

**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  
(IEC/TS 60034-18-42:2008)**

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  
(CEI/TS 60034-18-42:2008)

Drehende elektrische Maschinen -  
Teil 18-42: Qualifizierungs- und  
Abnahmeprüfungen  
teilentladungsresistenter Isoliersysteme  
(Typ II) von drehenden elektrischen  
Maschinen, die von Spannungsumrichtern  
gespeist werden  
(IEC/TS 60034-18-42:2008)

This Technical Specification was approved by CENELEC on 2011-01-25.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

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**CENELEC**

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

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## Foreword

The text of the Technical Specification IEC/TS 60034-18-42:2008, prepared by IEC TC 2, Rotating machinery, was submitted to the formal vote and was approved by CENELEC as CLC/TS 60034-18-42 on 2011-01-25.

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

The following date was fixed:

- latest date by which the existence of the CLC/TS  
has to be announced at national level (doa) 2011-07-25

Annex ZA has been added by CENELEC.

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## Endorsement notice

The text of the Technical Specification IEC/TS 60034-18-42:2008 was approved by CENELEC as a Technical Specification without any modification.

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

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     | -           | Rotating electrical machines -<br>Part 18-1: Functional evaluation of insulation<br>systems - General guidelines                                                                              | EN 60034-18-1  | -           |
| IEC 60034-18-32    | -           | Rotating electrical machines -<br>Part 18-32: Functional evaluation of insulation<br>systems - Test procedures for form-wound<br>windings - Evaluation of electrical endurance                | EN 60034-18-32 | -           |
| IEC/TS 60034-18-41 | -           | Rotating electrical machines -<br>Part 18-41: Qualification and type tests for<br>Type I electrical insulation systems used in<br>rotating electrical machines fed from voltage<br>converters | -              | -           |
| IEC 60216-3        | -           | Electrical insulating materials - Thermal<br>endurance properties -<br>Part 3: Instructions for calculating thermal<br>endurance characteristics                                              | EN 60216-3     | -           |
| IEC/TS 61251       | -           | Electrical insulating materials - A.C. voltage<br>endurance evaluation - Introduction                                                                                                         | -              | -           |
| IEC 61800-4        | -           | Adjustable speed electrical power drive<br>systems -<br>Part 4: General requirements - Rating<br>specifications for a.c. power drive systems<br>above 1 000 V a.c. and not exceeding 35 kV    | EN 61800-4     | -           |
| IEC 62068-1        | -           | Electrical insulation systems - Electrical<br>stresses produced by repetitive impulses -<br>Part 1: General method of evaluation of<br>electrical endurance                                   | EN 62068-1     | -           |
| IEC 62539          | -           | Guide for the statistical analysis of electrical<br>insulation breakdown data                                                                                                                 | -              | -           |

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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 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.