SLOVENSKI STANDARD
oSIST prEN IEC 60034-2-2:2023

01-januar-2023

Električni rotacijski stroji - 2-2. del: Posebne metode za ugotavljanje posameznih izgub velikih strojev s preskušanjem - Dodatek k IEC 60034-2-1

Rotating electrical machines - Part 2-2: Specific methods for determining separate losses of large machines from tests - Supplement to IEC 60034-2-1

Drehende elektrische Maschinen - Teil 2-2: Besondere Verfahren zur Bestimmung der Einzelverluste großer elektrischer Maschinen aus Prüfungen - Ergänzung zu IEC 60034-2-1

Machines électriques tournantes - Partie 2-2: Méthodes spécifiques pour déterminer les pertes séparées des machines de grande taille à partir d'essais - Complément à l'IEC 60034-2-1

Ta slovenski standard je istoveten z: prEN IEC 60034-2-2:2022

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COMMITTEE DRAFT FOR VOTE (CDV)

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IEC TC 2 : ROTATING MACHINERY	
SECRETARIAT: United Kingdom	SECRETARY: Mr Charles Whitlock
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT	☐ QUALITY ASSURANCE ☐ SAFETY
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TITLE:

Rotating electrical machines – Part 2-2: Specific methods for determining separate losses of large machines from tests – Supplement to IEC 60034-2-1

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ROTATING ELECTRICAL MACHINES –

Part 2-2: Specific methods for determining separate losses of large machines from tests – Supplement to IEC 60034-2-1

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International Standard IEC 60034-2-2 has been prepared by IEC technical committee 2: Rotating machinery.

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

FDIS	Report on voting

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 2.

NOTE A table of cross-references of all IEC TC 2 publications can be found in the IEC TC 2 dashboard on the IEC website.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC web site 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.

ROTATING ELECTRICAL MACHINES –

Part 2-2: Specific methods for determining separate losses of large machines from tests – Supplement to IEC 60034-2-1

1 Scope

This part of IEC 60034 applies to large rotating electrical machines and establishes additional methods of determining separate losses and to define an efficiency supplementing IEC 60034-2-1. These methods apply when full-load testing is not practical and result in a greater uncertainty.

NOTE In situ testing according to the calorimetric method for full-load conditions is recognized.

The specific methods described are:

- Calibrated-machine method.
- Retardation method.
- Calorimetric method.
- Summation of losses for permanent magnet excited synchronous machines.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60034-2-1, *Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

IEC 60034-4-1:2018, *Rotating electrical machines – Part 4-1: Methods for determining synchronous machine quantities from tests*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60034-1 and IEC 60034-2-1 apply, as well as the following.

3.1
calibrated machine
machine whose mechanical power input/output is determined, with low uncertainty, using measured electrical output/input values according to a defined test procedure

3.2
calibrated-machine method
method in which the mechanical input/output to/from an electrical machine under test is determined from the measurement of the electrical input/output of a calibrated machine mechanically coupled to the test machine

3.3
retardation method
method in which the separate losses in a machine under test are deduced from the measurements of the deceleration rate of its rotating components when only these losses are present

3.4
calorimetric method
method in which the losses in a machine are deduced from the measurements of the heat generated by them

3.5
thermal equilibrium
the state reached when the temperature rises of the several parts of the machine do not vary by more than rate of change 1 K per half hour

[IEV 411-51-08]

4 Symbols and abbreviations

4.1 Symbols

A is an area, m^2,

C is the retardation constant, kg m^2 s^2,

c_p is the specific heat capacity of the cooling medium, J/(kg K),

h is the coefficient of heat transfer, W/(m^2 K),

J is the moment of inertia, kg m^2,

n is the operating speed, s^{-1},

P_1 is the input power, W,

P_{1E} is the excitation power supplied by a separate source, W,

P_2 is the output power, W,

P_a is the I^2R armature-winding losses (interpole, compensation and series field winding loss in case of d.c. machines), W,

P_b is the brush losses, W,

P_c is the constant losses, W,

P_e is the excitation circuit losses, W,

P_{Ed} is the exciter losses, W,

P_{el} is the electrical power, excluding excitation, W,

P_f is the excitation (field winding) losses, W,

P_{fe} is the iron losses, W,

P_{fw} is the friction and windage losses, W,

P_k is the short-circuit losses, W,

P_{LL} is the additional load losses, W,

P_{mech} is the mechanical power, W,

P_r is the I^2R rotor winding losses, W,

P_s is the stator I^2R winding losses, W,

P_T is the total losses, W,

Q is the volume rate of flow of the cooling medium, m^3/s,

t is the time, s,

v is the exit velocity of cooling medium, m/s,

Δp is the difference between the static pressure in the intake nozzle and ambient pressure, N/m^2,

$\Delta\theta$ is the temperature rise of the cooling medium, or the temperature difference between the machine reference surface and the external ambient temperature, K,

δ is the per unit deviation of rotational speed from rated speed,

ρ is the density of the cooling medium, kg/m^3,

θ is the temperature, °C.

4.2 Additional subscripts

c for the cooling circuit,

E for exciter,

ers for outside reference surface,

i for inner voltage

irs for inside reference surface,

rs for the reference surface,

RR for test with rotor removed,

t test,

0 no-load,

1 input,

2 output.

5 Basic requirements

5.1 Direct and indirect efficiency determination

Tests can be grouped in the following categories.

5.1.1 Direct

Input-output measurements on a single machine are considered to be direct. This involves the measurement of electrical or mechanical power into, and mechanical or electrical power out of a machine.

5.1.2 Indirect

Measurements of the separate losses in a machine under a particular condition are considered to be indirect. This is not usually the total loss but comprises certain loss components. The method may, however, be used to calculate the total loss or to calculate a loss component.

The determination of total loss shall be carried out by one of the following methods:

– direct measurement of total losses;

– summation of separate losses.

NOTE The methods for determining the efficiency of machines are based on a number of assumptions. Therefore, it is not possible to make a comparison between the values of efficiency obtained by different methods.

5.2 Uncertainty

Uncertainty as used in this standard is the uncertainty of determining a true efficiency. It reflects variations in the test procedure and the test equipment.

Although uncertainty should be expressed as a numerical value, such a requirement needs sufficient testing to determine representative and comparative values.

6 Additional test methods for the determination of the efficiency of large machines

6.1 General

For the determination of performance when machine load and/or size exceed test capabilities (described in IEC 60034-2-1), the following test methods may be used.

Table 1 – Additional methods for large machines

Ref	Method	Description	Subclause	Application	Required facility
2-2-A	**Calibrated Machine**	Loss measurement via calibrated machine	6.2	All types of machines	Calibrated machine
2-2-B	**Retardation Method**	Loss measurement by retardation	6.3	Applicable for factory and on-site measurements	
2-2-C	**Calorimetric Method**	Loss measurement in the primary and secondary coolant	6.4	Applicable for factory and on-site measurements	

NOTE These methods are generally applicable to large machines where the facility cost for other methods is not economical.

Losses relative to machine load (with lowest uncertainty) are best determined from actual measurements. For example: measurements of current, resistance, etc. under full-load operation.

When this is not possible, these values shall be obtained from calculation of the parameters during the design stage.

Determination of losses not itemized in this part may be found in IEC 60034-2-1.

6.1.1 Efficiency

Efficiency is:

$$\eta = \frac{P_1 + P_{1E} - P_T}{P_1 + P_{1E}} = \frac{P_2}{P_2 + P_T}$$

where

P_1 is the input power excluding excitation power from a separate source;

P_2 is the output power;

P_{1E} is the excitation power supplied by a separate source;

P_T is the total loss

NOTE 1 Input power P_1 and output power P_2 are as follows:
in motor operation: $P_1 = P_{el}$; $P_2 = P_{mech}$;
in generator operation: $P_1 = P_{mech}$; $P_2 = P_{el}$.

NOTE 2 P_T includes the excitation power P_e of the machine where applicable.