rotating machinery.

IEC 60034-18-41 cancels and replaces IEC/TS 60034-18-41 (2006).

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

FDIS	Report on voting
2/1728/FDIS	2/1738/RVD

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.

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 web site 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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 60034-18-41:2014](https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014)

<https://standards.iteh.ai/catalog/standards/sist/36df3449-7e69-4808-a067-18b808105430/sist-en-60034-18-41-2014>

INTRODUCTION

The approval of electrical insulation systems for use in rotating electrical machines driven from voltage converters is set out in two IEC documents. They divide the systems into those which are not expected to experience partial discharge activity within specified conditions in their service lives (Type I) and those which are expected to withstand partial discharge activity in any part of the insulation system throughout their service lives (Type II). For both Type I and Type II insulation systems, the drive system integrator (the person responsible for co-ordinating the electrical performance of the entire drive system) shall inform the machine manufacturer what voltage will appear at the machine terminals in service. The machine manufacturer will then decide upon the severity of the tests appropriate for qualifying the insulation system. The severity is based on the impulse rise time, the peak to peak voltage and, in the case of Type II systems, the impulse repetition rate. After installation of the converter/machine system, it is recommended that the drive system integrator measures the phase/phase and phase/ground voltages between the machine terminals and ground to check for compliance.

IEC 60034-18-41

The Type I systems are dealt with in this standard. They are generally used in rotating machines rated at 700 V r.m.s. or less and tend to have random wound windings. The procedures described here are directed at:

- Qualification of the insulation system.
- Type and routine testing of the complete windings of service machines.

Before undertaking any testing, the machine manufacturer shall decide upon the level of severity that the system will be required to withstand. The severity is based on how large the voltage overshoot and how short the impulse rise time will be at the machine terminals. The machine designer then makes a choice from a table in which the range of expected overshoot voltage is divided into bands. Testing is performed at the extreme value of each band. A default value of 0,3 μ s is attributed to the impulse rise time. Other values of impulse rise time or voltage overshoot are dealt with as special cases.

In qualification testing, the insulation system is used to construct various representative test objects. These are subjected to the range of tests described in IEC 60034-18-21 or IEC 60034-18-31 with the addition of a high frequency voltage test and a partial discharge test. For the latter, it may be necessary to use impulse test equipment, as described in IEC/TS 61934. If the test object is partial discharge free under the specified test conditions at the end of the sequence of testing, the insulation system is qualified for the severity band that has been selected.

Type and optional routine tests are performed on complete windings to demonstrate that they are partial discharge free under sinewave or impulse voltage conditions (as appropriate) for the band of severity that the manufacturer has chosen. An impulse voltage insulation class is then assigned to the machine. A mechanism is described for dealing with special cases.

IEC/TS 60034-18-42

The tests for qualification and acceptance of electrical insulation systems chosen for Type II rotating electrical machines are described in this technical specification. These insulation systems are generally used in rotating machines and tend to have form-wound coils, mostly rated above 700 V r.m.s. The qualification procedure is completely different from that used for Type I insulation systems and involves destructive ageing of insulated test objects under accelerated conditions. The rotating machine manufacturer requires a life curve for the insulation system that can be interpreted to provide an estimate of life under the service conditions with converter drive. Great importance is attached to the qualification of any stress grading system that is used and testing here should be performed under repetitive impulse conditions. If the insulation system can be shown to provide an acceptable life under the