IEC 60034-18-42

Edition 1.0 2020-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

Rotating electrical machines – Part 18-42: Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters – Qualification tests

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

IEC 60034-18-42:2017-02/AMD1:2020-08(en-fr)

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COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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FOREWORD

This amendment has been prepared by IEC Technical Committee 2: Rotating machinery.

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

FDIS	Report on voting
2/1998/FDIS	2/2008/RVD

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

3 Terms and definitions

Replace the existing definitions with the following new definitions:

3.11
impulse voltage repetition rate
f
average of the inverse of the time between two successive impulses of the same polarity, whether unipolar or bipolar, in a considered set of pulses, for example for one period

3.18
impulse voltage insulation class for Type II insulation systems
IVIC
peak to peak voltage classes 1, 2, 3, 4, 5, 6, 7, S including certain time parameters for reliable operation, assigned by the manufacturer in relation to the rated voltage for a specified converter-driven machine and indicated in its documentation and, if applicable, on its rating plate

3.29
maximum allowable peak to peak phase to ground voltage
$U_{\mathbf{IVIC}}$
maximum allowable peak to peak phase to ground voltage in service, according to the IVIC-specification

Add the following new definition:

3.30
test voltage factor
TVF
maximum allowable peak to peak operating phase-ground-voltages in units of U_N, divided by $2\sqrt{2}$

Replace the existing Table 1 with the following:

Table 1 – Examples of the measured values of the characteristics of the terminal voltages for two converter-fed machines

Machine rating	3,3 kV	6,6 kV
Measured peak to peak voltage on the phase to ground insulation	7,9 kV	13,9 kV
Fundamental frequency	50/60 Hz	50/60 Hz
Impulse rise time at the motor terminals	1 µs	3 µs
Impulse repetition rate	1 kHz	900 Hz
IVIC required to qualify the insulation for this service (see Table D.2, column 2)	3	2

Replace the second paragraph below Table 1 with the following:

The maximum change in voltage or jump voltage (U_j) at the impulse repetition rate is shown in Figure 3. This parameter is important in defining the voltage enhancement that can occur across the first or last coil in the winding. A fundamental frequent double jump transition (Figure 3, $U_{j\ max}$)) is possible and needs to be considered accordingly.

Replace Figure 3 with the following:

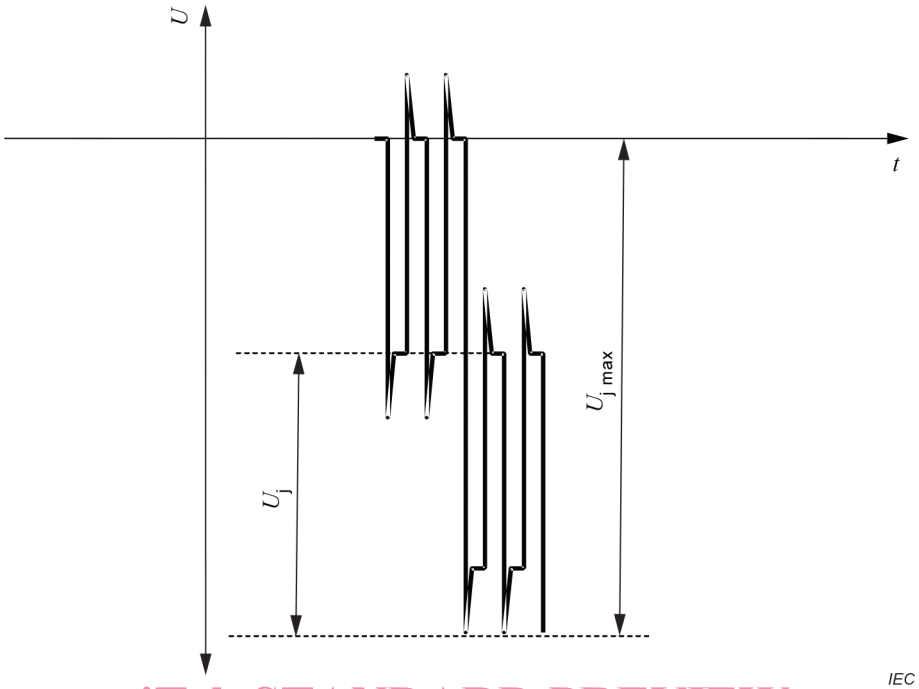

Figure 3 – Jump voltage (U_j or $U_{j\,max}$) at the terminals of a machine fed from a converter drive

10.2 Test methods

Replace the fist paragraph with the following:

The purpose of testing is to show that the electrical life of the turn insulation provides a life in service which is acceptable to the customer. It is expected that the manufacturer will know the maximum peak to peak voltage to appear between turns in a particular service application. The worst case insulation stress (depending on winding and coil design) shall be chosen. If the maximum peak to peak voltage between turns in service U_{turn} is unknown, it shall be assumed that the complete jump voltage falls across the first coil, and so the amplitude of U_{turn} is the jump voltage divided by the number of turns (for one layer coils) or calculated according to the arrangement of turns (for multilayer coils). The peak-peak turn-turn voltage is normally twice the amplitude –if the rise time and the fall time of the jumps are usually the same.

12.4 Stress control specimens

Replace the text of this subclause with the following:

To qualify the stress control system to be used, testing of coils or bars, built to production standards and fitted into representative slots, is undertaken. The slots shall be equipped with heaters for the heating of the straight part to service temperature. Heating may be produced by passing current through the conductors. In order to reduce the capacitive load on the test supply, the specimens and slots may be of reduced length but the specimens shall otherwise be manufactured in the same way as the coils or bars used in service. Supplemental heating by thermostatic chamber or other heating devices may be applied for the stable heating. Supplemental heating temperature should be below the operating temperature of stator coils – see Clause 7.

13.2 Mainwall insulation

Replace the second paragraph with the following.

At least three voltages shall be selected and the end-point is when electrical breakdown of the insulation takes place. At least seven separate bars or coil legs shall be tested at each voltage, using pass criterion a) or b) (see 14.1 below). If pass criterion c) is to be applied, at least four separate bars or coil legs shall be tested at each voltage. The life line for the candidate insulation system is compared with the reference life curve, i.e. one that has been derived from an insulation system that has been shown to provide an acceptable service life at the fundamental frequency (IEC 60034-18-1). The reference life line may have been obtained from satisfactory service life under converter drive.

14 Qualification test pass criteria

Replace subclause 14.1 with the following:

14.1 Mainwall insulation

Comparison between the candidate and reference life lines shall be at the same frequency. Any corrections for a different frequency used in testing shall be undertaken according to 9.3 before the comparison is made. The mainwall insulation is qualified according to IEC 60034-18-32 if

a) the upper 90 % confidence limit of the candidate system life line exceeds the upper 90 % confidence limit of the reference mainwall insulation life line over the same test voltages; or
b) the lower 90 % confidence limit of the candidate system life line exceeds or is equal to the lower 90 % confidence limit of the reference mainwall insulation life line at the lowest test voltage and the slope of the regression line of the mean values of the candidate system life line is steeper than that of the reference mainwall insulation life line (i.e. the value of n for the candidate system is greater than for the reference system);
c) if there are no confidence intervals available from the reference system – for example the reference line in Annex E – the pass criterion for the candidate system shall be that not more than one of the specimens at each voltage has a lifetime less than indicated by the reference line (see E.1.1). If one sample of the four falls below the reference line, then at least two more specimens have to be tested and pass. [15]

Annex D

Replace Table D.1 with the following:

Table D.1 – IVIC- and test voltage factor definition for Type II insulation systems

IVIC	Maximum allowable operating peak-peak-phase-ground-voltages (U_{IVIC}) in units of U_N	TVF	Maximum allowable enhancement ratio for the phase to ground peak to peak voltage	Examples of r.m.s. routine test voltages at 50/60 Hz (U_N = 6,6 kV)	
				Converter fed	Line fed
None (line)	1,6	-	1,0	-	14,2
1	1,8	1,0	1,1	14,2	-
2	2,1	1,0	1,3	14,2	-
3	2,4	1,0	1,5	14,2	-
4	2,8	1,0	1,7	14,2	-
5	3,3	1,2	2,0	16,4	-
6	3,8	1,3	2,3	18,5	-
7	4,2	1,5	2,6	20,8	-
S (manufacture specified)	Y	$\frac{Y}{2\sqrt{2}}$	$\frac{Y\sqrt{3}}{2\sqrt{2}}$	TVF × 2 U_N +1 kV	-

NOTE 1 Enhancement ratio is the phase-ground peak to peak machine terminal voltage under converter operation divided by the phase-ground peak to peak machine terminal voltage under normal line operation. The latter one is being calculated by $U_N \times 2 \times \sqrt{2}/\sqrt{3}$

NOTE 2 The value Y = U_{IVIC}/U_N – as it is used in 60034-18-41, is chosen by the manufacturer, specifying different values of U_{IVIC} than given in the second column, using IVIC S.

NOTE 3 14,2 kV is the test voltage specified by IEC 60034-1 for U_N = 6,6 kV.

NOTE 4 The test voltage is defined only by the maximum allowable peak to peak voltage at the motor terminals in operation. Other differences in the voltage waveform in operation are not taken into consideration.

NOTE 5 The formulas in the line of IVIC “S” apply to the other IVICs 1…7 as well.

Replace Table D.2 with the following:

Table D.2 – Impulse voltage insulation classes (IVIC)

Impulse voltage insulation classes for Type II insulation systems – Severity codes and limiting values						
IVIC		Independent parameters of the IVIC				
		Phase to ground machine terminal voltage		Phase to ground impulse voltage		
		Maximum allowable enhancement ratio for the voltage (Column 1)	Maximum allowable fundamental frequency (Column 2)	Ratio of the maximum allowable jump voltage to the maximum allowable phase to ground peak to peak voltage (Column 3)	Maximum allowable impulse voltage repetition rate (f) (Column 4)	Minimum allowable phase to ground impulse voltage rise time (t_r) (Column 5)
		Maximum $U_{pk/pk}$ converter operation divided by $U_{pk/pk}$ direct on line operation $\sqrt{3}(U_{IVIC}/U_N)/2\sqrt{2}$	Hz	$U_j/U_{pk/pk}$	kHz	µs
Severity code	1	1,1	Value to be reported in the documentation	Value to be reported in the documentation	Value to be reported in the documentation	Value to be reported in the documentation
	2	1,3				
	3	1,5				
	4	1,7				
	5	2,0				
	6	2,3				
	7	2,6				
	S	To be chosen by the manufacturer				

Annex E

E.1.1 Mainwall insulation

Replace the first paragraph below Figure E.1 with the following:

Comparison of the measured lifetimes shall be against the reference life line shown in Figure E.1. This life line reflects the electrical ageing at room temperature. It is consistent with those measured at 50 Hz or 60 Hz from mica/epoxy resin systems that have been shown to give reliable lives in service [16,17,18]. It is valid for an expected design life time of very large machines in steam, gas or hydro power plants, for example of 40 years.

Replace Annex F with the following.

Annex F
(informative)

Optional screening tests

F.1 General

Tests are described which offer the opportunity for providing short-term screening of the mainwall insulation system. It is not intended that they be viewed as type tests nor that they are required for every contract.

F.2 Short term endurance test on the mainwall insulation

Coils or bars made to production standards are mounted in simulated slots and subjected to a 50 Hz or 60 Hz sinusoidal voltage with an r.m.s. value of 1,53 or 1,31 times U_{IVIC}, respectively, the maximum peak to peak phase to ground voltage appearing on the coils during converter operation (see Annex C). The slot simulators should be earthed. Any stress control system to be used should be applied to the coils beforehand. This is a quality test of the mainwall insulation. It is similar to the test described in [15] and is primarily a test of the mainwall insulation. As such, the test conditions may be too severe for the stress control coating to last the complete test period and so remedial work on the stress control coating is permitted. The recommended number of test specimens is four and the pass criterion shall be that not more than one of the specimens at the test voltage has a lifetime less than 250 h or 400 h, respectively. If one sample of the four falls below the reference line, then at least two more specimens have to be tested and passed [15].

These optional winding insulation tests have rendered good experiences with quality checks for very large machines for example in steam, gas or hydro power plant applications, where a winding insulation life time of for example 40 years could be expected.

A withstand does not guarantee an acceptable service life with a converter drive. This is a damaging test and the specimens should not be used in a production machine.

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