SLOVENSKI STANDARD
SIST EN 60034-4:1999

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Rotating electrical machines - Part 4: Methods for determining synchronous machine quantities from tests (IEC 60034-4:1985 (Modified))

Rotating electrical machines -- Part 4: Methods for determining synchronous machine quantities from tests

Drehende elektrische Maschinen -- Teil 4: Verfahren zur Ermittlung der Kenngrößen von Synchronmaschinen durch Messungen

Machines électriques tournantes -- Partie 4: Méthodes pour la détermination à partir d'essais des grandeurs des machines synchrones

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ICS:

29.160.01	Rotacijski stroji na splošno	Rotating machinery in general

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EUROPEAN STANDARD

NORME EUROPÉENNE

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English version

Rotating electrical machines
Part 4: Methods for determining synchronous machine quantities from tests
(IEC 34-4:1985, modified)

Machines électriques tournantes
Partie 4: Méthodes pour la détermination à partir d'essais des grandeurs des machines synchrones
(CEI 34-4:1985, modifiée)

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This European Standard was approved by CENELEC on 1995-05-15. 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, 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

Foreword

The text of the International Standard IEC 34-4:1985, prepared by SC 2G, Test methods and procedures, of IEC TC 2, Rotating machinery, together with common modifications prepared by the Technical Committee CENELEC TC 2, was approved by CENELEC as HD 53.4 S2 on 1988-06-28.

This Harmonization Document was submitted to the formal vote for conversion into a European Standard and was approved by CENELEC as EN 60034-4 on 1995-05-15.

The following date was 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) 1996-07-15

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 34-4:1985 was approved by CENELEC as a European Standard with agreed common modifications as given below.

COMMON MODIFICATIONS

48 Line-to-line sustained short-circuit test

Figure 13 and Figure 14 have to be interchanged

54 Line-to-line and to neutral sustained short-circuit test.

Figure 13 and Figure 14 have to be interchanged.

55 Determination of quantities from the line-to-line and to neutral sustained short-circuit test

In the formula replace factor "3" by factor "$\sqrt{3}$" to read the first formula as follow:

$$X_0 = \frac{U_0}{I_0} \Omega; \quad \left[x_0 = \frac{\sqrt{3}\, u_0}{i_0} \right]$$

Delete Appendix A UNCONFIRMED TEST METHODS FOR DETERMINING SYNCHRONOUS MACHINE QUANTITIES FROM TESTS

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 51	series	Direct acting indicating analogue electrical-measuring instruments and their accessories	EN 60051	series

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
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Deuxième édition
Second edition
1985

Machines électriques tournantes

Partie 4:
Méthodes pour la détermination à partir d'essais des grandeurs des machines synchrones

Rotating electrical machines

Part 4:
Methods for determining synchronous machine quantities from tests

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Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES

Part 4: Methods for determining synchronous machine quantities from tests

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by Sub-Committee 2G: Test Methods and Procedures, of IEC Technical Committee No. 2: Rotating Machinery.

This second edition replaces the first edition of IEC Publication 34-4 (1967) — incorporating Amendment No. 1 (1973) — and the first edition of IEC Publication 34-4A (1972), first supplement.

In addition, this new edition includes some editorial changes.

This standard forms Part 4 of a series of publications dealing with rotating electrical machinery, the other parts being:

Part 1: Rating and Performance, issued as IEC Publication 34-1 (1983).

Part 2: Methods for Determining Losses and Efficiency of Rotating Electrical Machinery from Tests (excluding Machines for Traction Vehicles), issued as IEC Publication 34-2 (1972).

Part 3: Ratings and Characteristics of Three-phase, 50 Hz Turbine-type Machines, issued as IEC Publication 34-3 (1968).

Part 5: Classification of Degrees of Protection provided by Enclosures for Rotating Machines, issued as IEC Publication 34-5 (1981).

Part 6: Methods of Cooling Rotating Machinery, issued as IEC Publication 34-6 (1969).

Part 7: Symbols for Types of Construction and Mounting Arrangements of Rotating Electrical Machinery, issued as IEC Publication 34-7 (1972).

Part 8: Terminal Markings and Direction of Rotation of Rotating Machines, issued as IEC Publication 34-8 (1972).

Part 9: Noise Limits, issued as IEC Publication 34-9 (1972).

Part 10: Conventions for Description of Synchronous Machines, issued as IEC Publication 34-10 (1975).

Part 11: Built-in Thermal Protection, Chapter 1: Rules for Protection of Rotating Electrical Machines, issued as IEC Publication 34-11 (1978).

Part 12: Starting Performance of Single-speed Three-phase Cage Induction Motors for Voltages up to and Including 660 V, issued as IEC Publication 34-12 (1980).

Part 13: Specification for Mill Auxiliary Motors, issued as IEC Publication 34-13 (1980).

Part 14: Mechanical Vibration of Certain Machines with Shaft Heights 56 mm and Higher — Measurement, Evaluation and Limits of the Vibration Severity, issued as IEC Publication 34-14 (1982).

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

Six Months' Rule	Report on Voting
2G(CO)4 2G(CO)8 2G(CO)18	2G(CO)6 2G(CO)12 2G(CO)19

Further information can be found in the Reports on Voting indicated in the table above.

The following IEC publication is quoted in this standard:

Publication No. 51 (—): Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories.

ROTATING ELECTRICAL MACHINES

Part 4: Methods for determining synchronous machine quantities from tests

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SECTION ONE — SCOPE AND OBJECT

1. Scope

This standard applies to three-phase synchronous machines of 1 kVA rating and larger with rated frequency of not more than 400 Hz and not less than 15 Hz.

The test methods are not intended to apply to special synchronous machines such as permanent-magnet field machines, inductor type machines, etc.

While the tests also apply in general to brushless machines, certain variations do exist and special precautions should be taken.

2. Object

The object of this standard is to establish methods for determining characteristic quantities of three-phase synchronous machines from tests.

It is not intended that this standard should 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 shall be subject to a special agreement.

SECTION TWO — GENERAL

3. General

Tests for determining synchronous machine quantities should be conducted on a completely sound machine, all the devices for automatic regulation being switched off.

Unless otherwise stated, the tests are conducted at the rated speed of rotation.

3.1 Indicating measuring instruments and their accessories, such as measuring transformers, shunts and bridges used during tests, unless otherwise stated, should have an accuracy class not above 1.0 (IEC Publication 51: Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories). The instruments used for determining d.c. resistances should have an accuracy class not above 0.5.

It is not intended at this stage to specify an accuracy class for the oscillographic measuring equipment. This should, however, be chosen, having due regard to the rated frequency of the machine to be tested, so that the readings are taken in a linear portion of the vibrator amplitude against frequency characteristic.

The measurement of the speed of rotation, of synchronous machines may be conducted by means of a stroboscopic method or by using tachometers (mechanical or electrical).

Instead of measuring the speed of rotation, it is permissible to measure frequency by means of a frequency meter when the machine is running synchronously with any other machine or running on its own.

3.2 The temperature of the windings is measured in those tests when the quantities to be determined depend on it or when knowledge of it is required by the safety considerations of the machine during tests.

In cases where transient temperatures might exceed the safe values, it is recommended that the tests be started only after the machine has been run at no-load with normal cooling or has been at rest for a period to ensure low starting temperature, and the temperatures should be carefully monitored or pre-determined so that the test may be discontinued before the temperature becomes excessive.

3.3 During the test, the machine winding connection, as a rule, should be as for normal working.

The determination of all quantities is made considering star connection of the armature winding (unless special connections such as open delta are specified). If the armature winding is actually delta connected, the values of the quantities obtained in accordance with this standard correspond to an equivalent star connected winding.

3.4 All the quantities and characteristics should be designated in per unit values considering rated values of the voltage (U_n), and the apparent power (S_n) as basic ones. In this case basic current will be:

$$I_n = \frac{S_n}{\sqrt{3}\,U_n}$$

and basic impedance:

$$Z_n = \frac{U^2_n}{S_n} = \left[\frac{S_n}{3I^2_n}\right] \quad \Omega$$

The intermediate calculations, if it is convenient, may be performed in physical values with subsequent conversion to the quantity in per unit value. It is recommended to express time in seconds. In the calculations of characteristics, and when drawing diagrams, excitation current corresponding to the rated voltage on the no-load curve is taken as the basic value of the excitation current.

If a machine has several rated values, those taken for the basic values should be stated.

Unless otherwise stated, the above-mentioned system is accepted in this standard. Small letters designate the quantities in per unit values, and capital letters designate them in physical quantities.

3.5 In the formulae given in this standard for determining synchronous machine reactances, the positive sequence armature resistance, unless otherwise stated, is considered to be negligible.

When the positive sequence armature resistance constitutes more than 0.2 of the measured reactance, the formulae must be considered as approximate.

3.6 The definitions of the majority of quantities and their experimental methods of determination, as given in this standard, correspond to the widely accepted two-axis theory of synchronous machines with approximate representation of all circuits additional to the field winding, and stationary circuits relative to it, by two equivalent circuits, one along the direct axis and the other along the quadrature axis, neglecting armature resistance or taking it into consideration only approximately.