IEC 60034-18-41

Edition 1.1 2019-06
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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

IEC 60034-18-41:2014-03+AMD1:2019-06 CSV(en-fr)

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IEC 60034-18-41 edition 1.1 contains the first edition (2014-03) [documents 2/1728/FDIS and 2/1738/RVD], its amendment 1 (2019-06) [documents 2/1949/FDIS and 2/1957/RVD] and its corrigendum (2020-12).

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

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

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.

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- withdrawn,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

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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.

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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 μs 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

appropriate ageing conditions, it is qualified for use. Acceptance testing is performed on coils made using this insulation system when subjected to a voltage endurance test.

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

1 Scope

This part of IEC 60034 defines criteria for assessing the insulation system of stator/rotor windings which are subjected to voltage-source pulse-width-modulation (PWM) drives. It applies to stator/rotor windings of single or polyphase AC machines with insulation systems for converter operation.

It describes qualification tests and quality control (type and routine) tests on representative samples or on completed machines which verify fitness for operation with voltage source converters.

This standard does not apply to:

– rotating machines which are only started by converters;
– rotating electrical machines with rated voltage ≤ 300 V r.m.s.;
– rotor windings of rotating electrical machines operating at ≤ 200 V (peak).

2 Normative references

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.

IEC 60034-18-1:2010, *Rotating electrical machines – Part 18-1: Functional evaluation of insulation systems – General guidelines*

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*

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 of insulation systems used in rotating machines*

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*[1]

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*

[1] This TS is in the process of being transformed into an IS.

IEC/TS 60034-27, *Rotating electrical machines – Part 27: Off-line partial discharge measurements on the stator winding insulation of rotating electrical machines*

IEC 60172, *Test procedure for the determination of the temperature index of enamelled winding wires*

IEC 60664-1, *Insulation co-ordination for equipment within low voltage systems – Part 1: Principles, requirements and tests*

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*

3 Terms and definitions

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

3.1
partial discharge
PD
electric discharge that only partially bridges the insulation between electrical conductors

Note 1 to entry: It may occur inside the insulation or adjacent to an electrical conductor.

3.2
partial discharge inception voltage
PDIV
lowest voltage at which partial discharges are initiated in the test arrangement when the voltage applied to the test object is gradually increased from a lower value at which no such discharges are observed

Note 1 to entry: With sinusoidal applied voltage, the PDIV is defined as the r.m.s. value of the voltage. With impulse voltages, the PDIV is defined as the peak to peak voltage.

3.3
partial discharge extinction voltage
PDEV
voltage at which partial discharges are extinguished in the test arrangement when the voltage applied to the test object is gradually decreased from a higher value at which such discharges are observed

Note 1 to entry: With sinusoidal applied voltage, the PDEV is defined as the r.m.s. value of the voltage. With impulse voltages, the PDEV is defined as the peak to peak voltage.

3.4
peak (impulse) voltage
$\boldsymbol{U}_{\mathrm{p}}$
maximum numerical value of voltage reached during a unipolar voltage impulse (e.g. U_{p} in Figure 1)

Note 1 to entry: For bi-polar voltage impulses, it is half the peak to peak voltage (see Figure 2).

Note 2 to entry: The definition of peak to peak voltage is clarified in Clause 4.

3.5
steady state impulse voltage magnitude
$\boldsymbol{U}_{\mathbf{a}}$
final magnitude of the voltage impulse (see Figure 1)