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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Rotating electrical machines –
Part 15: Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines

Machines électriques tournantes –
Partie 15: Niveaux de tenue au choc électrique des bobines de stator préformées des machines tournantes à courant alternatif

IEC 60034-15:2009

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

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CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 6
2 Terms and definitions 6
3 Impulse voltage withstand levels 6
4 Sample tests 7
4.1 General 7
4.2 Impulse voltage withstand test of the interturn insulation 7
4.3 Lightning impulse voltage withstand test of the main insulation 8
4.4 Power-frequency voltage withstand test 8
5 Routine tests 8
5.1 Coils 8
5.2 Complete stators 8
Annex A (informative) Principles involved in the specification of impulse voltage withstand levels and test procedures 9
Annex B (informative) Testing details 10
Bibliography 12

Figure B.1 – Example of the test circuit for sample tests 10
Figure B.2 – Example of the test circuit for routine tests 11
Figure B.3 – Examples of the waveforms from undamaged and short-circuited coils tested directly connected in the stator core 11

Table 1 – Impulse voltage withstand levels for sample form-wound coils used in a.c. rotating machines 7

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES –

Part 15: Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines

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International Standard IEC 60034-15 has been prepared by IEC technical committee 2: Rotating machinery.

This third edition cancels and replaces the second edition published in 1995 and constitutes a technical revision. The principal technical changes are as follows.

- Change of title to clarify that it is form-wound coils that are being tested rather than machines.
- Removal of the limitation on voltage in the Scope.
- Additional definitions for consistency with IEC 60060-1.
- Reduction in tolerances for the risetime of the steep-fronted impulse voltage.
- Guidance on test levels for coils to be used in converter driven machines.
- Guidance on voltage levels for routine tests.
- Additional figures to show testing details and oscillograms of normal and faulty coils.

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

FDIS	Report on voting
2/1534/FDIS	2/1547/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 on the IEC TC 2 dashboard 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

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- replaced by a revised edition, or
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INTRODUCTION

IEC 60071-1 specifies general requirements for the phase to earth insulation of equipment in three phase a.c. systems and states that each apparatus committee is responsible for specifying the insulation levels and test procedures for its equipment, taking into consideration the recommendations of IEC 60071-1. The object of IEC 60034-15 is to specify requirements for rotating electrical machines. Experience has shown that the values given in this standard meet the insulation requirements for the essential stresses in service. An explanation of the principles adopted in preparing these requirements is given in Annex A. This standard is not intended for soft-start machines.

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ROTATING ELECTRICAL MACHINES –

Part 15: Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines

1 Scope

This part of IEC 60034 relates to a.c. machines incorporating form-wound stator coils. It specifies the test procedures and voltages to be applied to the main and interturn insulation of sample coils.

2 Terms and definitions

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

2.1
sample test
test carried out on coils in new condition which adequately represent the configuration of the finished item to be used in the machine for the purpose of evaluating the manufacturing procedures and processes incorporated in the insulation system

2.2
routine test
test carried out on all coils of the machine

2.3
form-wound stator coil
coil which is preformed to shape, insulated and substantially completed before insertion into the stator

2.4
front time
T_1
time for the impulse voltage to rise from 0 % to 100 % of the peak value and defined as 1,67 times the interval between the instants when the impulse is 30 % and 90 % of the peak value

2.5
time-to-half value
T_2
interval between the origin and the instant when the voltage has decreased to half the peak value

3 Impulse voltage withstand levels

Impulse voltage withstand levels for specific rated voltages shall be calculated in accordance with the formula given in Note 2 of Table 1. Table 1 gives the impulse voltage withstand levels for some common rated voltages rounded to the nearest whole number. The test levels for converter-fed machines depend upon how the rated voltage has been assigned by the manufacturer. It may be appropriate to increase the test levels by a factor to allow for the maximum overshoot which is likely to arise on the voltage at the machine terminals, as described in IEC 60034-18-42. This factor may be as high as 1,7 for a 3-level converter but lower if there are more levels.

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Table 1 – Impulse voltage withstand levels for sample form-wound coils used in a.c. rotating machines

Rated voltage	Rated lightning-impulse voltage withstand (peak) (see Notes 1 and 2)	Rated steep-front-impulse voltage withstand (peak) (see Notes 3 and 4)
U_N	U_P	U'_P
kV	kV	kV
2,3	14	9
3	17	11
3,3	18	12
4	21	14
6	29	19
6,6	31	20
10	45	29
11	49	32
13,2	58	38
13,8	60	39
15	65	42

NOTE 1 The levels in Column 2 are based on a standard lightning impulse having a front time of 1,2 µs ± 30 %, a time-to-half-value of 50 µs ± 20 % and a peak value of the impulse voltage U_p ±3 % as specified in IEC 60060-1.

NOTE 2 The levels in Column 2 are obtained by using the formula: $U_P = 4\ U_N + 5$ kV.

NOTE 3 The levels in Column 3 are based on an impulse having a front time of 0,2 ± 0,1 µs up to 35 kV. Above 35 kV, the front time is 0,2 µs with a tolerance of +0,3 µs/–0,1 µs.

NOTE 4 The levels in Column 3 are obtained by application of the formula: $U'_P = 0{,}65\ U_P$.

NOTE 5 The levels in Column 3 have been deemed appropriate for stresses related to circuit breaker operation that could occur in service. They may not be adequate for special operating conditions (e.g. interrupted start or direct connection to overhead lines). In such cases the windings should either be designed to withstand other impulse levels or be protected in an appropriate way.

4 Sample tests

4.1 General

These tests are carried out as an indirect proof of compliance as explained in Clause A.3 of Annex A. The test coils shall have completed their manufacturing process, including corona protection layer and stress grading if used, and shall be either embedded in earthed slots or fitted with the slot portion wrapped in earthed conducting tape or foil. The number of sample coils shall be at least two. Examples of test circuits for individual coils and for coils assembled in stators are shown in Clauses B.1 and B.2.

All sample coils shall withstand the electrical tests described below. In the case of a failure, the manufacturer shall investigate the cause. Failure in an impulse test may be detected from the shape of the signal seen on an oscilloscope. Examples of signals from normal and short-circuited coils are shown in Clause B.3.

4.2 Impulse voltage withstand test of the interturn insulation

The impulse test of the interturn insulation shall be carried out by applying a steep-fronted-impulse voltage between the two terminals of the sample coils (Table 1 Column 3).

The interturn test voltage shall be generated by the damped oscillatory discharge of a capacitor. The number of switching operations shall be at least five. The front time of the first voltage peak at the terminals of the sample coil shall be 0,2 ± 0,1 µs up to a test voltage of 35 kV. For test voltages above 35 kV, the front time shall be 0,2 µs with a tolerance of +0,3 µs/ –0,1 µs. The front time of the last voltage impulse applied during a test should be checked for compliance.

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