

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

**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**

**Machines électriques tournantes –
Partie 18-42: Essais de qualification et d'acceptation des systèmes d'isolation
électrique résistants aux décharges partielles (Type II) utilisés dans des
machines électriques tournantes alimentées par convertisseurs de tension**



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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Fax: +41 22 919 03 00

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 60034-18-42, which is a Technical Specification, has been prepared by IEC technical committee 2: Rotating machinery.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
2/1482/DTS	2/1502/RVC

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

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

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The approval of electrical insulation systems for use in rotating electrical machines driven from voltage converters is set out in two Technical Specifications. They separate 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 should 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.

IEC/TS 60034-18-41

Type I insulation systems are dealt with in IEC/TS 60034-18-41. They are generally used in rotating machines rated at less than 700 V r.m.s. and tend to have random wound stators. In this Technical Specification, the necessary normative references and definitions are given together with a review of the effects arising from converter operation. Having established the technical foundation for the evaluation procedure, the conceptual approach is then described.

IEC/TS 60034-18-42

In this Technical Specification, the tests for qualification and acceptance of electrical insulation systems chosen for Type II rotating electrical machines are described. 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 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.

This Technical Specification should be read in conjunction with IEC/TS 60034-18-41, which provides a background to the technology of converter drive/machine systems.

The winding insulation systems intended for converter-fed machines and converter technologies are evolving rapidly. In addition, there is on-going research into the best ways to test such insulation systems. It is expected therefore that there will be improvements in these Technical Specifications over the next few years.

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 Scope

This Technical Specification defines criteria for assessing the insulation system of stator/rotor windings of single or polyphase AC machines which are subjected to repetitive impulse voltages, such as pulse width modulation (PWM) converters, and expected to withstand partial discharge activity during service. It specifies electrical qualification and acceptance tests on representative samples which verify fitness for operation with voltage-source converters.

This document does not apply to:

- Rotating machines which are fed by converters only for starting.
- Electrical equipment and systems for traction.

NOTE Although this Technical Specification deals with voltage-source converters, it is recognised that there are other types of converters that can create repetitive impulse voltages. For these converters, a similar approach to testing can be used if needed.

2 Normative references

The following referenced documents are indispensable for the application 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 60034-18-1, *Rotating electrical machines – Functional evaluation of insulation systems – Part 18-1: General guidelines*

IEC 60034-18-32, *Rotating electrical machines – Functional evaluation of insulation systems – Part 18-32: Test Procedures for form-wound windings – Electrical evaluation of insulation systems used in machines up to and including 50 MVA and 15 kV*

IEC/TS 60034-18-41, *Rotating electrical machines – Part 18-41: Qualification and type tests for Type I electrical insulation systems used in rotating electrical machines when fed from voltage converters*

IEC 60216-3, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

IEC/TS 61251, *Electrical insulating materials – A.C. voltage endurance evaluation – Introduction*

IEC 61800-4, *Adjustable speed electrical power drive systems – Part 4: General requirements – Rating specifications for a.c. power drive systems above 1 000 V a.c. and not exceeding 35 kV*

IEC 62068-1, *Electrical insulating systems – Electrical stresses produced by repetitive impulses – Part 1: General method of evaluation of electrical endurance*

IEC 62539, *Guide for the statistical analysis of electrical insulation breakdown data*

3 Terms and definitions

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

3.1

voltage endurance coefficient

symbol: n

exponent of the inverse power model or exponential model on which the relationship between life and stressing voltage amplitude for a specific insulation system depends

3.2

life

time to failure

3.3

stress grading material

material generally having a non-linear resistivity characteristic, applied to the endwindings of stators to reduce the maximum surface electrical stress

3.4

corona protection material

material which is used to coat a stator bar within the slot portion of the stator core to avoid slot discharges

3.5

impulse rise time

symbol: t_r

time for the voltage impulse to go from 0 % to 100 % (See Figure 1)

NOTE Unless otherwise stated, it is estimated as 1,25 times the time for the voltage to rise from 10 % to 90 %.

3.6

electrical insulation system

insulating structure containing one or more electrical insulating materials together with associated conducting parts employed in an electrotechnical device

[IEC 62068-1]

3.7

(electric) stress

electric field in V/mm

3.8

rated voltage

symbol: U_N

voltage assigned, generally by the manufacturer, for a specified operating condition of a machine

3.9

fundamental frequency

first frequency, in the spectrum obtained from a Fourier transform of a periodic time function, to which all the frequencies of the spectrum are referred

NOTE For the purposes of this Technical Specification, the fundamental frequency of the machine terminal voltage is the one defining the speed of the converter-fed machine.