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PUBLICATION GROUPÉE SUR L'ÉFFICACITÉ ÉNERGÉTIQUE

Adjustable speed electrical power drive systems (PDS) – Part 9-2: Ecodesign for motor systems – Energy efficiency determination and classification

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Entraînements électriques de puissance (PDS) à vitesse variable – Partie 9-2: Écoconception des systèmes moteurs – Détermination et classification de l'efficacité énergétique

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Part 9-2: Ecodesign for motor systems – Energy efficiency determination and classification

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It has the status of a group energy efficiency publication in accordance with IEC Guide 118.

This second edition cancels and replaces the first edition published in 2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Additional IES Classes defined to IES5;
b) Removed reference motor loss data and now point to IEC 60034-30-2;

c) Expanded and modified factors in Clause 6 for CDMs;
d) Annex C is now the Mathematical Model for CDM Losses;
e) Moved the mathematical model for the CDM to Annex C;
f) Added Sub Drive Input Module and Sub Drive Output Modules to Annex B;
g) Annex D is now the Converter Topology (old Annex C);
h) Annex E is now the Interpolation of Motor Losses (Old Annex D);
i) Annex E expanded to include various motor connections and updated interpolation method;
j) New Annex E for determination of Interpolation Coefficients;
k) Annex F is the old Annex E;
l) New Annex J Explanation of Correction Factors for the Reference Losses in Table 8.

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

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Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61800 series, published under the general title *Adjustable speed electrical power drive systems (PDS)*, can be found on the IEC website.

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

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

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 61800 has been developed to allow evaluation of power losses of SDMs (sub drive modules), CDMs (complete drive modules) and PDSs (power drive systems).

The requirements for measuring energy efficiency of motors with non-sinusoidal supply are under the responsibility of IEC/TC 2 and will be published under the IEC 60034 series.

IEC SC 22G includes the standardization task force for dealing with this topic. It has close collaboration with several other technical committees (for example, IEC TC 2, IEC SC 121A, ISO/TC 115, ISO/TC 117, ISO/TC 118, CEN/TC 197) in order to provide a comprehensive standard for energy efficiency and ecodesign requirements.

IEC SC 22G maintains responsibility for all relevant aspects in the field of energy efficiency and ecodesign requirements for power electronics, switchgear, control gear and power drive systems and their industrial applications.

The IEC 61800 series does not deal with mechanical engineering components.

NOTE 1 Geared motors (motors with directly adapted gearboxes) are treated like power drive systems (converter plus motor). See IEC 60034-30-1 for classification of the losses of a geared motor. The efficiency classes of gearboxes as individual components are under consideration.

IEC 61800-9-2 is a subpart of the IEC 61800 series, which has the following structure:

– Part 1: General requirements – Rating specifications for low voltage adjustable speed DC power drive systems
– Part 2: General requirements – Rating specifications for adjustable speed AC power drive systems
– Part 3: EMC requirements and specific test methods
– Part 5: Safety requirements
– Part 6: Guide for determination of types of load duty and corresponding current ratings
– Part 7: Generic interface and use of profiles for power drive systems
– Part 8: Specification of voltage on the power interface
– Part 9: Ecodesign for motor systems

Some parts are further subdivided into several subparts, published either as International Standards or as Technical Specifications or Technical Reports and will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61800-9-2).

NOTE 2 It is understood that Formula (13) is for Direct-on-Line motors. Formula (13) will be modified in the next amendment to account for Variable Frequency Drive motors.

NOTE 3 A new figure will be developed to demonstrate the use of a star point for measuring the converter phase voltages to determine the cosphi for each phase in 7.5.3.1.

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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS (PDS) –

Part 9-2: Ecodesign for motor systems – Energy efficiency determination and classification

1 Scope

This part of IEC 61800 specifies energy efficiency indicators of power electronics (complete drive modules (CDM), input or output sub drive modules (SDM), power drive systems (PDS) and motor starters, all used for motor driven equipment.

This document is a group energy efficiency publication according to IEC Guide 119 and specifies the methodology for the determination of losses of the complete drive module (CDM), the sub drive module (SDM), the power drive system (PDS) and the motor system.

It defines IE and IES classes, their limit values and provides test procedures for the classification of the overall losses of the motor system.

Furthermore, this document proposes a methodology for the implementation of the best energy efficiency solution of drive systems. This depends on the architecture of the motor driven system, on the speed/torque profile and on the operating points over time of the driven load equipment. It provides a link for the energy efficiency evaluation and classification of the extended product.

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The methodology of the extended product approach and the semi analytical models are defined in IEC 61800-9-1.

The structure of this document is as follows:

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- the losses of standardized PDS, standardized reference CDM (RCDM) and the mathematical model for their calculation are given and classified;
- the reference motor (RM) and the reference CDM (RCDM) are defined. They are used for determining the efficiency class of a PDS if either the physical motor or physical CDM is unknown;
- the requirements for the determination of the losses of a physical PDS and a physical CDM including correction factors for other types of CDM, not defined as RCDM or SDM, are given and compared to the IES class limits and the RCDM;
- the requirements for type testing and user documentation are given;
- some exemplary losses of an overall system are illustrated in annexes;
- information about system and drive topologies are given in annexes.

Specific data for the RCDM and RM, limits for the PDS and IE/IES classes are given for low voltage (100 V up to and equal to 1 000 V), single axis AC/AC power drive systems with three-phase motors. Geared motors are treated as standard motors when motor and gearbox can be separated. A methodology is given in addition how this reference data can also be applied to other topologies like AC/DC or DC/AC converters.

All provided reference data is derived from PDS with induction motors. They can be used for various types of PDS with other types of motors as well, for example but not limited to, electronically commutated motors (ECM), permanent magnet motors (PM) or synchronous reluctance motors (SYN-RM), and line-start permanent magnet motors (LSPM).