

INTERNATIONAL STANDARD

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**Rotating electrical machines –
Part 2-3: Specific test methods for determining losses and efficiency of
converter-fed AC motors**

**Machines électriques tournantes –
Partie 2-3: Méthodes d'essai spécifiques pour la détermination des pertes
et du rendement des moteurs à courant alternatif alimentés par convertisseur**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES –

Part 2-3: Specific test methods for determining losses and efficiency of converter-fed AC motors

FOREWORD

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International Standard IEC 60034-2-3 has been prepared by IEC technical committee 2: Rotating machinery.

This first edition cancels and replaces IEC TS 60034-2-3, published in 2013.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
2/1974/FDIS	2/1982/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60034 series, published under the general title *Rotating electrical machines*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
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INTRODUCTION

The objective of this document is to define test methods for determining total losses including additional high frequency motor losses and efficiency of converter-fed motors. Additional high frequency losses appear in addition to the losses on nominally sinusoidal power supply as determined by the methods of IEC 60034-2-1:2014. Results determined according to this document are intended to allow comparison of losses and efficiency of different motors when fed by converters.

Furthermore, the document gives seven standardized operating points to characterize the development of losses and efficiency across the whole torque/speed range. An interpolation procedure is provided to calculate losses and efficiency at any operating point (torque, speed).

In power-drive systems (PDS), the motor and the frequency converter are often manufactured by different suppliers. Motors of the same design are produced in large quantities. They may be operated from the grid or from frequency converters of many different types, supplied by many different manufacturers. The individual converter properties (switching frequency, DC link voltage level, etc.) will also influence the system efficiency. As it is impractical to determine motor losses for every combination of motor, frequency converter, connection cable, output filter and parameter settings, this document describes a limited number of approaches, depending on the voltage level and the rating of the machine under test.

The losses determined according to this document are not intended to represent the losses in the final application. They provide, however, an objective basis for comparing different motor designs with respect to suitability for converter operation.

In general, when fed from a converter, motor losses are higher than during operation on a nominally sinusoidal system. The additional high frequency losses depend on the harmonic spectrum of the impressed converter output quantity (either current or voltage) which is influenced by its circuitry and control method. For further information, see IEC TS 60034-25:2014.

It is not the purpose of this document to define test procedures either for power drive systems or for frequency converters alone.

Comparable converter

Latest experience and theoretical analysis have shown that the additional high frequency motor losses generally do not increase much with load. The methods in this document are mainly based on supplies from converters with pulse width modulation (PWM).

With respect to these types of converters and the growing need for verification of compliance with national energy efficiency regulations, this document defines a so-called comparable converter for testing of low voltage motors.

In principle, the comparable converter is a voltage source with a typical high frequency harmonic content supplying the machine under test. It is not applicable to medium voltage motors.

Limitations for the application of the comparable converter

It has to be noted that the test method with the comparable converter described herein is a standardized method intended to give comparable efficiency figures for standardized test conditions. A motor ranking with respect to suitability for converter operation may be derived, but it is not equivalent to determining of the actual motor losses for operation with a specific converter which requires a test of the whole power drive system (PDS) with the specific converter used in the final application.

Deviations are also expected for motors driven by multi-level voltage source or current source converters where the additional high frequency motor losses differ much more depending on speed and load than for two-level voltage source converters. Hence the determination of losses and efficiency should preferably use procedures where the motor is operated together with the same converter with which it is driven in service.

Another option is the determination of the additional high frequency motor losses by calculation. If this is requested by the customer, the pulse pattern of the converter is required. Such procedures are not part of this document.

The provided interpolation procedure for the determination of losses and efficiency at any operating point (torque, speed) is limited to the base speed range (constant torque range, constant flux range).

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