SLOVENSKI STANDARD
SIST EN 61986:2004

01-september-2004

Rotacijski električni stroji – Tehnike enakovrednega obremenjevanja in superponiranja - Posredno preskušanje za ugotavljanje dviga temperature (IEC 61986:2002)

Rotating electrical machines - Equivalent loading and super-position techniques - Indirect testing to determine temperature rise

Drehende elektrische Maschinen - Verfahren der äquivalenten Belastung und Überlagerung - Indirekte Prüfung zur Ermittlung der Übertemperatur

Machines électriques tournantes - Charge équivalente et techniques par superposition - Essais indirects pour déterminer l'échauffement

Ta slovenski standard je istoveten z: **EN 61986:2002**

ICS:

29.160.01	Rotacijski stroji na splošno	Rotating machinery in general

SIST EN 61986:2004 **en**

EUROPEAN STANDARD **EN 61986**

NORME EUROPÉENNE

EUROPÄISCHE NORM February 2002

ICS 29.160.01

English version

Rotating electrical machines – Equivalent loading and super-position techniques – Indirect testing to determine temperature rise
(IEC 61986:2002)

Machines électriques tournantes – Charge équivalente et techniques par superposition – Essais indirects pour déterminer l'échauffement (CEI 61986:2002)

Drehende elektrische Maschinen - Verfahren der äquivalenten Belastung und Überlagerung – Indirekte Prüfung zur Ermittlung der Übertemperatur (IEC 61986:2002)

This European Standard was approved by CENELEC on 2001-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 61986:2002 E

Foreword

The text of document 2G/115/FDIS, future edition 1 of IEC 61986, prepared by SC 2G, Test methods and procedures, of IEC TC 2, Rotating machinery, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61986 on 2001-09-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2002-10-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-09-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61986:2002 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60034-1 (mod)	- [1)]	Rotating electrical machines Part 1: Rating and performance	EN 60034-1	1998 [2)]
IEC 60034-2	- [1)]	Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)	EN 60034-2	1996 [2)]

1) Undated reference.

2) Valid edition at date of issue.

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
IEC
61986

Première édition
First edition
2002-01

Machines électriques tournantes – Charge équivalente et techniques par superposition – Essais indirects pour déterminer l'échauffement

Rotating electrical machines – Equivalent loading and super-position techniques – Indirect testing to determine temperature rise

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE T

Pour prix, voir catalogue en vigueur
For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES – EQUIVALENT LOADING AND SUPER-POSITION TECHNIQUES – INDIRECT TESTING TO DETERMINE TEMPERATURE RISE

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61986 has been prepared by subcommittee 2G: Test methods and procedures, of IEC technical committee 2: Rotating machinery.

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

FDIS	Report on voting
2G/115/FDIS	2G/121/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 3.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

ROTATING ELECTRICAL MACHINES – EQUIVALENT LOADING AND SUPER-POSITION TECHNIQUES – INDIRECT TESTING TO DETERMINE TEMPERATURE RISE

1 Scope

This International Standard applies to machines covered by IEC 60034-1 when they cannot be loaded to a specific condition (rated or otherwise) for whatever reason. It is applicable to both motors and generators but the methods are not suitable for machines of and below 1 kW.

The object of this standard is to provide descriptions of various indirect load tests, the purpose of which is to determine the temperature rise of rotating electrical machines, including a.c. induction machines, a.c. synchronous machines and d.c. machines. The test methods in some cases provide, in addition, a means of measuring or estimating other parameters such as losses and vibration, but the methods are not designed specifically to provide such data.

The proposed methods of test are considered equivalent, the choice of them relying only on the location, the testing apparatus and the kind of machine, and the test result accuracy.

It is not intended that this standard be interpreted as requiring the carrying out of any or all of the tests described therein on any given machine. The particular tests to be carried out are subject to a special agreement between the manufacturer and the purchaser.

As the methods reproduce only approximately the thermal conditions of the machines which occur under normal rated condition, temperature-rise measurement results achieved from tests with these methods can be taken as the basis for the evaluation of machine heating according to 7.10 of IEC 60034-1 by agreement between the manufacturer and the purchaser.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-2, *Rotating electrical machines – Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)*

3 Symbols and units

K_{11}, K_{22}, etc.	coefficient of heating losses determining the temperature rise of component 1 due to losses in component 1, etc., K/W
K_{12}, K_{13}, etc.	coefficient of heating losses determining the temperature rise of component 1 due to losses in component 2, etc., K/W
$\Delta\theta$	temperature rise, K
θ	temperature, °C
K	slope factor of the straight line characterizing variation of temperature rise with losses, K/W
P	loss, W
I	current, A
R	resistance, Ω
X_L	stator leakage reactance, Ω
V	voltage, V
f	frequency, Hz
ω	angular frequency, rad/s
$f_{1,2}$	main/auxiliary frequency, Hz
Δt	time interval, s
λ	ratio of auxiliary voltage to main voltage
F	modulation frequency, Hz
δ	amplitude of frequency modulation, Hz
T	torque, Nm
J	moment of inertia, kgm^2
$\cos\varphi$	power factor
γ	test accuracy, %
σ	correction factor
Subscripts	
m, n, o, p	test conditions
1, 2, 3, etc.	machine component (for example, stator winding, rotor winding, stator core, etc.)
t	test
f	field
A	ambient
s	stator
N	rated value
α	overexcited/open-circuit
β	underexcited/short-circuit
super	superposition test
equiv	equivalent load test

4 General test requirements

Measurement of the electrical parameters shall be made as follows.

a) The class of accuracy of measuring instruments shall be not greater than 0,2, with the exception of wattmeters with $\cos\varphi$ lower than 0,5 and frequency meters, which may have accuracy class 0,5.

b) The measuring range of the instruments shall be chosen with a view to the measured values being higher than 30 % of the full-scale range. These requirements need not be complied with in the case of the three-phase power measurement by means of two wattmeters, but the currents and voltages in the measured circuits shall be at least 20 % of the rated currents and voltages of the wattmeters being used. The range of the other measuring instruments shall be chosen in such a way that the measuring errors are not increased.

c) The waveform and dissymmetry of the supply voltage at the machine terminals shall be in accordance with the requirements of 6.1 to 6.5 of IEC 60034-1.

d) Each line current shall be measured. If these are unequal, the arithmetic average value shall be used to determine the machine operating point.

e) Power input to a three-phase machine may be measured by two single-phase wattmeters connected as in the two-wattmeter method, or one polyphase wattmeter, or three single-phase wattmeters. The total power read on a wattmeter shall be reduced by the amount of the I^2R loss in the voltage circuits or in the current circuits of the instruments according to their connection whenever this loss is a measurable portion of the total power. There is no need to reduce the total power read on a wattmeter by the amount of the I^2R losses for digital measuring instruments.

All the electrical quantities to be measured are root-mean-square values unless otherwise indicated.

5 Principle of superposition tests

5.1 General

Superposition tests may be applied to any d.c. or a.c. machine. The method comprises a series of tests at operating conditions other than rated load, for example, reduced load, no load, short circuit, reduced voltage, leading (underexcited) or lagging (overexcited) reactive load.

The method allows the full-load temperature rise of various component parts of the machine to be deduced. For each component, the loss shall be known at each particular test condition and at full load. The tests should be undertaken with cooling conditions the same as when operating at rated load. Hence, a locked rotor test will not be suitable as the air-flow distribution and magnitudes will be incorrect.

On completion of the individual tests, a series of equations is constructed, each equation being of the form:

$$\Delta\theta_{1m} = K_{11}P_{1m} + K_{12}P_{2m} + K_{13}P_{3m}$$

where

$\Delta\theta_{1m}$ is the measured temperature rise of component 1 for test m;

P_{1m}, P_{2m} etc. is the loss in component 1, 2, etc. for test condition m;

K_{11}, K_{12}, etc. are the coefficients of heating losses determining the temperature rise of component 1 due to losses in component 1, and the temperature rise of component 1 due to losses in component 2, etc.