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Amendement 2

Machines électriques tournantes –

Partie 18:
Evaluation fonctionnelle des systèmes d'isolation –
Section 21: Procédures d'essai pour enroulements à fils – Evaluation thermique et classification

Amendment 2

Rotating electrical machines –

Part 18:
Functional evaluation of insulation systems –
Section 21: Test procedures for wire-wound windings – Thermal evaluation and classification

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AVANT-PROPOS

Le présent amendement a été établi par le sous-comité 2J: Classification des systèmes d'isolation des machines tournantes, du comité d'études 2 de la CEI: Machines tournantes.

Le texte de cet amendement est issu des documents suivants:

FDIS	Rapport de vote
2J/51/FDIS	2J/58/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cet amendement.

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Page 12

3.4.1 *Fabrication des éprouvettes*

La correction ne concerne que le texte anglais.

Page 14

3.7 *Températures de vieillissement et durées des sous-cycles*

Remplacer le quatrième alinéa par ce qui suit:

Il convient de sélectionner les températures de vieillissement et les durées des sous-cycles de vieillissement dans le tableau 2 de la section 1.

Remplacer, à la page 16, le septième alinéa par ce qui suit:

Par ailleurs, il convient de sélectionner au moins deux autres températures de vieillissement supérieures, qui seront séparées par des intervalles de 20 K ou plus. Des intervalles de 10 K peuvent être utilisés lorsque les essais sont effectués à plus de trois températures de vieillissement.

Page 16

4.1.1 *Procédure 1*

Remplacer le texte existant par ce qui suit:

Cette procédure, qui utilise des modèles de type «motorette» comme éprouvettes, doit être désignée sous la référence CEI 34-18-21, Procédure 1.

FOREWORD

This amendment has been prepared by subcommittee 2J: Classification of insulation systems for rotating machinery, of IEC technical committee 2: Rotating machinery.

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

FDIS	Report on voting
2J/51/FDIS	2J/58/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.

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Page 13

3.4.1 *Construction of test objects*

Replace the text of the note by the following:

NOTE – It is recognized that markedly different values of test life can be obtained for the same insulating materials, depending on insulation thicknesses and creepage distances.

Page 15

3.7 *Ageing temperature and subcycle lengths*

Replace the fourth paragraph by the following:

Ageing temperatures and lengths of ageing subcycles should be selected from table 2 of Section 1.

Replace, on page 17, the seventh paragraph by the following:

In addition, at least two higher ageing temperatures should be selected, separated by intervals of 20 K or more. Intervals of 10 K may be used when tests are made at more than three ageing temperatures.

Page 17

4.1.1 *Procedure 1*

Replace the existing text by the following:

This procedure, using "motorette" type models as test objects, shall be referred to as IEC 34-18-21, Procedure 1.

Page 22

5.1.1 *Procédure 2*

Remplacer le texte existant par ce qui suit:

Cette procédure, qui utilise comme éprouvettes des moteurs réels, doit être désignée sous la référence CEI 34-18-21, Procédure 2.

5.1.2 *Caractéristiques générales*

Les corrections ne concernent que le texte anglais.

Page 24

5.3.2 *Moyens de chauffage*

Les corrections ne concernent que le texte anglais.

Page 23

5.1.1 *Procedure 2*

Replace the existing text by the following:

This procedure, using actual motors as test objects, shall be referred to as IEC 34-18-21, Procedure 2.

5.1.2 *General features*

Replace the fourth paragraph by the following:

Even though actual motors are tested, the results may not be used to determine endurance time in actual service in an absolute sense. The tests may be used as a means of classification only by comparing insulation systems.

Page 25

5.3.2 *Means of heating*

Replace the first paragraph by the following:

The mode of heat generation is dictated by the type of motor being used in the test and the laboratory equipment available. Higher than normal winding temperatures can be obtained by increasing motor losses by such means as enlarging the air gap, starting and reversing each motor, superimposition of direct current on the normal alternating current, or by increasing the temperature of the air surrounding the motor. For temperature regulation during the heat ageing portion of the cycle, the motors may be run at normal voltage and frequency with an electrical control which automatically starts and stops or reverses the direction of rotation of the motors at intervals. Other acceptable means of temperature control include automatic voltage variation, adjustment of the surrounding air temperature, or combinations thereof.

Replace the third paragraph by the following:

Single-phase motors shall have at least 250 start-stop operations each day of the heat ageing portion of the cycle. The starting winding of a single-phase motor normally operates at a much higher current density than the main winding during starting. During each start it can reach a temperature of 10 K to 30 K higher than the main winding. In order to ensure that the correct emphasis is placed on the main winding portion of the insulation system, a reasonable number of starts should be employed.

Replace, on page 27, the fourth paragraph by the following:

Polyphase motors shall have at least 1000 starts or reversals each day of the heat ageing portion of the cycle. Often the electrical loss during reversal is used to maintain the elevated temperatures, in which case the number of reversals may greatly exceed 1000 per day. At the highest temperature test the total time of exposure is relatively short which results in a relatively low number of reversals during the life of the test. At the lowest temperature, the time of exposure can be 16 to 20 times as long as that of the highest level. A wide variation in total number of starts would affect the slope of the time-temperature curve within a cycle. Thus, it is recommended that the number of reversals at the low temperature be no greater than twice those at the high temperature. Ideally, an equal number of reversals at each temperature should be sought.

5.3.4 *Contraintes mécaniques pendant le sous-cycle de vieillissement thermique*

La correction ne concerne que le texte anglais.

5.4.1 *Essai d'humidité*

La correction au premier alinéa ne concerne que le texte anglais.

Remplacer, à la page 28, le second alinéa par ce qui suit:

Toutefois, les moteurs de grandes dimensions risquent d'être difficiles à déplacer et à placer dans l'équipement utilisé pour les essais d'humidité, ou il se peut qu'un tel équipement n'existe pas. Parmi les autres méthodes que l'on peut utiliser pour l'application d'humidité, on notera: pose d'une enceinte autour du moteur, utilisation d'une chambre d'humidification classique ou d'une chambre à brouillard.

5.4.2 *Essai de tension*

La correction ne concerne que le texte anglais.

5.3.4 *Mechanical stresses during the thermal ageing subcycle*

Replace the first paragraph by the following:

Mechanical stress is obtained in tests on actual motors by the normal vibration of the motor running and with starts or reversals, or both. There is mechanical shock from starting or reversing. The vibration amplitude at twice the line frequency can be increased by enlarging the air gap. Larger forces are present in the windings as a result of the high currents during starting and reversing of the motors. In a test, these mechanical forces occur at elevated temperatures.

5.4.1 *Moisture test*

Replace the first paragraph by the following:

A moisture test of at least 48 h shall be used, except that for totally enclosed machines (degrees of protection IP44 or more) and for d.c. machines a moisture test is not mandatory because it can be impracticable. Moisture shall be visible on the windings as droplets, without puddles, during the moisture test. To ensure visible condensation, the insulation system should be at a lower temperature than the dew point of the surrounding moisture-laden atmosphere at all times. The preferred method of meeting this requirement is by the use of a condensation test chamber with cooled test objects described in clause C.2 of annex C.

Replace, on page 29, the second paragraph by the following:

However, larger motors can be difficult to move and difficult to support in equipment for moisture test, or such equipment is not available. Other methods of applying moisture include: placing an enclosing hood around the motor, or using a conventional humidity cabinet or a fog chamber.

5.4.2 *Voltage test*

Replace the second paragraph by the following:

The motors should be started and run immediately after the moisture test while the windings are still wet. For machines that have to be reassembled prior to running, a power-frequency high potential test should be applied at the highest rated voltage from windings to frame for 10 min while wet before assembly. During at least part of the thermal ageing subcycle the motors are to be run at their highest rated nameplate voltage. A power source earthed through a current limiting impedance should be used and the motor frame should be earthed so that voltage stresses are present during the entire thermal ageing portion of the cycle. A detection circuit for current to frame should be used to detect when insulation to the frame has failed. The end point of the motor life in these tests is fixed by the electrical failure of its winding insulation, under a rated applied voltage. Indiscriminate starting in either direction of the rotation of a single-phase motor can indicate failure of the starting winding.

Page 34

7.2.1 *Fabrication des éprouvettes*

La correction ne concerne que le texte anglais.

Page 40

8.2.1 *Fabrication des éprouvettes*

La correction ne concerne que le texte anglais.

Page 42

8.2.2 *Nombre d'échantillons*

Remplacer le texte existant par ce qui suit:

Il convient de soumettre 10 échantillons au moins de chaque système d'isolation aux essais pour chaque température de vieillissement. Un rotor peut être bobiné de façon à comprendre plus d'un système d'isolation, chacun étant correctement identifié et isolé. De préférence, il convient de bobiner plusieurs rotors contenant chacun un système d'isolation différent pour un essai à chaque température de vieillissement.

Page 35

7.2.1 *Construction of test objects*

Replace, on page 37, the second paragraph by the following:

An example of a model coil assembly for the purpose of testing random-wound stator field coil insulation is described in annex B. Actual pole pieces taken from production may be used if desired and can actually be necessary in some cases if the stresses developed in the coil-pole assembly produce deflections of the formed-shell pole. Such movement would introduce inappropriate variations from actual service conditions.

Page 41

8.2.1 *Construction of test objects*

Replace, on page 43, the third and fourth paragraphs by the following:

Commutator design and materials are important considerations for the test object. The objective of the test may be the evaluation of the armature winding insulation only and therefore it may be preferred to exclude the effects of the commutator. The rationale for doing so can be differences in the cooling arrangements and therefore in the temperature rises of the winding and of the commutator. The thermal capability of the materials selected for the winding and commutator can therefore be different. For this situation, a fixture may be used that replaces the commutator for the required coil terminations and measurements.

Should the test objective be an evaluation of the winding and commutator as an assembly, some modifications at the commutator will usually be required, particularly on small test objects, to ensure valid measurements and useful data. Exposure of bare copper and the short distances between segments, and from segments to connections or to frame, which are inherent in the commutator design and function, can result in flashover or undue burning of insulations during overvoltage testing. To alleviate this condition, excess moisture on the commutator from humidification may be removed by carefully directed forced air or wiping prior to application of voltage. Enclosure of the commutator surface and bare connections can also be required.

Page 43

8.2.2 *Number of test specimens*

Replace the existing text by the following:

At least 10 test specimens of each insulation system should be tested at each ageing temperature. A rotor may be wound to incorporate more than one insulation system, each adequately identified and isolated. Preferably, several rotors each containing a different insulation system should be wound for test at each ageing temperature.

Page 48

A.2 Fabrication détaillée d'une motorette (exemple)

Remplacer le premier alinéa par ce qui suit:

Les renseignements détaillés donnés dans cette annexe risquent d'être inutiles dans un laboratoire où l'on peut apporter des modifications à une motorette donnée en vue d'améliorer ou de mieux atteindre un objectif d'essai. Toutefois, si l'on ne dispose pas d'une grande expérience dans l'évaluation des isolations, ou si l'on veut essayer de comparer des données d'essais entre laboratoires, la description de la fabrication d'une motorette, donnée ici, doit être suivie scrupuleusement. L'expérience a montré qu'il fallait apporter le plus grand soin à la conception et à la préparation d'une motorette pour que les résultats des essais pratiqués sur des échantillons dans des laboratoires différents soient comparables.

Remplacer, à la page 50, le troisième alinéa par ce qui suit:

La motorette achevée se compose d'une base métallique formant un support rigide avec quatre isolateurs saillants en porcelaine ou en un autre matériau approprié boulonnés à une extrémité et avec deux encoches constituées d'une tôle intérieure et d'une tôle extérieure boulonnées à l'autre extrémité. Le support de base comporte des trous pour le montage de la motorette pendant les essais de vibration. Les sections d'encoches sont fabriquées en tôles d'acier inoxydable. La partie d'encoche assemblée contient deux bobines isolées de la masse par l'isolation d'encoche et isolées l'une de l'autre par l'isolation entre phases et maintenues en place par les cales d'encoche. Ces composants sont des pièces représentatives de celles utilisées dans les moteurs réels. Les bobines sont composées de fils parallèles enroulés pour que l'on puisse procéder aux essais électriques entre conducteurs. Elles peuvent être bobinées à la machine sur des broches ou des gabarits comme cela se fait habituellement en atelier. Lorsque cela est nécessaire, les procédures de fabrication et de traitement peuvent être modifiées pour simuler l'utilisation prévue. On trouvera ci-après une description détaillée de la préparation des motorettes. Elle est présentée sous forme d'exemple de fabrication aux seules fins de cette norme.

Page 56

B.1 Montage d'essai pour bobines de champ à enroulement à fils jetés pour machines à courant continu

Remplacer le premier alinéa par ce qui suit:

Les figures 4 à 7 représentent, à titre d'exemple uniquement, les détails de fabrication d'un montage d'essai pour l'évaluation du système d'isolation d'une bobine de champ à enroulement à fils jetés. Ces informations détaillées peuvent être inutiles pour un laboratoire qui développe ses propres éprouvettes. Toutefois, pour les laboratoires ne possédant pas une expérience complète des essais, ou si l'on doit effectuer des comparaisons entre laboratoires, les moindres détails doivent être observés et respectés méticuleusement. On peut apporter des modifications aux dimensions ou à la conception pour que les constructeurs puissent simuler avec une plus grande fidélité leurs propres structures ou conceptions de bobines de champ.

Page 49

A.2 Detailed motorette construction (example)

Replace the first paragraph by the following:

In a laboratory where modifications to a prescribed motorette assembly can be made to improve or more conveniently achieve a test objective, the detailed information in this annex can be unnecessary. However, if extensive experience in insulation evaluation is unavailable or if any attempt is to be made to compare test data between laboratories, the motorette construction described here is to be followed meticulously. Experience has shown that only the greatest care in the design and preparation of a motorette will result in specimens which can be tested in different laboratories with results that are comparable.

Replace, on page 51, the third paragraph by the following:

The finished motorette consists of a rigid supporting metal base with four suitable stand-off insulators of porcelain or other appropriate material bolted to one end and with two slots, formed by an inner and outer sheet, bolted to the other end. The supporting base has holes for mounting the motorette during vibration testing. The slot selections are fabricated from stainless steel sheets. The assembled slot portion contains two coils insulated from the frame by slot insulation, insulated from each other by phase insulation and held in place by slot wedges. These components are typical parts as used in actual motors. The coils are each wound with parallel wires so that conductor-to-conductor electrical tests can be made. They can be machine-wound on pins or forms, as in ordinary shop practice. When appropriate, the construction and processing procedures may be modified to simulate the intended use. The following is a detailed description of the preparation of motorettes. It is presented as an example for construction for the purpose of this standard.

Page 57

B.1 Test fixture for random wire-wound field coils for d.c. machines

Replace the first paragraph by the following:

Details of the construction of a test fixture for the evaluation of the insulation system of a random-wound field coil are shown, as an example only, in figures 4 to 7. The detailed information can be unnecessary for a laboratory developing its own test objects. However, for laboratories without extensive testing experience, or if comparisons are to be made between laboratories, the minute details shall be observed and followed meticulously. Modifications of dimensions or of design may be made to allow manufacturers to simulate more closely their own field coil structures or designs.