SLOVENSKI STANDARD
oSIST prEN 50598-2:2014

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Ekološko snovanje (ecodesign) motornih pogonskih sistemov, motornih zaganjalnikov, močnostne elektronike in njihove aplikacije, ki jih ti poganjajo - 2. del: Energijska učinkovitost indikatorjev motorno gnanih sistemov in motornih zaganjalnikov

Ecodesign for power drive systems, motor starters, power electronics & their driven applications - Part 2: Energy efficiency indicators for power drive systems and motor starters

Ökodesign für Antriebssysteme, Motorstarter, Leistungselektronik und deren angetriebene Einrichtungen -- Teil 2: Indikatoren für die Energieeffizienz von Antriebssystemen und Motorstartern

Ecoconception des entraînements électriques de puissance, des démarreurs de moteur, de l'électronique de puissance et de leurs applications entraînées -- Partie 2: Indicateurs d'efficacité énergétique pour les entraînements électriques de puissance et les démarreurs de moteur

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ICS:

13.020.99	Drugi standardi v zvezi z varstvom okolja	Other standards related to environmental protection
31.020	Elektronske komponente na splošno	Electronic components in general

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ICS

English version

Ecodesign for power drive systems, motor starters, power electronics & their driven applications - Part 2: Energy efficiency indicators for power drive systems and motor starters

Ecoconception des entraînements électriques de puissance, des démarreurs de moteur, de l'électronique de puissance et de leurs applications entraînées - Partie 2: Indicateurs d'efficacité énergétique pour les entraînements électriques de puissance et les démarreurs de moteur

Ökodesign für Antriebssysteme, Motorstarter, Leistungselektronik und deren angetriebene Einrichtungen - Teil 2: Indikatoren für die Energieeffizienz von Antriebssystemen und Motorstartern

This draft European Standard is submitted to CENELEC members for CENELEC enquiry. Deadline for CENELEC: 2014-02-21.

It has been drawn up by CLC/TC 22X.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CENELEC 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 CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Contents

Page

Foreword

This document [prEN 50598-2:2013] has been prepared by CLC/TC 22X "Power electronics".

This document is currently submitted to the Enquiry.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

The TC22X Working Group 6 as being the standardization Task Force for dealing with the Mandate M/476 from European Commission for standardization in the field of variable speed drives and/or Power Drive System products has been set a close collaboration with several other technical committees (i.e. CLC/TC2; CLC/TC17B; CEN TC 197) in order to provide a comprehensive standard for energy efficiency and eco design requirements.

Key points:

- Clear requirements how to achieve an energy efficient driven equipment using a power drive system
- Requirements and limits for IE-classes for power electronic converters
- Requirements and limits for IES-classes for Power Drive Systems (PDS)
- Loss determination of the PDS and requirements for the link to the driven equipment in order to determine the energy efficiency classification/evaluation of the extended product
- Requirements how to achieve the environmental conscious design and environmental declaration of PDS

It is the intention of the working group that this document, once finalised as European standard, will be further processed to an international consensus in IEC according to the UAP procedure agreement between CENELEC and IEC.

Introduction

The CENELEC TC22X Technical Committee has circulated on last 2010-03-31 for a short period of time the CLC/TC22X/Sec0100/DC document including the Mandate M/476 from European Commission for standardization in the field of variable speed drives and/or Power Drive System products.

As the PDS contains converter driven motors, the additional requirements for measuring of the energy efficiency of those motors with non-sinusoidal supply and the labelling for the whole PDS are also included. This covers the requirements coming from the Mandate M/470.

The document is based on the CENELEC Technical board document referenced BT137/DG8058/INF also reproducing this EC-Mandate.

The TC22X Working Group 6 as being the standardization Task Force for dealing with this Mandate has anticipated that a close collaboration with several other technical committees (i.e. CLC/TC2; CLC/TC17B) should be set.

Therefore CLC TC22X Committee has taken its responsibility this field and has started a standardization work to clarify all aspects in field of Energy efficiency and Eco-design requirements for Power electronics, Switchgear, Control gear, and Power drive systems and their industrial applications.

The sometimes controversial requirements in the field of these tasks are illustrated in Figure 1. The work has been agreed to provide the reasonable target as a best compromise in this field.

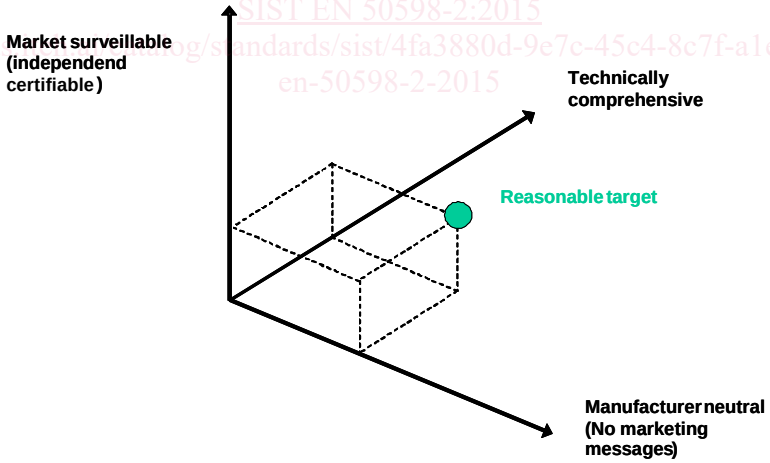

Figure 1 - Illustration of controversial requirements for the Energy related product (ErP) Standardization

EN 50598 is developed under the CENELEC projects number 24602 to 24604 for compliance with requirements from the horizontal mandate M/495. EN 50598 "*Ecodesign for power drive systems, motor starters, power electronics & their driven applications*" will consist of the following parts:

Part 1: General requirements for setting energy efficiency standards for power driven equipment using the extended product approach (EPA), and semi analytic model (SAM);

Part 2: Energy efficiency indicators for power drive systems and motor starters;

Part 3: Quantitative eco design approach through life cycle assessment including product category rules and the content of environmental declarations.

The parts together will provide the appropriate set of standards also covering the individual mandates M/470, M/476, M/498, M/500 already in reference within the mandate M/495 and the upcoming mandates for standardization of other power driven applications.

Table 1 - Mandates of the European Commission given to CEN, CENELEC and ETSI and how they are solved by the individual parts of the standardization of CLC/TC 22X WG 6

Mandates	Part 1	Part 2	Part 3
M/470 Motors		✓	✓
M/476 PDS		✓	✓
M/495 Horizontal all future Applications	✓	✓	✓
M/488 HVAC comfort fans	✓	✓	(✓)
M/498 Pumps	✓	✓	(✓)
M/500 Compressors	✓	✓	(✓)

NOTE Geared motors (motor plus gearbox) shall be treated for efficiency classes like a Power Drive system (converter plus motor). See IEC 60034-30-1 for determination of the losses of a geared motor. The efficiency class of a gearbox itself is under consideration.

1 Scope

This part of EN 50598 specifies the Energy Efficiency indicators for power drive systems, motor starters, power electronics (e.g. Complete Drive Modules, CDM) used in motor driven applications in the power range of 0,12 kW up to 1000 kW.

This part of EN 50598 specifies the methodology for determination of losses of the complete motor system, the power drive system (PDS) and the CDM. It defines IE and IES-classes, their limit values and provides test procedures for the classification and the overall losses of the motor system.

Furthermore, this part of EN 50598 proposes a methodology for characterization of the best energy efficiency solution to be implemented, depending on the motor driven system architecture, the speed/load profile and the duty profiles of the application.

The structure of EN 50598 contains the following:

- the losses of a standardized reference PDS (RPDS) and the mathematical model of their calculation are given;
- requirements for determining the losses of a real PDS are given, and be classified in comparison to the RPDS;
- requirements for the type testing and the content of user documentation;
- some illustrations of losses in an overall system as an example are given in Annexes;
- information about system and drive topologies are given in Annexes.

Specific data on losses and IE/IES-classes are given for low voltage (100 V up and equal to 1 000 V) single axis AC/AC power drive systems with three phase induction motors. Geared motors shall be treated as standard motors.

This part of EN 50598 does not specify the methodology for eco-design for environmental impact. This is defined in Part 3 of EN 50598.

2 Normative references

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

NOTE As it is intended by the working group to process this document, once finalised, as IEC Standard, some normative references are given even in case if no European harmonized document exists.

IEC EN 60038:, *IEC standard voltages*

IEC 60050, *International Electrotechnical Vocabulary (IEV)*

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

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

IEC/TS 60034-2-3, *Rotating electrical machines – Part 2-3: Specific test methods for determining losses and efficiency of converter-fed AC motors*

IEC EN 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of single-speed, three-phase, cage-induction motors (IE Code)*

IEC/TS 60034-31, *Rotating electrical machines – Part 31: Guide for the selection and application of energy-efficient motors including variable speed applications*

IEC EN 60072-1, *Dimensions and output series for rotating electrical machines – Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080*

IEC EN 60146-1-1, *Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements*

IEC EN 60947-4-1, *Low voltage switchgear and Controlgear – Part 4-1: Contactors and motor starters*

IEC EN 60947-4-2, *Low voltage switchgear and Controlgear – Part 4-2: Contactors and motor starters - AC semiconductor motor controllers and starters*

IEC EN 61800-2, Adjustable speed electrical power drive systems – Part 2: Rating specifications for low voltage adjustable frequency a.c. power drive systems

IEC EN 61800-3, *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods*

IEC/TS 62578, *Power electronics systems and equipment - Operations and characteristics of active infeed converter applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050(161) and the following apply.

3.1
Active infeed converter
AIC
Self-commutated electronic power converters of all technologies, topologies, voltages and sizes which are connected between the a.c. power supply system (lines) and a stiff d.c.-side (current source or voltage source) and which can convert electric power in both directions (generative or regenerative) and which can control the reactive power or the power factor (see IEC/TS 62578)

Note 1 to entry: In IEV these terms (VSC and CSC) are defined as voltage stiff a.c./d.c. converter [551-12-03] and current stiff a.c./d.c. converter [551-12-04]. Most of the AICs are bi-directional converters and have sources on the d.c. side. So, they are known as voltage source converters and current source converters.

3.2
c_{liquid}
Specific heat capacity of liquid

3.3
CDM
Complete Drive Module according to IEC 61800-2. Means the AC/AC frequency converter which feeds the motor. Some countries use the term "Drive" instead of CDM.

Also the term "Drive Controller" is somehow used instead of CDM

3.4
Driven equipment
Apparatus mechanically connected to the shaft of a motor

3.5
EEI
Energy Efficiency Index (EEI) of an extended product (e.g. a pump unit). The higher the EEI value, the higher the gap to the "best efficient pump unit". The smaller the EEI value, the lower the losses of a dedicated pump unit

3.6
E_D
Switching loss energy per volt and per ampere of a power diode

3.7
E_T
Switching loss energy per volt and per ampere of a power transistor

3.8
Extended product
EP

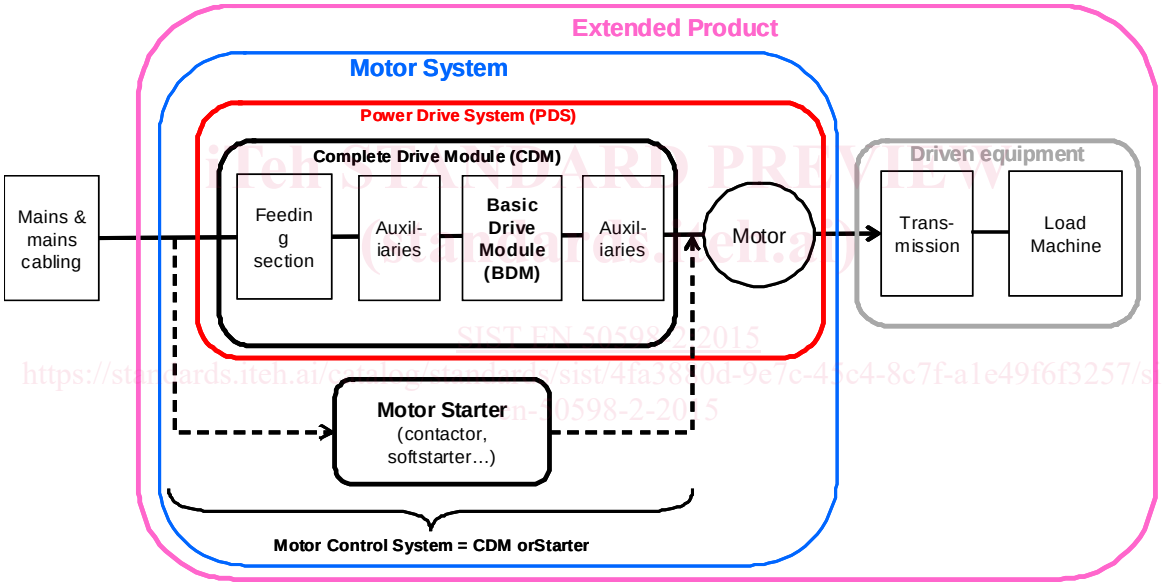

Figure 1 bis

An extended product is the combination of a motor system and a driven equipment

3.9
f_{sw}
The switching frequency is the number of switching events of one semiconductor within one second. It determines, together with the selected pulse pattern and the converter topology, the lowest frequency of non-controllable harmonics or interharmonics at the IPC (in-plant point of coupling) or the motor

3.10
G_{dose}
Metering level (or operation level) of a driven application, its range of values is between zero and one (without overload considerations). Zero corresponds to a fully blocked flow (throttling valve is closed, friction brake is fully enabled), one to a situation where the working machine operates at rated load (flow, or completely open throttling valve, completely released friction brake).

G_{Dose} is the relation between the rated working point of a machine and the actual working point in a process

3.11
H
Pump head is the height/pressure to which a pump can transfer fluid at some flow

3.12
H_{BEP}
The Pump heat of the best efficiency (HBEP) is the pump head at the point of best pump efficiency

3.13
IE class
IE is an abbreviation for "International Efficiency" which stands for the efficiency classification of components of a Motor system. It shall not be mixed with the so called Energy Efficiency Index (EEI) see 3.5

3.14
IES class
IES is an abbreviation for "International Efficiency of Systems" which stands for the efficiency classification of a motor system (e.g. PDS or a gear drive motor). It shall not be mixed with the so called IE class see 1.1 or with the EEI class see 3.5

3.15
$I_{motor\ cable}$
Current in the motor cable of one power port (see IEC EN 61800-2) of the PDS, used for calculating switching losses. $I_{motor\ cable}$ represents a capacitive leakage current, which is normally for shielded motor cables

3.16
$I_{1,r\ CDM}$
Fundamental of the rated CDM or PDS input current waveform

3.17
I_r
Rated CDM or PDS input current

3.18
I_{out}
Output current

3.19
$I_{r,out}$
Rated CDM output current

3.20
I_{rM}
Rated motor current

3.21
$k1_{DC\_link}$
Load independent DC link losses per rated ampere and volt square of the CDM

3.22
$Z1_{choke}$
Choke impedance, relative to the rated inverter impedance

3.23
$P2_{DC\_link}$
Load dependent DC link losses per ampere rated inverter current