



SLOVENSKI STANDARD
SIST EN 60034-4:1999

01-april-1999

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 Kenngößen 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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Ta slovenski standard je istoveten z: EN 60034-4:1995

ICS:

29.160.01 Rotacijski stroji na splošno Rotating machinery in general

SIST EN 60034-4:1999

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EUROPEAN STANDARD

EN 60034-4

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 1995

UDC 621.313:621.317.3
ICS 29.160.00

Supersedes HD 53.4 S2:1988

Descriptors: Rotating machines, synchronous machines, test methods

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)

Drehende elektrische Maschinen
Teil 4: Verfahren zur Ermittlung der
Kenngrößen von Synchronmaschinen
durch Messungen
(IEC 34-4:1985, modifiziert)

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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.

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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.

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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:

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

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

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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.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 51	series	Direct acting indicating analogue electrical-measuring instruments and their accessories	EN 60051 ¹	series

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NORME
INTERNATIONALE
INTERNATIONAL
STANDARD

CEI
IEC
34-4

Deuxième édition
Second edition
1985

Machines électriques tournantes

Partie 4:

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

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Rotating electrical machines

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Part 4:

Methods for determining synchronous machine
quantities from tests

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CONTENTS

	Page
FOREWORD	11
PREFACE	11

SECTION ONE – SCOPE AND OBJECT

Clause

1. Scope	15
2. Object	15

SECTION TWO – GENERAL

3. General	15
----------------------	----

SECTION THREE – TERMINOLOGY AND METHODS OF DETERMINATION

4. Direct-axis synchronous reactance X_d	19
5. Short-circuit ratio K_c	19
6. Quadrature-axis synchronous reactance X_q	19
7. Direct-axis transient reactance X'_d	21
8. Direct-axis subtransient reactance X''_d	21
9. Quadrature-axis subtransient reactance X''_q	21
10. Negative-sequence reactance X_2	23
11. Negative-sequence resistance R_2	23
12. Zero-sequence reactance X_0	23
13. Zero-sequence resistance R_0	23
14. Potier reactance X_p	25
15. Armature and excitation winding direct-current resistance R_a and R_f	25
16. Positive-sequence armature winding resistance R_1	25
17. Direct-axis transient open-circuit time constant τ'_{do}	25
18. Direct-axis transient short-circuit time constant τ'_d	25
19. Direct-axis subtransient short-circuit time constant τ''_d	27
20. Armature short-circuit time constant τ_a	27
21. Acceleration time τ_J	27
22. Stored energy constant H	27
23. Rated excitation current I_{fn}	29
24. Rated voltage regulation ΔU_n	29

SECTION FOUR – DESCRIPTION OF THE TESTS AND DETERMINATION
OF MACHINE QUANTITIES FROM THESE TESTS

25. No-load saturation test	29
26. Sustained three-phase short-circuit test	31
27. Determination of quantities from the no-load saturation and sustained three-phase short-circuit characteristics	31
28. Overexcitation test at zero power-factor	33
29. Determination of the excitation current corresponding to the rated voltage and rated armature current at zero power-factor (overexcitation)	35
30. Determination of Potier reactance from the no-load and sustained three-phase short-circuit characteristics and the excitation current corresponding to the rated voltage and rated armature current at zero power-factor (overexcited)	37

31. Determination of the rated excitation current by the Potier diagram	37
32. Determination of the rated excitation current by the ASA diagram	41
33. Determination of the rated excitation current by the Swedish diagram	43
34. Negative excitation test	45
35. Determination of X_q from the negative excitation test	45
36. Low slip test	45
37. Determination of X_q from the low slip test	47
38. On-load test measuring the load angle δ	49
39. Determination of X_q from the on-load test measuring the load angle	51
40. Sudden three-phase short-circuit test	51
41. Determination of quantities from the sudden three-phase short-circuit test	57
42. Voltage recovery test	59
43. Determination of quantities from the voltage recovery test	61
44. Applied voltage test with the rotor in direct and quadrature axis positions with respect to the armature winding field axis	61
45. Determination of quantities from the applied voltage test with the rotor in direct and quadrature axis positions with respect to the armature winding field axis	63
46. Applied voltage test with the rotor in any arbitrary position	63
47. Determination of quantities from the applied voltage test with the rotor in any arbitrary position	65
48. Line-to-line sustained short-circuit test	65
49. Determination of quantities from the line-to-line sustained short-circuit test	67
50. Negative-phase sequence test	67
51. Determination of quantities from the negative-phase sequence test	69
52. Single-phase voltage application to the three-phase test	69
53. Determination of quantities from the single-phase voltage application to the three-phase test	69
54. Line-to-line and to neutral sustained short-circuit test	71
55. Determination of quantities from the line-to-line and to neutral sustained short-circuit test	71
56. Direct-current winding resistance measurements by the voltmeter and ammeter method and by the bridge method	73
57. Determination of winding d.c. resistance from the direct-current winding resistance measurements by the voltmeter and ammeter and by the bridge methods	73
58. Field current decay test with the armature winding open-circuited	75
59. Determination of τ'_{do} from the field current decay test with the armature winding open-circuited	77
60. Field current decay test with the armature winding short-circuited	77
61. Determination of τ'_d from the field current decay test with the armature winding short-circuited	77
62. Suspended rotor oscillation test	77
63. Determination of τ_J and H from suspended rotor oscillation test	77
64. Auxiliary pendulum swing test	79
65. Determination of τ_J and H from the auxiliary pendulum swing test	79
66. No-load retardation test	79
67. Determination of τ_J and H from the no-load retardation test	81
68. On-load retardation test of mechanically coupled machines with the synchronous machine operating as a motor	81

STANDARD PREVIEW

(for members only)

<https://standards.iteh.ai/catalog/standards/sist/4772c580-7412-4e49-93a8-787580b7e0034-4-1999>

69. Determination of τ_J and H of mechanically coupled machines from the on-load retardation test with the synchronous machine operating as a motor	81
70. Acceleration after a load drop test with the machine operating as a generator	83
71. Determination of τ_J and H of mechanically coupled machines from the acceleration after a load drop test with the machine operating as a generator	83
72. Determination of quantities by calculations using known test quantities	83

TABLE I	87
-------------------	----

APPENDIX A — Unconfirmed test methods for determining synchronous machine quantities from tests	91
A1. Scope	91
A2. Object	91
A3. General	91

TERMINOLOGY AND METHODS OF EXPERIMENTAL STUDY

A4. Excitation current corresponding to the rated armature short-circuit current (i_{fk})	93
A5. Direct-axis synchronous reactance X_d	93
A6. Quadrature-axis synchronous reactance X_q	93
A7. Direct-axis transient reactance X'_d	95
A8. Quadrature-axis transient reactance X'_q	95
A9. Quadrature-axis subtransient reactance X''_q	95
A10. Negative-sequence reactance X_2	95
A11. Armature-leakage reactance X_σ	95
A12. Initial starting impedance of synchronous motors Z_{st}	97
A13. Direct-axis transient open-circuit time constant τ_{d0}	97
A14. Direct-axis transient short-circuit time constant τ_{d1999}	97
A15. Quadrature-axis transient open-circuit time constant τ_{q0}	97
A16. Quadrature-axis transient short-circuit time constant τ_{q1999}	97
A17. Direct-axis subtransient open-circuit time constant τ''_{do}	99
A18. Quadrature-axis subtransient open-circuit time constant τ''_{q0}	99
A19. Quadrature-axis subtransient short-circuit time constant τ''_q	99
A20. Direct-axis open-circuit excitation winding time constant τ_{fd0}	101
A21. Direct-axis open-circuit equivalent damper circuit time constant τ_{kdo}	101
A22. Direct-axis short-circuit excitation winding time constant τ_{fd}	101
A23. Direct-axis short-circuit equivalent damper winding time constant τ_{kd}	101
A24. Frequency response characteristics	101

DESCRIPTION OF THE TESTS AND DETERMINATION OF QUANTITIES AND CHARACTERISTICS FROM THESE TESTS

A25. Over-excitation test at zero power factor and variable armature voltage	103
A26. Determination of the excitation current corresponding to the rated armature sustained short-circuit current (i_{fk})	105
A27. Phase shifting test	105
A28. Determination of quantities from the phase shifting test	105
A29. Disconnecting applied low armature voltage at a very low-slip test	107
A30. Determination of quantities from the disconnecting applied low armature voltage at a very low-slip test	107
A31. Disconnecting applied low armature voltage test, the machine running asynchronously on load	109

A32.	Determination of quantities from the sudden disconnection of applied low armature voltage, the machine running asynchronously on load, test	111
A33.	Sudden short-circuiting of machine, running on load at low-voltage, test	113
A34.	Determination of quantities from sudden short-circuiting, running on load at low voltage test	113
A35.	Sudden line-to-line short-circuit test	115
A36.	Determination of negative-sequence reactance from the sudden line-to-line short-circuit test	115
A37.	Suddenly applied short-circuit test following disconnection from line	117
A38.	Determination of quantities from the suddenly applied short-circuit test following disconnection from line	117
A39.	Applied voltage test with rotor removed	117
A40.	Determination of quantities from the applied voltage test	117
A41.	Locked rotor test	119
A42.	Determination of initial starting impedance from the locked rotor test	121
A43.	Suddenly applied excitation test with armature winding open-circuited	121
A44.	Determination of τ'_{do} from the suddenly applied excitation test with armature winding open-circuited	123
A45.	Suddenly applied excitation test with armature winding short-circuited	123
A46.	Determination of τ'_d from suddenly applied excitation test with armature winding short-circuited	123
A47.	Voltage recovery test	123
A48.	Determination of quantities from the voltage recovery test	125
A49.	Field extinguishing test with armature winding open-circuited	125
A50.	Determination of quantities from the field extinguishing test with armature winding open-circuited	125
A51.	Field extinguishing test with armature winding short-circuited	129
A52.	Determination of quantities from the field extinguishing test with armature winding short-circuited	129
A53.	Asynchronous operation on-load test	129
A54.	Determination of frequency response characteristics and quantities from the asynchronous operation on-load test	131
A55.	Asynchronous operation during the low-voltage test	133
A56.	Determination of the frequency response characteristics and quantities from the asynchronous low-voltage operation test	133
A57.	Applied variable frequency voltage test at standstill	135
A58.	Determination of the frequency response characteristics and quantities from the applied variable frequency voltage test at standstill	135
A59.	D.C. decay in the armature winding at standstill test	139
A60.	Determination of frequency response characteristics and quantities from the d.c. decay test	141
A61.	Suddenly applied d.c. at standstill test	147
A62.	Determination of frequency response characteristics from the suddenly applied d.c. at standstill test	151
A63.	Determination of quantities by calculation using known test quantities	153
TABLE IA	155
REFERENCE LIST	161
FIGURES A1 TO A23	164

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.

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ROTATING ELECTRICAL MACHINES

Part 4: Methods for determining synchronous machine quantities from tests

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.

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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:

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

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and basic impedance:

$$Z_n = \frac{U_n^2}{S_n} = \left[\frac{S_n}{3I_n^2} \right] \Omega$$

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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.